Recent Trends and Development In
Science & Technology

K. Sudha Rameshwari

Dr. Kusuma Kumari B. M

Dr. Manjunatha D

Recents Trends and Developments in Science and Technology

India | UAE | Nigeria | Uzbekistan | Montenegro | Iraq | Egypt | Thailand | Uganda | Philippines | Indonesia

Recents Trends and Developments in Science and Technology

Edited By:

K. Sudha Rameshwari
Assistant Professor of Biochemistry, V.V. Vanniaperumal College for Women, Virudhunagar, Tamilnadu, India

Dr. Kusuma Kumari B M
Assistant Professor, Department of Studies and Research in Computer Applications, Tumkur University, Tumakuru, Karnataka-572103

Dr. Manjunatha D
Assistant Professor, Department of Electronics, University College of Science, Tumkur University, Tumkur, Karnataka - 572103

Recents Trends and Developments in Science and Technology

Rs. 1000/- ($80)

PREFACE

The evolution of science is like a boon to the world, as human beings come to know a lot about the world they are living in including the activities they indulge into. Furthermore, the development of technology along with the advancement in Science helps to bring in a revolution in various fields such as medicine, agriculture, education, information and technology, and many more.

In the present world, if we think of any sort of development, then the presence of science and technology cannot be ignored.

Science fundamentally is the systematic study of the structure and behaviour of the natural and physical world through observations and experiments. Study of science evolved with the civilization of human beings. Technology is basically derived from the Greek word 'technologia' is an art, skill or ability, which is used to create and develop products and acquire knowledge.

Scientists used their knowledge to develop technology and then used technology to develop Science; so, because of this reason science and technology are an integrated term in today's world.

ACKNOWLEDGEMENT

Table of Contents

FORECASTING BICYCLE TRAFFIC VOLUME BY ORIGIN AND DESTINATION ANALYSIS WITH GIS AND PYTHON SCRIPTING

Jurgis Zagorskas

Vilnius Gediminas Technical University, VILNIUS TECH, Saulėtekio av. 11, Vilnius, Lithuania

ABSTRACT

As a sustainable transportation for future cities, the non-motorized mode is considered to be the most ecological. It is also sustainable considering other aspects – human health, energy savings, positive influence on urban renewal, etc. While the benefits of increased pedestrian and bicycle mobility are obvious, there are number of unresolved issues arising in planning and providing the infrastructure for walking and cycling. The most important problem is forecasting the use of specific pathways in order to calculate the pay-back terms of investments. Existing cost-benefit analysis methods are not self-evident, they are not suitable for micro-level and therefore often are not welcomed by stakeholders. Proposed method uses GIS and Python scripting, it does not require high-end software, therefore it is affordable for many potential users.

Keywords: Sustainable transportation; Urban traffic; Cycling; Bicycle flow forecast; Travel mode; Origin and destination; GIS analysis, Python, QGIS.

1. INTRODUCTION

World cities are striving for sustainable transportation because it is the most problematic sector in urban environments. The promotion of cycling in modern cities is a very popular topic, as it meets the goal of reducing the negative environmental impacts of transport and improving quality of life. Active transportation modes like bicycling are becoming major elements to achieve sustainable transportation [1]. In response to the benefits of bicycling to the environment and public health, the municipalities in many cities of the world are working to establish new bicycle routes and to promote bicycle use for commuting trips.

European cost-benefit analysis (CBA) that accounts for health, pollution, and climate, reveals that in the EU whole territory cycling brings a yearly benefit worth € 24 billion

while automobility costs society around € 500 billion [2]. Recently many initiatives in bicycle network reconstruction and building were made in European cities and much investment funds were raised for this purpose. In most cases the funding was based on economical calculations of increased property value and health factors, both of them being not very obvious and consistent, because these are lacking methodology on prediction of future cycling traffic volumes. To get the most, cities must invest into bicycle networks with the right growth strategy, and persistency [3].

In transportation theory classic method of origin-destination (OD) is based on transportation districts and the demands to interconnect between them. This approach has quite limited use when considering cycling traffic flow prediction. The distances covered by cyclists are usually 3-4 km, but the borders of classic traffic districts cover much bigger territories.

Most of recent research is concentrated on methods of OD matrix estimations strictly theoretically, without concerning the real scale matrix elements [4-6]. Others focus on use of smart-card or mobile application data to fine down and itemize the locations [7,8]. In OD theory now the most prominent are fuzzy systems [9-12], deep learning [13-16] and real time estimation approaches. There are even attempts to model synthetic bicycle networks in real cities following different growth strategies aiming to generate a cohesive network [3].

This paper demonstrates an approach to predict the flows in a classic way, but on a smaller (neighborhood) scale. Proposed approach uses modern techniques of network graph analysis (Python scripting and Networkx graph analysis library) and is visualized by standard GIS techniques. Used software is license free and therefore available to every participant of planning process. The described method can be expanded and used for more precise or more complex travel demand calculations involving time, cost-benefit, preferred route selection and terrain analysis.

The proposed solution combines origin-destination method with route calculation and graph analysis methods to graphically demonstrate cycling demand as flow diagram. According to the diagram the solutions on how to ensure a fair distribution of

investment may follow. This approach is more effective at improving cycling network connectivity than random allocation of cycling infrastructure based on CBA.

The resulting clear GIS map view of predicted traffic flows is based on separate precise micro-scale objects and helps to understand the demands for cycling and walking in local place.

2. MATERIALS AND METHODS

At initial stage the data is prepared. As micro-scale logic supposes – both origins and destinations in this case are considered the buildings. The building entities have the essential numbers:

1. Information of population living in building;

2. Working places in every building (this number is not so easy to obtain. There are number of factors concerning working days and labor practices. Also, within the modern society as much as 5-15 percent of population is working at home and this number increases at the time of CORONA virus pandemic.

3. Number of other persons attracted to building per day. This is additional category because only part of human activities can be considered by categories of living and working. Visiting friends, shopping, dining, leisure activities fall out of two previous categories. These numbers are empirical and can be approximately estimated from mobile devices and other similar sources of location sensitive data.

Gathered information is stored in simple GIS layer with just three attributes.

The next step is to calculate the relations between the objects, estimate travel distances and then add the predicted flow to the street segment layer. This layer may consist of existing streets and bicycle pathways, or can include planned segments as well.

The algorithm logic is as follows:

1. Identify all links that can arise from one selected building to other buildings, possibly taking in account the travel distance.

2. Calculate the value of possibility of a trip from building i to building j to happen.

3. Add this value to cumulative variable, associated with street segments on the path from building i to building j.

4. Repeat steps 1 and 3 until all buildings are cycled throw.

Written in Python programming language this algorithm looks as follows:

import processing, networkx, math

from qgis**.**core **import** *

def NEAREST_NODES**(**Points**,** Result**):**

This function finds the array of nearest nodes in Graph

and returns a list of numbers

....

return Result

GT **= []** #these are the location matrixes of living places,

DT **= []** #working places

TT **= []** # attraction places

finding the nearest network nodes

Nodes**=**G**.**nodes**()**

aGT**=**NEAREST_NODES**(**Nodes**,**GT**)**

aDT**=**NEAREST_NODES**(**Nodes**,**DT**)**

aTT**=**NEAREST_NODES**(**Nodes**,**TT**)**

vlayer **=** processing**.**getObject**(**'T'**)**

n4 **=** vlayer**.**getFeatures**()**

pathways**=[]**

for i **in** n4**:**

pathways**.**append**((**i**[**'id'**],**i**[**'x1'**],**i**[**'y1'**],**i**[**'x2'**],**i**[**'y2'**]))**

```
# the main cycle of calculating the possible relations

# between entity i and j

S=[]

i = 0

while i<len(GT):

j = 0

while j<len(DT):

try:

trump = networkx.shortest_path(G,aGT[i],aDT[j],weight='length')

S.append((trump, Living_places[i]*Working_places[j]))

except networkx.NetworkXNoPath:

print 'path not found'

j=j+1

k=0

while k<len(TT):

try:

trump =networkx.shortest_path(G,aGT[i],aTT[k],weight='length')

S.append((trump, Living_places[i]*Attraction_places[k]))

except networkx.NetworkXNoPath:

print 'path not found'

k=k+1

i=i+1
```

The final step is to associate the calculated data with proper line segments on GIS map:

```
def SEGMENT_NUMBER(paths,x1,y1,x2,y2):
```

```
# this function only finds the number of segment

# in segment coordinate matrix

..............

if found:

return index

else:

return -1

# function end

# Here the main code begins

layer = processing.getObject('T')

n1 = layer.getFeatures()

line_weights=[] #this is a matrix for pathway segments

#obtained from the GIS layer "T"

for i in n1:

line_weights.append(0)

#at the beginning it is filled with 0 values

# Here the cycle begins

for path in S: #"S" is an array of pathway segments

#a list of pairs of X and Y coordinates

segment=path[0]

for i in range(0,(len(segment)-1)):

number=SEGMENT_NUMBER(paths,segment[i][0],segment[i][1],segment[i+1][0],segment[i+1][1])

if number<>-1:
```

line_weights**[**number**]+=**1

Now the numbers are pushed back into GIS layer attributes

layer**.**startEditing**()**

i**=**0

while i**<len(**line_weights**):**

layer**.**changeAttributeValue**(**i**,** 5**,** line_weights**[**i**])**

i**=**i**+**1

layer**.**commitChanges**()**

After calculations are made and applied to pathway segment layer, the results can be displayed by standard GIS tools, using the calculated value of predicted bicycle traffic volume as a value for the graduated thickness line symbol. In this way the classic transportation flow cartogram is generated.

The software used for this experiment was QGIS with built-in Python editor.

3. RESULTS

The described method was executed on three small towns in Lithuania, Europe. The selected towns are Kupiškis (7,892 population), Pakruojis (4,352 population) and Pasvalys (6,361 population). These towns were selected, because it is easy to create the data for the experiment in such a small towns. The data was collected empirically and added manualy to GIS layer attributes for each building (Table 1). Number of attracted people was not only added from empirical study, but summed with the number of living and working places, because these attract some random visits also.

Table 1: The pathway GIS layer attribute table, presenting the numbers of living, working and attracted people per day to each building.

Building ID	Living places	Working places	Attraction number per day
entity 1	5	0	0.2
entity 2	64	5	4.5
….	….	….	….

Calculations were run on all three models and produced similar results with very clear logic – the most intense traffic flow is found in the areas where there are big multi-family living houses and in the town central street segments (see figures 1-3).
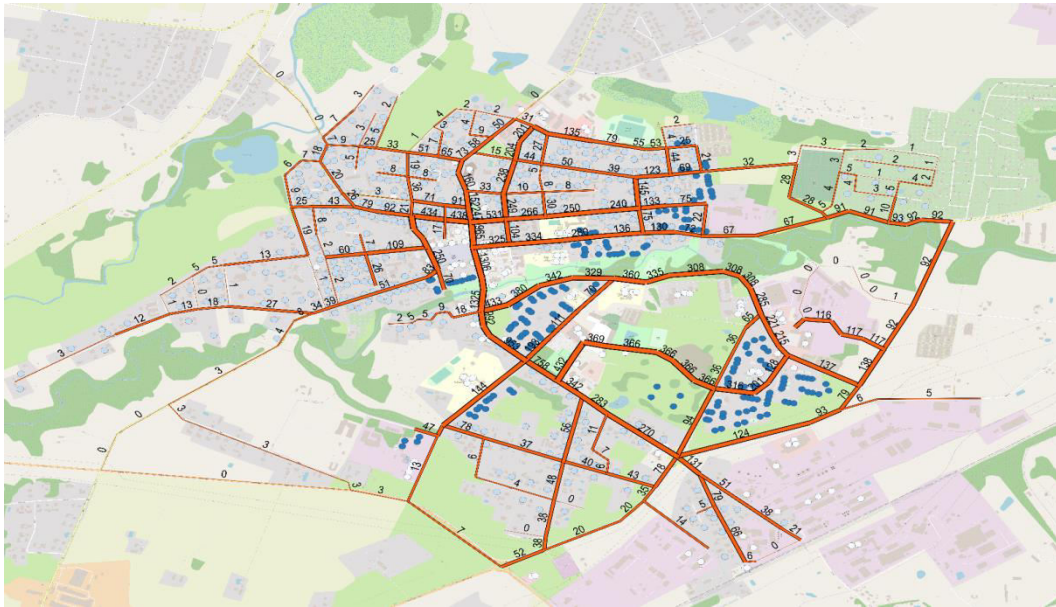
Figure 1: Kupiškis town bicycle traffic volume prediction**.**
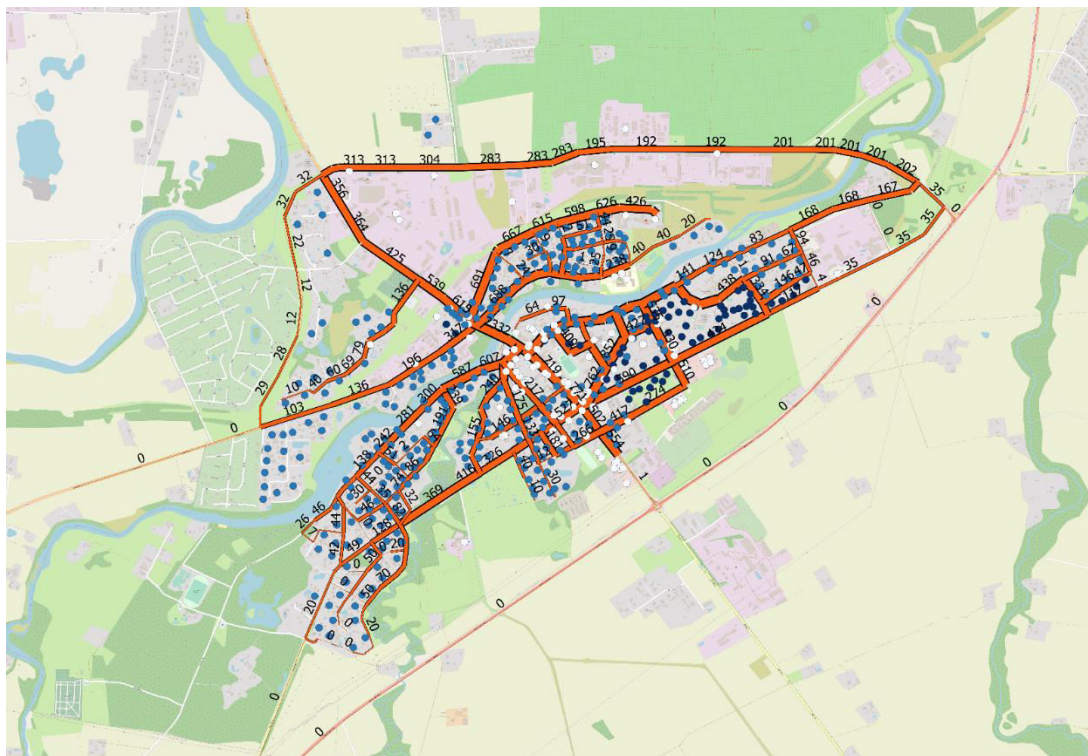
Figure 2: Pasvalys town bicycle traffic volume prediction**.**
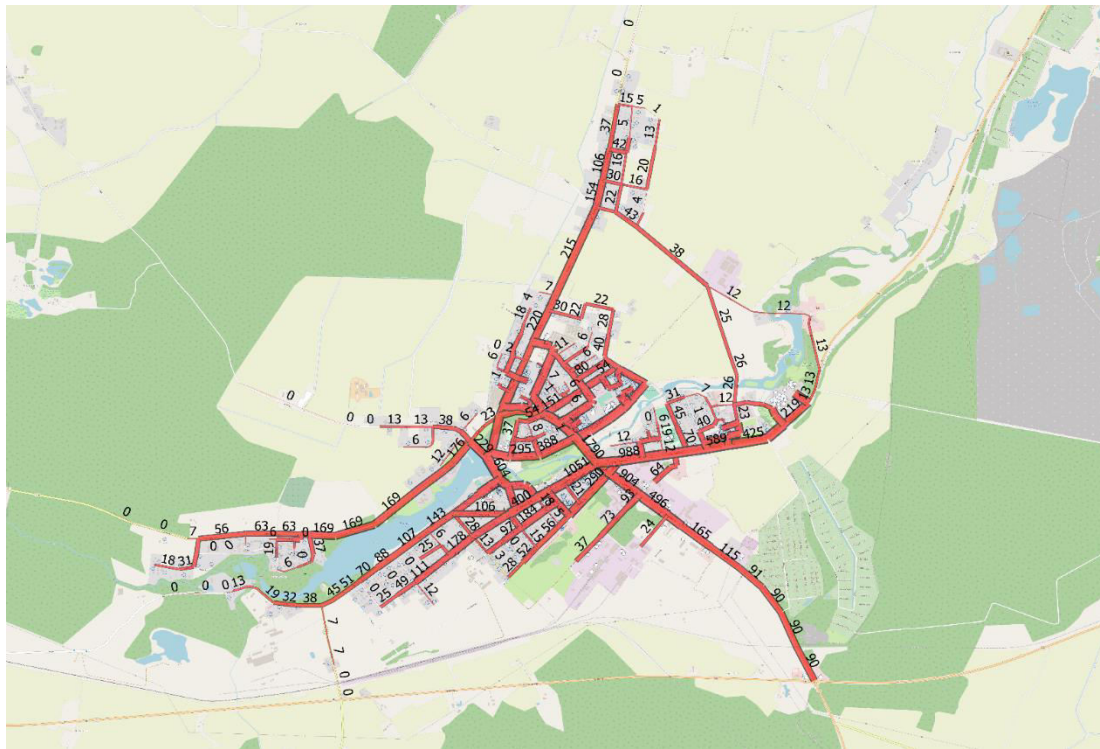
Figure 3: Pakruojis town bicycle traffic volume prediction**.**

4. DISCUSSION AND CONCLUSIONS

Recent research of transport flow obtained from OD methods is focused mostly on popular innovative methods (fuzzy systems, AI) and on new technologies (mobile application data, BIG data). The focus rarely is turned back to the data scale and applicability.

Presented method is unique in its simplicity and accuracy of results on small scale. It can be easily adopted to other scales also, but works best on micro-scale.

Such predictions are most useful when considering the distribution of investment. Other existing methods like CBA in Europe Union are far less efficient and give results that are mor distorted and less detailed.

REFERENCES

1. Luo, J.; Boriboonsomsin, K.; Barth, M. Consideration of exposure to traffic-related air pollution in bicycle route planning. Journal of Transport & Health **2020**, 16, 100792.

2. Gössling, S.; Choi, A.; Dekker, K.; Metzler, D. The Social Cost of Automobility, Cycling and Walking in the European Union. Ecological Economics **2019**, 158, 65-74, doi:https://doi.org/10.1016/j.ecolecon.2018.12.016.

3. Szell, M.; Mimar, S.; Perlman, T.; Ghoshal, G.; Sinatra, R. Growing urban bicycle networks. Scientific Reports **2022**, 12, 6765, doi:10.1038/s41598-022-10783-y.

4. Cheng, Z.; Trepanier, M.; Sun, L. Real-time forecasting of metro origin-destination matrices with high-order weighted dynamic mode decomposition. Transportation Science **2022**.

5. He, Y.; Zhao, Y.; Tsui, K.-L. Short-term forecasting of origin-destination matrix in transit system via a deep learning approach. Transportmetrica A: Transport Science **2022**, 1-28.

6. Mohammed, M.; Oke, J. Origin-destination inference in public transportation systems: a comprehensive review. International Journal of Transportation Science and Technology **2022**.

7. Ait-Ali, A.; Eliasson, J. The value of additional data for public transport origin–destination matrix estimation. Public Transport **2022**, 14, 419-439.

8. Cerqueira, S.; Arsenio, E.; Henriques, R. Inference of dynamic origin–destination matrices with trip and transfer status from individual smart card data. European Transport Research Review **2022**, 14, 1-18.

9. Maqbool, A.; Sharma, C.; Lone, M.; Alshalabi, R. Intuitionistic Fuzzy Programming Technique to Solve Multi-objective Transportation Problem. Information Sciences Letters **2022**, 11, 25.

10. López-Ospina, H.; Cortés, C.E.; Pérez, J.; Peña, R.; Figueroa-García, J.C.; Urrutia-Mosquera, J. A maximum entropy optimization model for origin-destination trip matrix estimation with fuzzy entropic parameters. Transportmetrica A: Transport Science **2022**, 18, 963-1000.

11. Maity, G.; Yu, V.F.; Roy, S.K. Optimum intervention in transportation networks using multimodal system under fuzzy stochastic environment. Journal of Advanced Transportation **2022**, 2022.

12. Singh, S.; Singh, S. A method for solving bi-objective transportation problem under fuzzy environment. Meta-heuristic Optimization Techniques: Applications in Engineering **2022**, 10, 37.

13. Jiang, W.; Ma, Z.; Koutsopoulos, H.N. Deep learning for short-term origin–destination passenger flow prediction under partial observability in urban railway systems. Neural Computing and Applications **2022**, 34, 4813-4830.

14. Nagaraj, N.; Gururaj, H.L.; Swathi, B.H.; Hu, Y.-C. Passenger flow prediction in bus transportation system using deep learning. Multimedia tools and applications **2022**, 81, 12519-12542.

15. Wang, Y.; Currim, F.; Ram, S. Deep Learning of Spatiotemporal Patterns for Urban Mobility Prediction Using Big Data. Information Systems Research **2022**.

16. Andersen, N.S.; Chiarandini, M.; Debrabant, K. Dynamic Origin-Destination Matrix Estimation in Urban Traffic Networks. arXiv preprint arXiv:2202.00099 **2022**.

BLOCKCHAIN TECHNOLOGY FOR DEBOTTLENECKING SUSTAINABLE DEVELOPMENT IN THE CIVIL CONSTRUCTION SECTOR

Dr. Roodheer Beeharry

Senior Lecturer and Student, Université des Mascareignes, Concorde Avenue, Rose Hill Campus, Mauritius

ABSTRACT

The Sustainable Development Goals cannot be achieved without sustainable practices in all spheres of development. Sustainability in the built environment sector is at the base of sustainable development in many other key sectors. However, the civil construction industry is unable to maximize on sustainable practices due to its highly fragmented, scattered and complex supply chain and processes. To manage such an extended supply chain, keep track of work in progress, schedules, costs and payments, enormous effort and resources are needed. Current operation methods cannot deal with inefficiency, mismanagement and the gross lack of accountability which result in growth of unethical practices and ease of deflecting blame for failures. This review paper highlights how Blockchain Technology can boost reliability, trust, security, transparency, efficiency including privacy through smart contracts, digitally approved payments, procurement and supply chain management. Blockchain technology is being applied in many spheres of development like supply chain, finance and the health sector but not much in the construction sector. This paper showcase the relevancy of blockchain that together with BIM and Digital Twin can enable much more transparent, accountable and sustainable practices throughout the whole construction project lifecycle.

Keywords: Blockchain, BIM, Digital Twin, sustainable development, construction industry, SDGs

1.0 INTRODUCTION

There is universal agreement that urgent action needs to be taken if we are to save our planet. The importance of practicing and embracing the principles of sustainable development is becoming the top priority in all fields of human activity and is

intensified by the alarming consequences of climate change [1]. There is an urgent need for scaling up risk reduction and resilience building in order to safeguard sustainable development and economic continuity of communities worldwide [2]. Sustainable development and climate change have multiple inter-linkages, and this is reflected in the three global converging policy frameworks adopted in 2015: the 2030 Agenda for Sustainable Development, the Paris Climate Change Agreement and the Sendai Framework for Disaster Risk Reduction. These transformative agreements adopted at a global scale calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and the planet whereby a balance must be struck between economic growth, social inclusion, and environmental protection. Addressing global warming quickly and effectively requires urgent, clear and resolute actions and relies on establishing the adequate infrastructure and systems for long term sustainability.

The construction sector has been globally acknowledged as one of the main engines of economic growth and development. It provides and maintains the infrastructure required for other sectors of the economy to flourish. Infrastructure is the backbone of economic capacity, and it also impacts directly on human development, social inclusion, environmental sustainability. The built environment while contributing, largely to the overall socio-economic development in every country, is a major exploiter of natural resources and a significant polluter of the environment through waste generation and emissions [3]. The latter aspects include the extraction and beneficiation of raw materials, the manufacturing of construction materials and components, the construction project cycle from feasibility to deconstruction and the management, operation and maintenance of the built infrastructure [4]. The impact of the provision of infrastructural facilities on the environment rates as one of the highest among all industries [5]. The vital role of the built environment in serving human endeavours means that when elements of it are damaged or destroyed by hazards such as extreme weather events, the ability of society to function, both economically and socially, is severely disrupted. Thus, achieving sustainability within the construction sector stands as a crucial prerequisite for accelerating and enhancing sustainable development in other sectors such as transport, education, health, culture, or any of the myriad of policy areas that affect people's lives.

As it currently operates, the challenge remains significant regarding attainment of sustainable development practices in the construction sector. Despite, the term 'sustainable development' having reached quite deep into popular consciences worldwide and where institutions often recognise sustainability as a major policy goal, still no major change or improvement can be observed in the infrastructure development industry. The latter sector suffers from persistent bottleneck regarding performance measurement, operational efficiency and accountability which impedes tangible progress towards sustainable practices [6]. The reasons for the afore-mentioned impediment reside in the complexity of the construction sector. More specifically, the complex contractual structure; the diversity of skills and standards involved; different project phases; the large size, uniqueness and the concealment of some items of work by other items; are some major intricacies. Infrastructure projects normally have a large number of participants linked together in a complex contractual structures. Each link has its own contractual documents, and particular risks and difficulties. The project owner may contract with funders, consultants and with a main contractor to construct the project. The main contractor may then sub-contract key parts of the project to major sub-contractors and so on. The infrastructure industry is a diverse industry, in terms of the number of different professions, trades and specialist contractors who interacts with each other. Projects normally have several different phases, each involving different management teams, and each requiring handovers of the completed phase to the contractors undertaking the next phase. There is an acute mismatch between the overall complexity in the construction industry and the current operational methods which are liable to mismanagement and inefficiency, which preclude sustainable development. Moreover, the latter complexity fosters a significant lack of transparency within the sector which highly accentuate the risk of unethical practices thereby further constraining sustainability [7].

According to the United Nations Development Programme, corruption is a major obstacle to sustainable development. Corruption has the potential to undermine the successful implementation of all 17 Sustainable Development Goals (SDGs). It leads to weak institutions, creates injustice and insecurity, hampers economic growth, threatens environmental resources, destroys innovation, increases inequality and inhibits

prosperity. The Corruption Perception Index (CPI) 2020 released by Transparency International revealed a grim picture of the state of corruption worldwide, with more than two-thirds of 180 countries still scoring less than 50 over a maximum of 100, with an average score of 43. Most countries have still failed to effectively address corruption for nearly half a century [8]. It is no secret that the construction sector is particularly vulnerable to corruption. The result of unethical practices in the construction sector may result in waste of project funds, increased price of projects, increased maintenance and repair costs, reduced spending in infrastructure, inadequate and dangerous infrastructure, damage to the environment and loss of quality of life, among others. The latter negative effects of corruption in the construction sector hugely impact the most pressing global challenges that we face, including elimination of poverty, rebuilding the global economy and dealing with the effects of climate change, thereby suppressing sustainable development.

This paper aims to address the above-mentioned issues by systematically reviewing published literature related to digital transformations for improving both efficiency and transparency in organizations. Emerging and disruptive digital technologies have the potential to offer new possibilities and solutions which could help individuals, organizations, and nations achieve a more sustainable planet in light of the sustainable development goals. In line with the latter objectives, Blockchain Technology (BT) is a major breakthrough offering tremendous efficiency possibilities while enabling transparency and ethical business tactics. It has so far been applied in many sectors such as healthcare, finance, government, identity verification and cryptocurrency but not much in the civil construction sector. Blockchain is a relatively new technology that is still not widespread in all industries but it is slowly gaining more momentum. Artificial Intelligence (AI) has the unique capacity to gather and interpret large, complex data sets whereby the technology can be used to support all stakeholders in a specific activity in taking a more informed and data-driven approach which is crucial for sustainability. Overall, this paper explores the features of BT which is being used in many different industries worldwide and put emphasis on its applicability, together with AI, in the construction sector for debottlenecking and boosting sustainable development in the latter sector.

2.0 LITERATURE REVIEW

2.1 An overview of Blockchain Technology

A blockchain is a digital ledger or database where encrypted blocks of digital asset data are stored and chained together, forming a chronological single-source-of-truth for the data by making the history of any digital asset unalterable and transparent through the use of a decentralized network and cryptographic hashing [9-10]. Bitcoin was the first application of blockchain technology was October 2008. The development of blockchain applications can be divided into four stages; Blockchain 1.0, 2.0, 3.0 and 4.0. Blockchain 1.0 is the deployment of cryptocurrencies as a peer-to-peer cash payment system. Blockchain 2.0 concerns applications further than simple cash transactions and includes stocks, bonds, loans, smart property, and smart contacts. Blockchain 3.0 enhances beyond currency, finance, and markets to enable application in areas of government, health, science, education, culture, and art. Blockchain 4.0 has the possibility of applying other powerful technologies such as Artificial Intelligence and enables proliferation of a seamless integration of different platforms to work under a single umbrella in coherence to fulfill business and industry demands. Speed, user experience and usability by larger and common mass are the key focus areas for the latest version of Blockchain [11 – 12]. There are four types of blockchain networks, each suited for different purposes. Public blockchains are the earliest and most prominent examples of blockchain networks, Bitcoin and Ethereum, are public networks. Anyone can read a public blockchain, send transactions to it, or participate in the consensus process. Every transaction is public, and users can remain anonymous. Semi-private blockchains are run by a single company that grants access to any user who satisfies pre-established criteria [13]. This type of "permissioned" blockchain is appealing for business-to-business use cases and government applications. Private blockchains are controlled by a single organization. It determines who can read it, submit transactions to it, and participate in the consensus process. Finally, in a Consortium blockchain, the consensus process is controlled by a pre-selected group and the right to read the blockchain and submit transactions to it may be public or restricted to participants [14]. Consortium blockchains are considered to be "permissioned" blockchains and are best suited for use in business.

A cryptographic proof of identity, which is a pair of public and private keys, is used for identification of users [15-17]. Transaction are broadcasted to the memory pool of the blockchain network waiting for transaction verification & validation. Then, a new block is generated by obtaining a certain number of approved nodes referred to as reaching consensus [18]. After reaching consensus, a new block is added to the blockchain network and each node updates its respective copy of the blockchain ledger. The consensus stage is achieved through the use of a consensus algorithm. This process is called mining [19]. Each node can vote in order to accept valid blocks by taking extensions or reject invalid blocks by denying expansions. Any required rules and incentives can be implemented through this consensus mechanism [20]. Each transaction in a block is tagged by a specific timestamp. Blockchain uses specialized hardware to construct sizeable cryptographic data chain, and SHA-256 hash function is used to prevent the tampering of data of third-party users [21].

Essentially, blockchain is a distributed network of computers or users (nodes) used to maintain the source of information sharing. Each node maintains the security and accuracy of the information by keeping a complete set of ledgers of past transactions. When a new block is being created by a miner, who is the first one to validate all the transactions in the block and solve the mathematical problem by generating a digital signature for the block which meets a pre-defined rule using the hash function. The newly created block will be broadcasting to the whole blockchain network, allowing all nodes to maintain the same complete ledger [22].

Consensus mechanism is achieved through three major verification mechanisms. Bitcoin uses a verification mechanism called Proof of Work [23]. The miners are nodes working in a blockchain peer-to-peer network. Their task is to validate all transactions included in one block and solve the mathematical problem of the digital signature using a hash function. The miners compete with each other, and once someone solves the problem, the solution will be shared with other mining nodes. The winning miner receives additional bitcoins as rewards. Other miners accept the Proof of Work, and the new block will be added to the blockchain network [24]. Ethereum has four development stages, including Frontier, Homestead, Metropolis, and Serenity. The first

three stages use the verification mechanism of Proof of Work, and the fourth stage uses Proof of Stake. The Proof of Stake requires the certifier to show the ownership of a certain amount of cryptocurrency [25]. "Proof of Zero Knowledge" is the consensus mechanism used in Zcash which can provide better privacy to its users. Compared with other verification mechanisms, Proof of Zero Knowledge has improved both regarding functionality and efficiency [26].

2.2 Key Features of Blockchain Technology

The transformative potential of blockchain technology lies mainly in four features: decentralization, traceability, tamper-proof, tokenisation, smart contracts and oracles.

Decentralization refers to the processes of data verification, storage, maintenance, and transmission on blockchain which are based on a distributed system structure. In this structure, the trust between distributed nodes is built through mathematical methods rather than the centralized organizations [27].

Traceability means that all transactions on blockchain are arranged in chronological order, and a block is connected with two adjacent blocks by the cryptographic hash function. Therefore, every transaction is trackable by examining the block information linked by hash keys.

Blockchain is essentially tamper-proof due to the cryptographic sealing and sequential stringing of blocks. Tampering with any transaction would result in different hash values and would thus be detected by all the other nodes running precisely the same validation algorithm. On the other hand, blockchain is a shareable public ledger stored on thousands of node, and all ledgers continue to sync in real time. Successful tampering would need to change over 51% of the ledgers stored in the network [28].

Tokenisation refers to the use of coins or tokens on a blockchain. There are two general distinctions; (i) Coin-based, whereby coins or tokens are the data-base of every coin-based blockchain. All transactions are

related to coin movements and data is added to those coins to enable additional functionality, and (ii) Data-based blockchains which offer storage within the blocks of a

blockchain without the necessity to attach the data to tokens. All transactions include new data to be added into the chain or changes and deletions [29].

A Smart Contract is a computer code that can be built into the blockchain to facilitate, verify, or negotiate a contract agreement. Smart contracts operate under a set of conditions to which users agree. When those conditions are met, the terms of the agreement are automatically carried out. A smart-contract platform, such as Ethereum, leverages its immutable write-once nature [30].

Oracles are external data feeds that provide information from outside of the blockchain network, such as Internet of Things (IoT) sensors.

2.3 Advantages of Blockchain Technology

Reliability: The decentralized nature of a blockchain network changes the databases of the entire transaction records from closed and centralized ledgers maintained by only a few accredited institutions to open distributed ledgers maintained by tens of thousands of nodes. The failure of a single node does not affect the operation of the whole network. This avoids the single point of failure and ensures the high reliability of the applications [31].

Trust: Blockchain network makes the trust decentralized too. Unlike the centralized trust we take for granted, such as central governments issuing currencies and commercial banks, blockchain network acts as new trust bearers with decentralized ledgers. These ledgers are shared among a network of tamper-proofed nodes [32].

Security: Blockchain network uses the one-way hash function which is a mathematical function that takes a variable-length input string and converts it into a fixed-length binary sequence. The output bears no apparent relationship to the input. The process is hard to reverse because, given just the output, the input is impossible to determine. Furthermore, the newly generated block is strictly following the linear sequence of time [33].

Transparency: Because of the decentralized nature of Bitcoin's blockchain, all transactions can be transparently viewed by either having a personal node or using blockchain explorers that allow anyone to see transactions occurring live. Each node has

its own copy of the chain that gets updated as fresh blocks are confirmed and added [34].

Efficiency: all data are automatically run through pre-set procedures. Therefore, blockchain technology can not only significantly reduce the cost of labor but also improve efficiency. For the digital currency of Blockchain 1.0, the automation of distributed ledger is mainly the automation of settlement. Blockchain technology could speed the clearing and settlement of certain financial transactions by reducing the number of intermediaries involved, and by making the reconciliation process faster and more efficient [35].

Privacy: Many blockchain networks operate as public databases, meaning that anyone with an Internet connection can view a list of the network's transaction history. Although users can access details about transactions, they cannot access identifying information about the users making those transactions.

When a user makes a public transaction, their unique code, called a public key is recorded on the blockchain. Their personal information is not. If a person has made a Bitcoin purchase on an exchange that requires identification, then the person's identity is still linked to their blockchain address but a transaction, even when tied to a person's name, does not reveal any personal information [36].

3.0 METHODOLOGY

A systematic review of both academic and grey literature on blockchain technology was undertaken in the following databases; SCOPUS, PubMed, IEEE Xplore, Web of Science, and Google Scholar for relevant literature. By choosing these databases, it was intended was to focus only on peer-reviewed articles that have been published in reputable journals, conferences, workshops, books or symposiums and were relatively recent, published between 2010 and 2022 inclusive. The search terms used were "sustainable development", "construction sector", "climate resilience", "digital technology", "blockchain technology", "Building Information Modelling (BIM)", "corruption" and "Digital Twin" combinations. Additionally, the references of evaluated articles were screened for additional publications meeting the inclusion criteria. After retrieving the papers from the database, the next step was to screen them

for relevance. The first phase of this process step was to screen the papers for relevance based on their titles. Retrieved papers whose titles clearly indicate that they are not relevant to the study were discarded. Some of the papers returned from the search protocol were not related to the application of blockchain for sustainable development in the construction industry and were removed. In situations where the relevance of the paper could not easily be determined from the title, the paper was passed to the next stage for further screening. The second phase of the screening involved the reading of the abstracts of the papers that passed through the first stage. In some cases, it was necessary to also read the introduction and the conclusion of a paper to determine if the paper passed the exclusion criteria. In order to discard a paper, the exclusion criteria were the following: (i) papers that are not peer-reviewed, such as press articles; (ii) papers without full text availability; (iii) papers whose main focus are not related to the application of blockchain technology; (iv) duplicate papers; (v) papers that are not written in English; (vi) retracted papers. Papers that passed these exclusion criteria and that were deemed to be focusing on the application of blockchain in the construction industry for sustainable development were included in the next step of the mapping study process. Following multiple phases of checking for irrelevance, in excess of 30 relevant articles were identified and explored in order to identify the possible application of blockchain in the civil construction sector as highlighted in this paper in the following sections.

4.0 SMART CONTRACTS FOR BOOSTING EFFICIENCY

Smart contracts are one of the most exciting opportunities presented by blockchain technology, because through them a wide range of processes can be improved, automatized and eventually become more effective. A Smart Contract is basically a digital contract, which can execute its terms automatically when the predefined conditions are met. One of the first blockchain related applications was on the Ethereum platform which had the ability to execute computer codes and scripts on the blockchain [37]. As the input conditions came from the blockchain as immutable data, and the code itself was also secured on the blockchain, such conditional functions acted as digitally binding contracts.

Moreover, advantages of Smart Contracts can be scaled up in a way that the execution of payments, submissions and project updates are completed automatically making the whole process more effective. Nevertheless, in this way all data and information registered, like the number of work hours, and transactions such as payments, project updates sent are also logged on the blockchain, making the whole system transparent and traceable for the collaborative participants. If contractual terms and conditions are precisely registered on a smart contract, the execution and monitoring of conditions are highly accurate. The network of smart contracts can ensure transparency and reduced complexity for the whole construction procurement. In this way, the risk of late payment and the number of disputes can be reduced. Significant cost savings can be reached on overheads, administration and project control. Moreover, project procurement information is logged in a traceable way unlocking project evaluation and cost optimization insights. Contractual collaboration which is supported and automatized with smart contracts can decrease significantly the number of claims and disputes in correlation with the time of solving them, improving stakeholder relationships. If any mistake occurs, as a clause in the smart contract with the agreement of all parties involved, a reverse transaction can be easily initiated. The great advantage is that all these interactions are tamper-proof and transparent for the business participants.

An important aspect of such a smart contract enabled process is that often, external parties or source of information need to be involved as well. These collaborators, also called oracles, ensure the link between the smart contract and the process it manages. Another example of such an oracle or collaborator system can be the ID registering at the access point to the site, which ensure that the exact person is identified with the time when entering or leaving the site. A collaborator can also be the engineer on site who signs that a piece of work has been conducted with the right quality.

Applicability of sensors installed on site can be highly magnified with Smart Contracts in blockchain. Sensors at the construction site can measure temperature, which data is then cross checked with the weather data at that particular part of the city from different websites. This data can be periodically assessed by a smart contract and when certain

terms are triggered, such as too high or too low temperature, the agreed actions and compensation events can be initiated automatically. Other sensors can send GPS location of structural elements as they are built or information of the arrived materials to update the project plans and monitor progress. Another set of sensors on cranes can update its operational status and its leasing terms which can be managed automatically by smart contract [38].

5.0 SOLVING PROCUREMENT & SUPPLY CHAIN MANAGEMENT ISSUES

Blockchain can ensure provenance for structural materials, and create a verified chain of custody transparent for all parties in the supply chain. Designers, contractors and suppliers nowadays need to be far more aware of the provenance of materials used in construction projects for reasons such as strict quality assurance, health and safety, material standards and sustainability. However, the system is still not free from mistakes and negligence. In case of a blockchain system, the specific structural materials can be logged and traced along the supply chain until construction. The advantages are significant for all stakeholders in the project. For instance, as client or project owner all information on the materials bought are visible, such as production and quality certificates, together with the track of transportation, until delivery to site. Through this immutable chain of custody at any point of the supply chain, stakeholders can have confidence in the quality, safety specifications and standards of materials. Moreover, as every transaction along the supply chain is also tracked, monitoring of delivery timing and conditions become easier, quicker and less bureaucratic.

Through the above-mentioned blockchain enabled solution the high level of fragmentation in the industry's supply chain can be reduced dramatically with standardized processes and a more transparent procurement operation. With the real time material provenance, a true track-and-trace application would become available for the industry in order to reduce waste and improve material streamlining on site, and tackling material counterfeiting. Through a blockchain powered platform, instead of manual paper-based documentation and wet signatures, digital tamper-proof approvals can govern the movements of products. Moreover, the status of the shipment can be updated continuously and shared across all parties involved in the blockchain. In case

all of the documentation occurs through the blockchain system, smart contracts can manage invoicing and authorize payments automatically when the certain shipment terms and conditions are met. The cohesion of documents and supply chain management enabled by such a blockchain solution can ultimately create a more accountable system, in which any issues are identified and solved faster, reducing risks and overall complexity.

The optimization of the industry's fragmented procurement processes and the implementation of the provenance of materials can improve sustainability. Regarding the principle of responsible sourcing in the industry, the provenance of materials is particularly crucial as the reuse and recycling of materials, in line with sustainable development, can depend on the certified material specifications [39]. However, impactful sustainability is often driven by considering the whole lifecycle of a structure. This includes design, construction, its sustainable procurement, operation and maintenance through to demolition. Currently, it can be difficult to confirm the specification and origin of materials in the structure after construction. This can complicate decisions on whether a structure's lifespan should be extended or how its maintenance strategy should be designed. If all the material certificates and quality checks during construction are stored and shared through a blockchain system, this makes it far easier to measure the sustainability aspects (total carbon footprint, percentage of reusable materials changing in time, whole life cycle costs, etc.).

Clearly the opportunities of utilizing blockchain technology are thriving regarding the provenance of applied materials, and how a construction project is procured. The system, with a transparent chain of custody would encourage good behaviour and drive quality throughout the whole supply chain. For example, if structural materials do not meet with quality standards and criteria, regulators can easily identify who is responsible through the blockchain enabled chain of custody. In this way, trustworthy suppliers with high quality products will be recognized and incentivized to maintain quality certificates in order to establish long-term relationships. Such trust can move the supply chain of the industry from one-off transactions to a more integrated, relationship basis. Overall, with a new blockchain enabled procurement strategy, the transparency of

the supply chain together with the provenance of materials would be improved significantly. In this way project owners would have a full view of the quality of materials and the details of transportation at any time. The system permits high level monitoring of shipments and streamlining of construction materials and components in a way that information is securely logged ensuring high accountability as well.

6. OPTIMIZING TRANSPARENCY FOR PAYMENT & PROJECT MANAGEMENT

One of the most plausible application of blockchain in the construction industry is to embed a blockchain based platform into the project execution practice, which can initiate payments based on digitally approved work, contractual terms and smart contract actions. One of the key advantages of such a platform, apart from being very effective, is the high level of transparency for all parties involved. For capital construction projects, complex contracts, terms and conditions are often applied. Through the whole lifecycle of a project it can be a challenge to ensure collaboration on every level between all the parties according to the contract. With such a system and applied smart contracts it can be ensured, that every action always happens according to the agreed terms. This transparency and effective collaboration can improve many aspects of a construction project. Blockchain can help to solve payment issues and enhance project management efficiency.

Late payments and the relating cash flow issues have been enduring problems in the construction industry. It is clear then that there is a high need of transparency and traceability of payments in the industry. Especially with regard to the fact that there is an increasing trend of managing project funding in public-private partnerships which requires more control from the client side and enhanced accountability from every participant. In the project planning phase, the different design packages and deliverables are defined according to the program. In case of an underlying blockchain platform similar milestones and packages can be added together with smart contracts which can be prepared to initiate payments according to worked hours and the submitted deliverables in time. These transparent and faster payments would be activated by smart contracts through blockchain application linked to the project bank account. In this way, payment can still be made in normal fiat currency, but initiated by the blockchain

enabled smart contract [40]. As the design process starts, the platform helps to collect and record every necessary interaction within between project participants. It needs to be highlighted that in the platform, the different design packages or calculations itself would not be shared, but rather the digital signatures, approvals and quality assurance steps of developing that design. This allows smart contracts to use these inputs to automatically update project progress measurements and, because it is a tamper-proof system, the accountability and traceability of design approvals are safeguarded. In addition, all the associated worked hours can be registered and shared on the blockchain across the parties, hence there is no need of valuable time and resource consuming additional bureaucracy. Smart contracts can handle these administrative data and inform each participant through the updated blockchain ledger.

When a design is finished, the document control system can inform the smart contract that a design package has been submitted. The necessary parties can then notify for checking the document and as their ID is registered as well on the blockchain with their trustworthy digital signature, the document can be signed off. All of these interactions can be registered on the same blockchain platform, hence payments and project performance measure updates can then be initiated by smart contracts. The advantages of establishing such a collaborative system can enhance how a project is managed and monitored. It can help to minimize misalignments of contracts and enable collective corrective actions in the joint venture. Through the traceable data on the blockchain the progress monitoring and the accuracy of cost and schedule estimates can be increased substantially. The same concept can be applied not just in the design phase of the project, but at the construction stage as well. There is no substantial difference, because instead of submitting design packages, the different construction tasks are the deliverables. The team who carries out the work will be registered and assigned to the task. These details will be registered on the blockchain. During and after construction of the component the pre-defined specifications and quality assurance procedure need to be followed, which will be supervised by the site engineer, quality controller and the project manager. After their digitally signed approval the smart contract can release payments and update the program. The process is actually very similar to what is in place on a construction site today. However, because there is an underlying automatic

and immutable blockchain layer, every task order, approval and work completion on site with its relating payment are registered and traceable. In this way, the payments can be continuous from the project account and create a transparent flow of value right to the bottom of the supply chain.

However, construction projects are always very complex challenges hence just the registration of work completion is not always enough. There are usually unforeseen issues, changes in programme or major health and safety aspects involved on site, which can result in additional claims and disputes. As a direct effect of such shared, the secured record of the past is the enhanced liability. As the transactions, approvals and payments are all immutably registered across all parties on the blockchain, it can dramatically increase the effectiveness of any dispute resolution. This transparency can positively affect not just the accountability of all parties but also the quality services across the whole lifecycle of the project. For instance, if a claim is submitted based on instructions issued by the client, or compensation events, they can be assessed and additional or reverse payment can be accommodated through the system. However, it will be still recorded in the same way ensuring a high level of transparency in the industry, which would not be possible without blockchain.

This example of claims leads us to a very important aspect, namely the health and safety and risk management angle of projects. It is crucial, that every health and safety related information or incident is also properly logged in order to discover its root cause and to have an immutable record in the case of claims and related issues. Through a blockchain enabled construction management system, every health and safety incident or record of unsafe conditions (extreme weather conditions, unauthorized actions on site, events logged in the risk register, etc.) can be registered and the risk mitigation can be initiated. At this stage the use of sensors and the internet of things (IoT) are primarily useful as these tools can act as a reliable source of data. The critical information from these sensors is then processed in a smart contract. If certain thresholds and trigger levels are reached, the smart contract can notify the appropriate person on site to prepare risk mitigation or to change the construction plan. The important two aspects here are; (i) the data is fostered and processed automatically and, (ii) all the important information

sharing interactions (data from sensors, alarm from smart contract) are registered on the blockchain system. In this way the system creates a tamper-proof source of health and safety information with accountability.

7.0 BLOCKCHAIN WITH BIM & DIGITAL TWIN

7.1 The Application of BIM with Blockchain Technology

The combination of Building Information Modelling (BIM) and blockchain technology offers huge potential and can be seen as the best direction of development. In its fundamental form, BIM is a process that deals with the digital representations of real-life assets. At its centre is a computer model that holds a wide array of information about the asset such as the 3D geometry, construction management information like time schedules and costs or operation and maintenance metrics. While BIM adoption has come a long way in developed countries it is yet to reach its full potential in developing nations. The level of information in a model or its development varies greatly from project to project and between the sectors in the construction industry. Based on the types of information used, modelling levels are usually described by assigning "dimensions" to the different information categories. This goes from 3D geometry, 4D time, 5D cost, 6 D sustainability, to 7D which incorporates BIM to asset management to use operational performance data and cover the full life cycle of the asset. Although, BIM as a technology, working method and mindset has already created significant improvements in the construction industry, the combination of BIM and blockchain technology has the capability to facilitate the development of BIM and leverage its full potential [41].

The fundamental concept that can enable the combination of BIM and blockchain technology is their shared ability to serve as a single source of truth. Engineering projects contain vast amounts and types of data and similarly high volumes of corresponding design and managerial decisions. Through the blockchain solutions explained in the previous chapters, not only can additional data be added to the BIM model, but high accountability and transparency can be ensured due to the irrefutable nature of the ledger. Nevertheless, a sufficiently advanced digital engineering framework can make sure that BIM technology works as a single source of truth for

data, while putting the audit trail of design approvals, data verification and project management decisions on a blockchain would result in a combined source of truth that covers all aspects of the project. This single property of these technologies can have significant consequences and provide a tool for creating solutions to the long-standing issue of lack of accountability and fragmented information sources in the construction industry. In such a way, BIM can act as a single source and dashboard of all information. The data is not just crucial to deliver the project, but also for its whole lifecycle. Hence, we can distinguish two major ways of utilizing BIM and blockchain together, namely; (i) BIM can combine information from the blockchain, such as supply chain information, provenance of materials, payment details, etc. particularly during construction; and, (ii) it can also assign information to the blockchain, like design decisions, source of data or model modification orders. This information can later be used by smart contracts to initiate further action, such as payments or material orders.

In the combination of Blockchain and BIM and, the blockchain would act as an underlying infrastructure to further strengthen any kind of BIM model and in this way add accountable information. This data exchange process between a BIM model and the blockchain can be automated while automatic payment obligations and task orders can be initiated through smart contracts. One of the main consequences of this blockchain enabled BIM scheme is the introduction of inherent trust within the system. As every decision is logged and traceable on the blockchain, many time-consuming and redundant checks, which emanate from the lack of trust between the project participants, can be eliminated. By capturing a comprehensive collection of datasets, on the blockchain e.g. design decisions, content checks, procurement and transactional data, and linking them to the BIM model, a secure and immutable log can be created that provides detailed information of who did what and what effect it had. This audit trail of design changes will help to create a collaborative environment as liabilities and accountability is clearly established, reducing or eliminating entirely any disputes between the cooperating parties. Considering that data collection would run throughout the whole lifecycle of an asset a blockchain enhanced BIM framework could also facilitate a circular economy. Certain features of the data captured about the building during construction could be retained in a blockchain in order that the materials and

components can be maintained, replaced and eventually removed throughout the lifecycle. The important point is to maintain a good record of the condition of materials, components and the maintenance activities performed. In this way, buildings could act as materials banks and enable a considerable reduction in waste [42].

7.2 Digital Twin for sustainable whole lifecycle management of built environment

Digital Twin (DT) is the digital replica of the physical assets, processes, and systems. DT is broader than BIM in the sense that it transmits data, monitors the asset in real-time and supports analytics, control and simulation functions by Artificial Intelligence and Machine Learning processes. Most projects do not stop at the delivery of the asset but transform and continue until the end of the life-cycle. The BIM model needs to be updated during construction to make sure everything is built as planned, or if there are necessary modifications, then those are implemented in the model. Many times, the 'as built' state is not accurately captured, which is one of the main weaknesses for a BIM model to become a "Digital Twin" of the real asset. At its basic level a digital twin is a digital representation of a real-life asset. It embodies a holistic view where the asset management is performed throughout the whole lifecycle of an asset from initial concept to decommissioning and recycling. In order to achieve this, a sufficient BIM framework is required from the inception of the project so that the delivery of models can provide the basis of the operation and maintenance phase. The BIM need to collect data such as, lifetime of structural parts specified by the factory, preventive maintenance required by the designer or the data about the embedded carbon footprint in the structural materials, during design and construction in order to support the operation and maintenance phase [43].

Through blockchain a Digital Twin not only contains all the relevant information to define operational strategies, preventive maintenance or a decommissioning plan, but it also ensures traceability of these data. For instance, if a certain part of the structure has an unexpected failure, through the Digital Twin it is easy to identify exactly which elements caused the issue, who was responsible for its assembly, and for its procurement. Through such a system, the time and cost of insurance disputes and warranty claims can reduce significantly, not to mention the inherent incentives of every

participant in the project to deliver quality products and services. A Digital Twin system does not have to be limited to the 'as built' state. It can incorporate Internet of Things (IoT) data services which provide vast amounts of data from highly specialized devices and sensors. This is the key step that turns the Digital Twin into a live and information rich dashboard and reporting tool for asset management. However, as with any data science application the insights and knowledge gained from a Digital Twin are only as good as the data that has been fed in to it. Using blockchain to continue the development of the log of actions taken during operation and maintenance (O&M) can make sure that the quality of the data from the IoT services are appropriately verified and adhere to the client's requirements. The log can provide the same benefits that it did for the design and construction of the asset. On one hand, it can enforce higher quality services by introducing unavoidable accountability, while on the other hand, it can serve as a legal tool and/or deterrent against project participants not playing by the rules.

Together with the live data and O&M action logs it would be possible to build a database in the blockchain empowered BIM model, which can serve as a basis for gaining new insights into design and project management practices. This database can accumulate data over the whole life cycle of an asset, and it can connect the decisions made that are logged on the blockchain to their effect in the models, and in the real-life asset as well. Valuable insights can be gained by analyzing such datasets, such as the time until maintenance, potential to reduce the carbon footprint, or whole life cycle costs which are invaluable for optimizing sustainable development actions.

8.0 CONCLUSION

Sustainable Development including climate resilience, are the strategic priority of the United Nations Sustainable Development Goals (SDGs) for saving the planet and the human race. Sustainability in the construction sector, which is actually highly unsustainable, is fundamental and is a prerequisite for enabling sustainable development in many other sectors. With the existing traditional processes within the civil construction sector, even with thorough effort and dedication, sustainable development practices cannot be much improved due to the inherent immense complexity within the structure and functioning the infrastructure industry. The situation is further exacerbated

by the risks of unethical practices which are almost impossible to control under actual circumstances.

Emerging and disruptive digital technologies such as Blockchain Technology (BT) can be applied as a digital backbone within infrastructure projects and operations. Application of Building Information Modelling (BIM) and Digital Twin with blockchain have the potential to enhance efficiency, accountability and transparency within the global infrastructure systems.

This paper highlighted how blockchain can shift the current payment and project management system towards a more transparent and fair practice. By reducing late payments, remediation and disputes, small and medium enterprises are no longer placed in continuous cash flow risk. Instead, the industry as a whole can become a more trusted entity. Through smart contracts, business processes and administrative tasks can be automatised to increase efficiency and always be aligned with the agreed contractual terms. This can result in significant cost savings, increment in the low margins of the industry and better control project costs. Blockchain can deliver a more streamlined procurement process, reducing the high level of fragmentation and complexity of major projects. The provenance of the materials can reduce waste and drive quality of products and service forward with high accountability. Such systems can enhance predictability with regards to procurement, but also in the case of the whole project delivery. Together with BIM, blockchain can create the single source of truth for all aspects of a construction project. Such a model can become the trusted Digital Twin of an asset supporting not only its design and construction, but its operation and maintenance along the whole lifecycle. The technology is relatively new and there are several early challenges to tackle, but the potential of reshaping the industry for the better is simply too great to miss. Construction is one of the largest industries in the world and the infrastructure it creates is the backbone of economic growth and productivity. It is our inherent responsibility to facilitate its digital transformation to make it ready for the challenges of the 21st century. However, the potential of these emerging technologies remains largely unexploited, as there is a lack of consensus, integrated approaches and legislation in support of their use.

REFERENCES

1. Emmanuel, A.-J., Ibrahim, A. D., & Adogbo, K. J. (2014). An assessment of professionals' perception of the sustainability performance of infrastructure projects in Nigeria. Journal of Construction Project Management and Innovation: Supplement 1, 4, 912-932.

2. Abidin, N. Z. (2010). Investigating the awareness and application of sustainable construction concept by Malaysian developers. Habitat International, 34(4), 421-426.

3. Cotgrave, A., & Riley, M. (2012). Total Sustainability in the Built Environment: Palgrave Macmillan.

4. Mostafavi, M., & Doherty, G. (2010). Ecological Urbanism. Harvard University Graduate School of Design: Lars Müller Publishers.

5. Serpell, A., Kort, J., & Vera, S. (2013). Awareness, actions, drivers and barriers of sustainable construction in Chile. Technological and Economic Development of Economy, 19(2), 272-288.

6. Shen, L.-y., Tam, V. W., Tam, L., & Ji, Y.-b. (2010). Project feasibility study: the key to successful implementation of sustainable and socially responsible construction management practice. Journal of Cleaner Production, 18(3), 254-259.

7. Gan, X., Zuo, J., Ye, K., Skitmore, M., & Xiong, B. (2015). Why sustainable construction? Why not? An owner's perspective. Habitat International, 47, 61-68.

8. Mauro, Paolo, 1998. "Corruption: causes, consequences and agenda for further research", IMF/World Bank, Finance and Development, 35(1): 13

9. Crosby, M., Pattanayak, P., Verma, S., Kalyanaraman, V.: Blockchain technology: beyondbitcoin. Appl. Innov. 2(6–10), 71 (2016)

10. Pilkington, M.: Blockchain technology: principles and applications. In: Research Handbookon Digital Transformations. Edward Elgar Publishing (2016)

11. Zheng, Z., Xie, S., Dai, H., Chen, X., Wang, H.: An overview of blockchain technology:architecture, consensus, and future trends. In: 2017 IEEE International Congress on Big Data (BigData Congress), pp. 557–564. IEEE (2017)

12. Yaga, D., Mell, P., Roby, N., Scarfone, K.: Blockchain technology overview. arXiv preprintarXiv:1906.11078 (2019)

13. Nofer, M.,Gomber, P.,Hinz, O., Schiereck,D.: Blockchain.Bus. Inf. Syst. Eng. 59(3), 183–187(2017)

14. Preneel, B.: Cryptographic hash functions. Eur. Trans. Telecommun. 5(4), 431–448 (1994)

15. Bakhtiari, S., Safavi-Naini, R., Pieprzyk, J.: Cryptographic hash functions: a survey, vol.4.Technical Report 95-09, Department of Computer Science, University of Wollongong

16. Carlozo, L.: What is blockchain? J. Account. 224(1), 29 (2017)

17. Nakamoto, S.: Bitcoin: peer-to-peer electronic cash system (2008)

18. Underwood, S.: Blockchain beyond bitcoin (2016)

19. Urquhart, A.: The inefficiency of Bitcoin. Econ. Lett. 148, 80–82 (2016)

20. Baliga, A.: Understanding blockchain consensus models. Persistent 2017(4), 1–14 (2017)

21. Dannen, C.: Introducing Ethereum and Solidity, vol. 1. Apress, Berkeley (2017)

22. Mohanta, B.K., Panda, S.S., Jena, D.: An overview of smart contract and use cases in blockchain technology. In: 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), pp. 1–4. IEEE (2018)

23. Cachin, C.: Architecture of the hyperledger blockchain fabric. In: Workshop on DistributedCryptocurrencies and Consensus Ledgers, vol. 310, no. 4 (2016)

24. Watanabe, H., Fujimura, S., Nakadaira, A., Miyazaki, Y., Akutsu, A., Kishigami, J.J.:Blockchain contract: a complete consensus using blockchain. In: 2015 IEEE 4th global conference on consumer electronics (GCCE), pp. 577–578. IEEE (2015)

25. Mingxiao, D., Xiaofeng, M., Zhe, Z., Xiangwei,W., Qijun, C.:Areviewon consensus algorithm of blockchain. In 2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC), pp. 2567–2572. IEEE (2017)

26. Lin, I.C., Liao, T.C.: A survey of blockchain security issues and challenges. IJ Netw. Secur.19(5), 653–659 (2017)

27. Kiayias, A.,Russell, A.,David,B., Oliynykov, R.:Ouroboros:Aprovably secure proof-of-stake blockchain protocol. In: Annual International Cryptology Conference, pp. 357–388. Springer,Cham (2017)

28. Kiayias, A., Koutsoupias, E., Kyropoulou, M., Tselekounis, Y.: Blockchain mining games.In: Proceedings of the 2016 ACM Conference on Economics and Computation, pp. 365–382 (2016)

29. Zheng, Z., Xie, S., Dai, H.N., Chen, X., Wang, H.: Blockchain challenges and opportunities:a survey. Int. J. Web Grid Serv. 14(4), 352–375 (2018)

30. Norman, M.D., Karavas, Y.G., Reed, H.: The emergence of trust and value in public blockchain networks. In: IX International Conference on Complex Systems, p. 22 (2018)

31. Mills, D.C.,Wang, K.,Malone, B., Ravi, A., Marquardt, J., Badev, A.I., Brezinski, T., Fahy, L.,Liao, K., Kargenian, V., Ellithorpe, M.: Distributed ledger technology in payments, clearing,and settlement (2016)

32. Maull, R., Godsiff, P., Mulligan, C., Brown, A., Kewell, B.: Distributed ledger technology:applications and implications. Strateg. Chang. 26(5), 481–489 (2017)

33. Ølnes, S., Ubacht, J., Janssen, M.: Blockchain in government: benefits and implications ofdistributed ledger technology for information sharing (2017)

34. Macrinici, D., Cartofeanu, C., Gao, S.: Smart contract applications within blockchaintechnology: a systematic mapping study. Telematics Inform. 35(8), 2337–2354 (2018)

35. Buterin, V.: Ethereum: Platform Review. Opportunities and Challenges for Private andConsortium Blockchains (2016)

36. Katsiampa, P.: Volatility co-movement between Bitcoin and Ether. Fin. Res. Lett. 30, 221–227 (2019)

37. Chris Gage (2017): Digital Transformation of Construction, IBM Presentation on 10th May 2017.

38. Wang J., Wu, P., Wang, X., Shou, W. (2017) The outlook of blockchain technology for construction engineering management. Frontiers of Engineering Management, 2017, 4(1): 67-75.

39. Tata Steel (2016): Sourcing responsibly - A market insight into sustainability attitudes and practices.

40. PwC (2018): Global Blockchain Survey 2018 - Blockchain is here. What's your next move?

41. PwC (2017): BIM Level 2 Benefits Measurement - Application of PwC's BIM Level 2 Benefits Measurement Methodology to Public Sector Capital Assets

42. Chris Gage (2016): Circular Construction. Insight on Business - IBM Manufacturing Blog,

43. East, E. W. (2007): Construction Operation Building Information Exchange. USACE ERDC

A MODIFIED FUZZY PROGRAMMING APPROACH FOR VECTOR MINIMUM PROBLEMS

Monoranjan Mishra and Sasmita Hota

Gandhi Institute for Technology, Bhubaneswar, Odisha, India

ABSTRACT

The problems related with profit and production maximization problem may be considered as a vector maximum problem whereas the problems related to transportation network like multi-objective transportation problem is considered as a vector minimum problem. Fuzzy programming technique may be used to solve multi-objective linear as well as nonlinear programming problems. Here we use a modified fuzzy programming approach to solve linear vector minimum problems occur in the field of multi criteria decision making analysis. In decision making problem there often exist several non-commensurable criteria, which must have to be considered. This situation is formulated as a multi criteria optimization problem in which decision maker's goal is to minimize and or maximize not a single objective function but several objective functions simultaneously.

INTRODUCTION

The application of fuzzy set theory to the decision making problem has received considerable attention by a number of authors since the pioneering work of Zadeh (1965) and Bellman and Zadeh (1970). Zimmermann's (1978) work was further developed by Leberling (1981) and Hannan (1981a). Following the maximization problem proposed by Bellman and Zadeh (1970) together with linear or hyperbolic linear membership functions, they proved that there exists an equivalent linear programming problem. In order to determine the compromise solution the decision maker may use the following major approaches: Goal programming Approach (Charhes and Cooper (1961), Leg (1972) and ignizio (1976) (ii) Utility Function Approach (Keeney and Raiffa (1976), and Dyson (1980)), (iii) Interactive Approach (Dyer (1972), and Ringuest and Rinks (1987), and (iv) Fuzzy Programming Approach (Zimmermann (1976, 78, 83).

Each of these approaches has its own advantages and disadvantages relative to others. In this chapter, some modifications have been made to construct a new membership function. This may be considered as an extension of the work of Zimmermann (1978). But the procedures remain unchanged.

A linear vector minimum problem is stated as follows:

Minimize $Z_k = \sum_{j=1}^{n} c_j^k x_j, \quad k = 1,2,\ldots\ldots K$ (1)

Subject to $\sum_{j=1}^{n} a_{ij} x_j (*) b_1, \quad i = 1,2,\ldots\ldots m$ (2)

$x_j \geq 0, \quad j = 1,2,\ldots\ldots n$ (3)

Where the expression (*) is either $\leq$ or $\geq$ or $=$ for each i.

If all the objectives are of maximization type instead of minimization type then foregoing problem becomes a vector maximum problem.

Modified Fuzzy Programming Algorithm:

Step 1. Consider only the first objective function. Solve it as a single objective linear programming problem subject to all the constraints by using an appropriate linear programming method and continue the process K times for K different objective functions. Let $x_1^*, x_2^*, \ldots\ldots x_k^*$ be the optimum solutions for K different linear programming problems.

Step 2 Calculate all the values of the of the objective functions at all these K optimal points

Step 3 For each objective function find the upper bound (U_k), lower bound (L_k) and average value (M_k) of U_k and L_k corresponding to the set of optimal solutions.

After assigning the aspiration level for each objective function the initial fuzzy model to a vector minimum problem is presented as follows:

Find $X_j, \quad j = 1,2,\ldots\ldots n$ So as to satisfy

$Z_k \leq L_k, \quad K = 1,2,,\ldots\ldots K$ (4)

and constraints (2), and (3)

Step 4. Associated a membership function $\mu_k(x)$ with k-th objective function Z_k for the vector minimum problem. The membership function $\mu_k(x)$ is defined as:

$$\mu_k(x) = \begin{cases} 1 & \text{if } Z_k \leq L_k \\ (\frac{M_k - Z_k}{M_k - L_k}) & \text{if } L_k < Z_k < M_k \\ 0 & \text{if } Z_k \geq M_k \end{cases} \qquad (5)$$

Where

L_k= acceptable level of achievement for objective Z_k

M_k= highest aspired level of achievement for objective Z_k

$d_k = M_k - L_k$ = degradation allowance for objective Z_k

Associate a membership function $\mu_k(x)$ with k-th objective functionZ_k, for the vector maximum problem. The membership function $\mu_k(x)$ is defined as:

$$\mu_k(x) = \begin{cases} 1 & \text{if } Z_k \leq U_k \\ 1 - (\frac{M_k - Z_k}{M_k - L_k}) & \text{if } M_k < Z_k < U_k \\ 0 & \text{if } Z_k \geq M_k \end{cases} \qquad (6)$$

Where

U_k = highest acceptable level of achievement level of achievement for objectiveZ_k , $d_k = U_k - M_k$ =degradation allowance for objective Z_k and $M_k = (U_k + L_k)/2$ = aspired level of achievement for objectiveZ_k .

Step 5. Formulate a fuzzy linear programming problem with a single objective function. Find out the optimal solution by using an appropriate linear programming method. Here, the optimal solution is an optimal compromise solution is an optimal compromise solution of the given vector minimum problem. Substituting this value of each objective.

By using the max-min operator, the equivalent linear programming of the vector minimum problem is formulated as follows:

Max λ (7)

Subject to $\lambda \leq \left(\frac{M_k - Z_k}{M_k - L_k}\right)$ for all k   (8)

Constraints (2), (3), and $\lambda \geq 0$

Example: To illustrate the solution producer for a vector minimum, we adopted a numerical problem from Diaz (1978).

Minimize $Z_1 = 9x_{11} + 12x_{12} + 9x_{13} + 6x_{14} + 9x_{15}$

$$+7x_{21} + 3x_{22} + 7x_{23} + 7x_{24} + 5x_{25} + 6x_{31}$$

$$+5x_{32} + 9x_{33} + 11x_{34} + 3x_{35} + 6x_{41} + 8x_{42}$$

$+11x_{43} + 2x_{44} + 2x_{45}$ (9)

Minimize $Z_2 = 2x_{11} + 9x_{12} + 8x_{13} + x_{14} + 4x_{15} + x_{21} + 9x_{15}$

$+9x_{23} + 5x_{24} + 2x_{25} + 8x_{31} + x_{32} + 8x_{33} + 4x_{34}$

$+ 5x_{35} + 2x_{41} + 8x_{42} + 6x_{43} + 9x_{44} + 8x_{45}$ (10)

Minimize $Z_3 = 2x_{11} + 4x_{12} + 6x_{13} + 3x_{14} + 6x_{15}$

$$+4x_{21} + 8x_{22} + 4x_{23} + 9x_{24} + 2x_{25} + 5x_{31}$$

$$+3x_{32} + 5x_{33} + 3x_{34} + 6x_{35} + 6x_{41} + 9x_{42}$$

$+6x_{43} + 3x_{44} + x_{45}$ (11)

Subject to

$\sum_{j=1}^{5} x_{1J} = 5$ $\qquad \sum_{j=1}^{5} x_{2J} = 4$ $\qquad \sum_{j=1}^{5} x_{3J} = 2$

$\sum_{j=1}^{5} x_{4J} = 9$ $\qquad \sum_{i=1}^{4} x_{1J} = 4$ $\qquad \sum_{i=1}^{4} x_{12} = 4$ (12)

$$\sum_{j=1}^{4} x_{i3} = 6 \qquad\qquad \sum_{i=1}^{4} x_{i4} = 2 \qquad\qquad \sum_{i=1}^{4} x_{i5} = 4$$

$x_{ij} \geq 0$ $\quad$ i = 1,2,3,4; $\quad$ j = 1,2,3,4,5 (13)

Applying the fuzzy linear programming technique to Diaz's (1978) problem, we get:

$\qquad x_{11} = 2.74, \quad x_{13} = 0.26, \quad x_{14} = 2.0, \quad x_{22} = 2.0, \quad x_{23} = 1.84,$

$$x_{25} = 0.16, \quad x_{32} = 2.0, \ x_{41} = 1.26, \quad x_{43} = 3.9, \quad x_{45} = 3.84,$$

, and $\lambda = 0.7332$ as dummy variable.

Optimal compromise solution of Z_1 , Z_2 and Z_3 are 126.7930, 103.1039 and 77.5235 respectively

By using the modified method for the above problem, we get

$$U_1 = 157, \quad L_1 = 102, \ M_1 = 129.5$$

$$U_2 = 141, \quad L_2 = 72, \quad M_2 = 106.5$$

$$U_3 = 94, \quad L_3 = 64, \quad M_3 = 79$$

$$\mu_1(x) = \begin{cases} 0 & \text{if } Z_1 \geq 129.5 \\ (\frac{129.5 - Z_1}{129.5 - 102}) & \text{if } 102 < Z_1 < 129.5 \\ 1 & \text{if } Z_1 \leq 102 \end{cases}$$

(14)

$$\mu_2(x) = \begin{cases} 0 & \text{if } Z_2 \geq 106.5 \\ (\frac{106.5 - Z_2}{106.5 - 72}) & \text{if } 72 < Z_2 < 106.5 \\ 1 & \text{if } Z_2 \leq 72 \end{cases} \qquad (15)$$

$$\mu_3(x) = \begin{cases} 0 & \text{if } Z_3 \geq 79 \\ (\frac{79 - Z_3}{79 - 64}) & \text{if } 64 < Z_3 < 79 \\ 1 & \text{if } Z_3 \leq 64 \end{cases} \qquad (16)$$

Where $\mu_1(x)$, $\mu_2(x)$ and $\mu_3(x)$ are the membership functions corresponding to the objectives function Z_1 , Z_2 and Z_3 respectively.

By using Min-Max operator, the equivalent linear programming problem of the above vector minimum problem is formulated as follows:

Max λ

Subject to $Z_1 + 27.5\lambda \leq 129.5$

$$Z_2 + 34.5\lambda \leq 106.5$$

$$Z_3 + 15\lambda \leq 79$$

$$\lambda \geq 0$$

Solving the foregoing linear programming problem by the simple method, we get

$$x_{11} = 2.74, \quad x_{13} = 0.26, \quad x_{14} = 2.0, \quad x_{22} = 2.0, \quad x_{23} = 1.84,$$

$$x_{25} = 0.16, \quad x_{32} = 2.0, \quad x_{41} = 1.26, \quad x_{43} = 3.9, \quad x_{45} = 3.84,$$

, and $\lambda = 0.7332$ as dummy variable.

Optimal compromise solution of Z_1, Z_2 and Z_3 are 126.7930, 103.1039 and 77.5235 respectively

CONCLUSION

We have used modified fuzzy programming method for the vector minimum problem. This method has been compared with Diaz's (1978) method by illustrating a numerical example. In this modified method we use only half of the decision interval instead of the whole interval$[L_k, U_k]$. Generally, the compromise value of each objective lies in the interval $[L_k, M_k]$ for a vector minimum problem. In this method, we have reduced the decision interval. The minimizing solution always turns out to be an efficient solution for the min-operator. In Zimmermann's (1978) fuzzy programming method, the dummy variable λ lies in the interval [0.1] for a vector minimum problem. In case of a vector minimum problem if the dummy variable λ lies in the interval [0.5, 1], then only it is possible to apply the modified fuzzy programming method where the compromise solution of the k-th objective lies in the interval$[L_k, M_k]$; otherwise, it lies in the interval$[M_k, U_k]$. The method discussed in this paper can be implemented to the vector maximum problem by using the membership function (6). From the solutions of numerical example it is evident that the representation of the membership function is not unique.

REFERENCES

[1] Zadeh, L.A. – Fuzzy Sets, Information control, (1965), pp 338-353

[2] Zimmermann, H.J. -Fuzzy programming and linear programming with several objective functions, Fuzzy Sets and Systems 1, (1978), pp.45-55.

[3] Bellman, R.R, Zadeh, L.A – Decision making in a fuzzy environment. Management Sci B17, pp 203-218.

[4] Ringuest, J. L., Rinks, D.B. - Interactive solutions for the linear multi-objective transportation problem, European Journal of Operational Research 32, (1987), pp 96-106.

[5] Dyson, R.G. - Maxmin programming, fuzzy linear programming and multi criteria decision making, Journal of the Operational Research Society, 31 (1980), pp. 263 – 267

[6] Leberling, H-On finding compromise solutions in multi-criteria problems using the fuzzy min-operator, Fuzzy Sets and Systems, Vol.6,(1981) pp.105-118.

[7] Hanan, E. L - On fuzzy goal programming, Decision Science, Vol.12, (1981), pp.522-531.

[8] Dyer, J. S, Geoffrion, A. M, Feinberg, A - An Interactive Approach for Multi-Criterion Optimization, with an Application to the Operation of an Academic Department, Management Science, Vol. 19, No. 4, Application Series, Part 1 (1972), pp. 357–368.

[9] Keeney, R, Raiffa, H. - Decisions with Multiple Objectives: Preferences and Value Tradeoffs. New York: Wiley (1976).

[10] Charnes, A., Cooper, W.W - Management Models and Industrial Applications of Linear Programming. New York: Wiley (1961).

DESIGN OF BEAM AND SLAB BY USING C PROGRAMMING

Kutwade Rutuja S.[1], Kutwade Rutvik S.[2] and Patil Yogesh S.[3]

[1,2]Student and [3]Assistant Professor, Department of Civil Engineering Sharad Institute of Technology College of Engineering, Yadrav-Ichalkaranji 416121, Maharashtra, India

ABSTRACT

Beam and Slab design is done mainly by manual method or using design and analysis software. In this project, a C coding has been done for the design of a simply supported reinforced concrete beam and design of a simply supported reinforced concrete slab . Computer is very useful tool in the engineering works but sometimes computer software has some limitations. The solution could be an appropriate use of computer programming. Knowledge of programming allows to solve various civil engineering difficulties.The design criteria will change with the grade of concrete and grade of steel used. Indian standard design procedure has been followed, and the clauses in the IS 456:2000, has been followed during the coding. This coding has done to overcome the delay in the manual calculations, to obtain the accuracy in the result calculations. Also the unit conversion is not allowed in the coding, and all the dimensions are to be submitted in millimeters only.

1. METHODOLOGY

This project is to develop a C program for design of RCC beam. In that the major part of this project is based on C language. To develop this program " Turbo C " Software is essential. Important knowledge for this project that is divided into four parts: (1) Literature Review (2) Study of C language (3) Theory of Design of Reinforced concrete beam and (4) Develop a program.

The literature review is a search for keywords about research in applied computer language for   civil engineering such C/C++ ,computer program. One of the literature reviews is developing   program for Analysis of standard beam conditions by C programming. Whereas, someone did Analysis by STAAD-PRO and Design of Structural Elements by MATLAB. But in this project we will design RCC beam by developing C Program.

In this project, We refer to IS-456:2000 standard.Besides, we learn about the fundamentals of C language to be used to develop the program.

➢ **Statements Used in the Program if Else**

In this statement if condition are satisfy true, then a single or block of statement executed otherwise another single or block of statement is executed.

Nesting of if …else

When there are another if else statement in if-block or else-block, then it is called nesting of if-else statement.

Ladder if else

In this type of nesting there is an if else statement in every else part except the last part. If condition is false control pass to block where condition is again checked with its if statement.

Array

Array variable can store more than one value at a time where other variable can store one value at a time.

Switch Case

Switch case statement evaluates a given expression and based on the evaluated value(matching a certain condition), it executes the statements associated with it.

For loop

In a program, for loop is generally used when number of iteration are known in advance. The body of the loop can be single statement or multiple statements.

Break

Sometimes it becomes necessary to come out of the loop even before loop condition becomes false then break statement is used. Break statement is used inside loop and switch statements.

➢ **Operators Used in Program**

Arithmatic Operator

This operator used for numeric calculation. These are of either Unary arithmetic operator, Binary arithmetic operator. Where Unary arithmetic operator requiredonly one

operand such as +,-, ++, --,!, tiled. And these operators are addition,subtraction, multiplication, division. Binary arithmetic operator on other hand required two operand and its operators are +(addition), -(subtraction), *(multiplication), /(division), %(modulus). But modulus cannot applied with floating point operand as well as there are no exponent operator in c.

Assignment Operator

A value can be stored in a variable with the use of assignment operator. The assignment operator(=) is used in assignment statement and assignment expression. Operand on the left hand side should be variable and the operand on the right hand side should be variable or constant or any expression. When variable on the left hand side is occur on the right hand side then we can avoid by writing the compound statement.

Relational Operator

It is use to compared value of two expressions depending on their relation. Expression that contain relational operator is called relational expression.

Increment and Decrement

The Unary operator ++, --, is used as increment and decrement which acts upon single operand. Increment operator increases the value of variable by one .Similarly decrement operator decrease the value of the variable by one.

Logical or Boolean Operator

Operator used with one or more operand and return either value zero (for false) or one (for true). The operand may be constant, variables or expressions. And the expression that combines two or more expressions is termed as logical expression.

Where logical NOT is a unary operator and other two are binary operator. Logical AND gives result true if both the conditions are true, otherwise result is false. And logial OR gives result false if both the condition false, otherwise result is true.

C Has Three Logical Operators:

OperatorMeaning

&&   AND

‖	OR
!	NOT

2. DESIGN CONSIDERATIONS

There are some certain steps and procedures to be followed to design the beam.

a) For Singly Reinforced Beam

1) Calculation of Depth

Required depth (dreq)= √Mu/Rumax*b

OverallRequireddepth (Dreq)= dreq+dia/2+clear cover

Provided depth (dprov)= D-dia/2-clear cover.

2) Calculation of Ast

Ast=0.5*fck/fy(1-√1-(4.6*Mu/fck*b*dprov))*b*dprov

Number of bars = Ast/π/4*dia2

3) Calculation of Shear Reinforcement

Nominal shear stress i.e. Tv is calculated by IS 456:2000(Clause no.40.1)

Ptlim= Ast/b*1/dprov*100

Design shear strength of concrete i.e. Tc is calculated from Table no.19 in IS 456:2000.

Tcmax has taken from Table no.20 in IS 456:2000.

Comparing Shear stresses -

Tv<Tv/2 - No need of shear reinforcement

Tv<Tc - Nominal shear reinforcement is required

Tcmax>Tv>Tv - Shear reinforcement is required

Calculation of spacing in shear reinforcement

Minimum of -

Sv1= 0.75*dprov

Sv2= Sv2=0.87*fy*Asv*1/0.4*1/b

Sv3=300

b) For Doubly Reinforced Beam

1) Calculation of Mulim

For Fe250 - Mulim=0.149*fck*b*dprov*dprov

For Fe415 - Mulim= 0.138*fck*b*dprov*dprov

For Fe500 - Mulim=0.133*fck*b*dprov*dprov

2) Check for Singly or Doubly reinforced section

If Mulim is less than Mugiven then it is Doubly reinforced section. And if Mulim is greater than Mugiven then it is Singly reinforced section.

3) Calculation of Ast

Ast1 is calculated by following formula

Mulim = 0.87*fy*Ast1*(dprov-0.42*xumax)

Ast2 is calculated by, Mu1= Mugiven- Mulim

Mu1= 0.87*fy*Ast2*(dprov- cc- dia/2)

Now, Ast= Ast1+Ast2

4) Calculation of Asc

Asc is calculated by following formula

Mu1= fsc*Asc*(dprov- cc- dia/2)

5) Calculation of Shear Reinforcement

Nominal shear stress i.e. Tv is calculated by IS 456:2000(Clause no.40.1)

Ptlim= Ast/b*1/dprov*100

Design shear strength of concrete i.e. Tc is calculated from Table no.19 in IS 456:2000.

Tcmax has taken from Table no.20 in IS 456:2000.

Comparing Shear stresses -

Tv<Tv/2 - No need of shear reinforcement.

Tv<Tc - Nominal shear reinforcement is required.

Tcmax>Tv>Tv - Shear reinforcement is required.

6) Calculation of Spacing in Shear Reinforcement

Minimum of -

Sv1= 0.75*dprov

Sv2= 0.87*fy*Asv*1/0.4*1/b

Sv3=300

3. RESULTS AND DISCUSSION

The maximum bending moment of a beam is acting at mid span of beam so we will have to provide maximum steel in the part of mid span of beam. The section of the beam must be able to resist the   maximum bending moment to which it is subjected. The section of the beam must be able to resist the maximum shear force to which it is subjected. Shear design of reinforced concrete beam involves the determination of spacing between stirrups. According to conditions which is given in calculation of shear reinforcement and Calculation of spacing in shear reinforcement we determined shear reinforcement details.

Values recorded by the manual calculation and the C programme are tabulated in Table 1, Table 2 and Table3. Recorded values exhibit the difference between the manual calculation and the calculation with the computer applying C programming. Note that the input data considered under both cases is same, but the output through computer slightly differed from the manual calculation. Required depth for the singly reinforced beam by manual calculation is 524.7 mm, whereas the computer output recorded was 525.1 mm, as presented in Table 1. There is a variation of 0.08% higher as compared to manual calculation. Similarly, 0.09% higher value for provided effective depth, 0.49% less for steel area compared to manual calculation and 0.46% more in case of vertical stirrups' spacing as compared to manual computation, as in Table 1. As steel are recorded by the computer output gives less compared to the manual, and also the stirrups' spacing was more compared to manual calculation, the design is observed to be economical and sound also.

Similar calculations were carried out for the one-way and two-way slabs also. Results recorded are as presented in Table 3. Input and data considered, again, were same values for both, computer and manual calculation, as seen from Table 3. Although almost similar output was recorded, still there were slight variations in the results exhibiting the difference of values between these approaches. Overall depth by manual calculation was 141.25 mm and by C programme, it is 150 mm, which is just around 6% more than the manual approach. Effective length of the slab recorded a value of 3126.5 mm by manual and 3125 mm by C programme. Effective length of the slab is 1.5 mm more for the manual approach, and is around 0.05% . Similarly, for area of steel C programme looked to be more economical compared to the manual calculation.

Fig. 1, 2 and 3 represent the variations in these values graphically.

Hence, the approach by manual calculation is tedious and laborious, and prone for human errors. Study of the comparison clearly exhibits that the computer application is easy, reliable and also least susceptible for any errors.

Table 1: Comparative values of Computer (C) and manual (M) computations for Singly Reinforced Beam

	Gr.of Concrete		Gr.of Steel		Width of beam (mm)		Clear cover (mm)		Dia of bar (mm)		Ultmate Momentum(N/mm)		SF value (N)	
	M	C	M	C	M	C	M	C	M	C	M	C	M	C
I/P	M20	M20	Fe415	Fe415	230	230	20	20	16	16	175000000	175000000	60000	60000
O/P	Required Depth(mm)		Provided(Eff) Depth (mm)		Area of steel (mm²)		No.of bars		Tv		Tc		Vertical stirrups' spacing (mm)	
	524.7	525.1	571.5	572	1005	1000	5.89	6	0.4559	0.456066	0.56955	0.57455	219.68741	220.7114

Table 2: Comparative values of Computer (C) and manual (M) computations for Doubly Reinforced Beam

	Gr.of Concrete		Gr.of Steel		Width of beam (mm)		Clear cover (mm)		Dia of bar (mm)		Ultmate Momentum(N/mm)		SF value (N)	
	M	C	M	C	M	C	M	C	M	C	M	C	M	C
I/P	M20	M20	Fe415	Fe415	300	300	20	20	16	16	87000000	87000000	60000	60000
O/P	Provided(Eff) Depth (mm)		Area of steel (mm²) ASt1		Area of steel (mm²) Ast2		No.of bars		Tv		Tc		Vertical stirrups' spacing (mm)	
	270.88	272	780.9	781.29	290.68	292.19	5.9	6	0.742688	0.735294	0.711256	0.710487	171.4512	169.2121

Table 3: Comparative values of Computer (C) and manual (M) computations for One way slab Singly Reinforced Beam

	Gr.of Concrete		Gr.of Steel		Breadth of slab (mm)		Length of slab (mm)		Clear cover (mm)		Value of support (mm)		Dia of main bar (mm)		Value of LL (N/mm)		Floor Finish load (N/mm)			
	M	C	M	C	M	C	M	C	M	C	M	C	M	C	M	C	M	C		
I/P	M20	M20	Fe415	Fe415	3000	3000	6200	6200	20	20	300	300	10	10	9E+07	8.7E+07	60000	60000		

	Pdepth (mm)		Overall depth (mm)		Effective length (mm)		Factored load		Bending Moment (N/mm)		Depth Required (mm)		Area of Steel (mm²)		Main bar spacing (mm)		Distr bar spacing (mm)		Shear Force (N)	
O/P	125	125	141.25	150	3126.5	3125	14.25	13.875	2E+07	1.7E+07	79.86	78.34	414.5	402.35	197.65	195.104	282.3	279.1	19325.2	20812.5
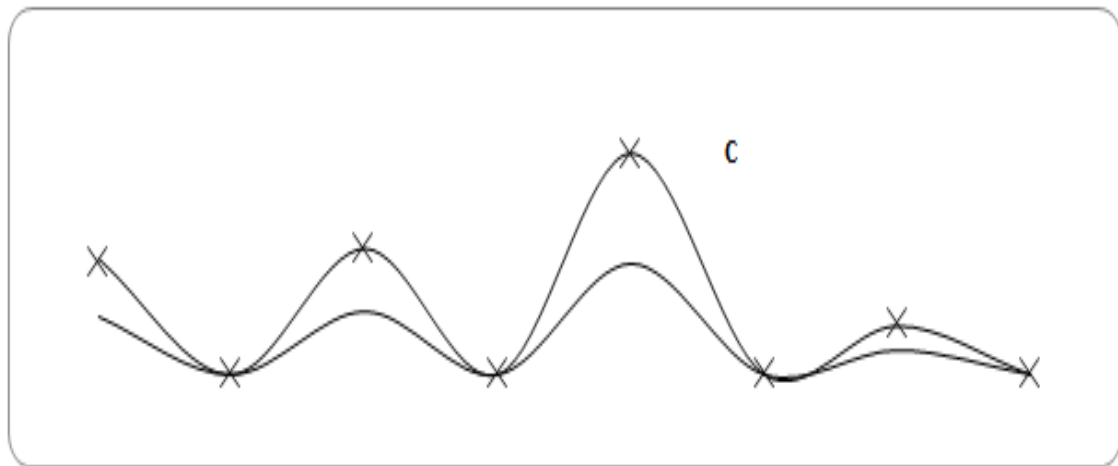
Fig.1: Comparison of Required, effective depths, Area of steel and vertical stirrups' spacing by manual (M) and computer (C) approach.
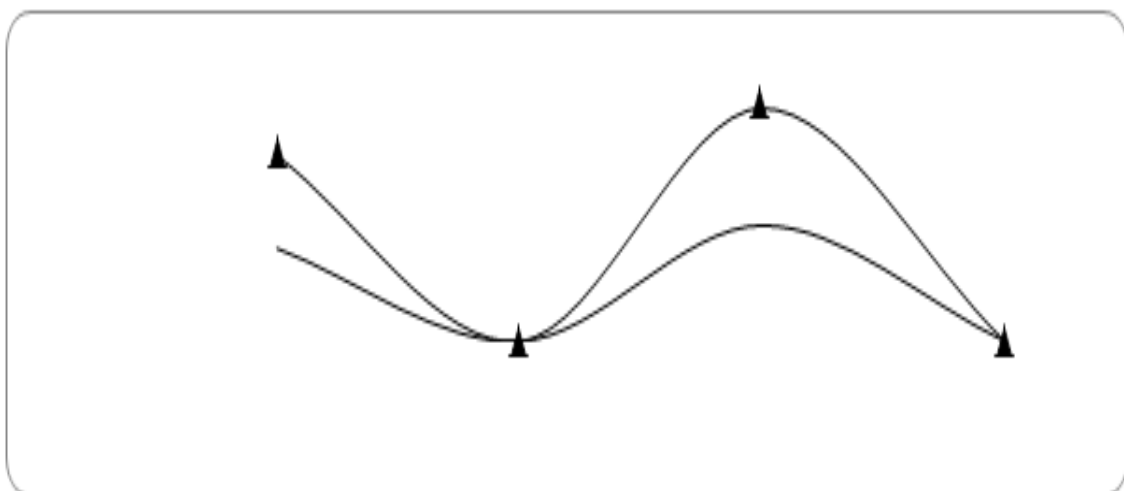
Fig. 2: Comparison of TV & Tc values manual (M) and computer (C)

Doubly Reinforced Beam:

Fig.3: Comparison of Required, effective depths, Area of steel and vertical stirrups'
spacing by manual (M) and computer (C) approach.

Fig. 4: Comparison of Tv & Tc values manual (M) and computer (C)
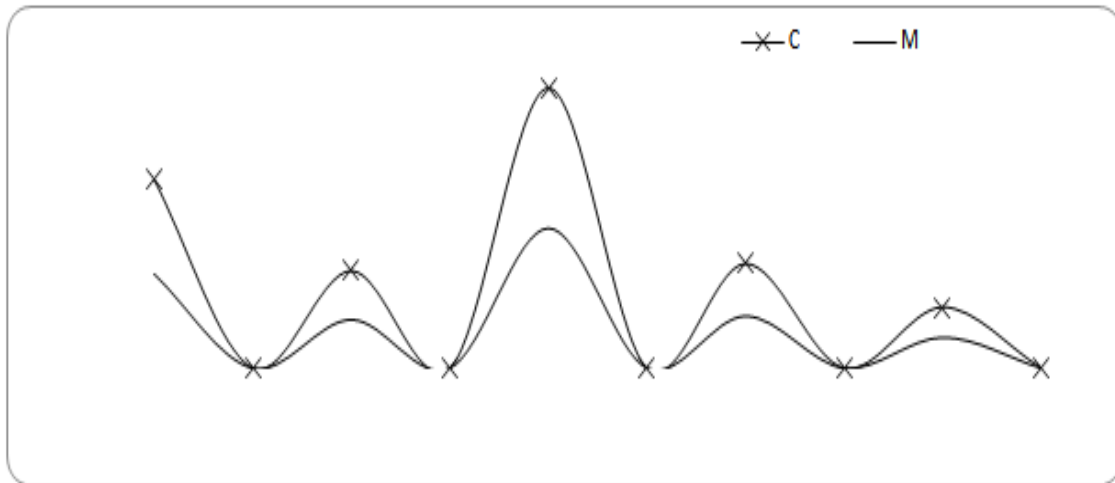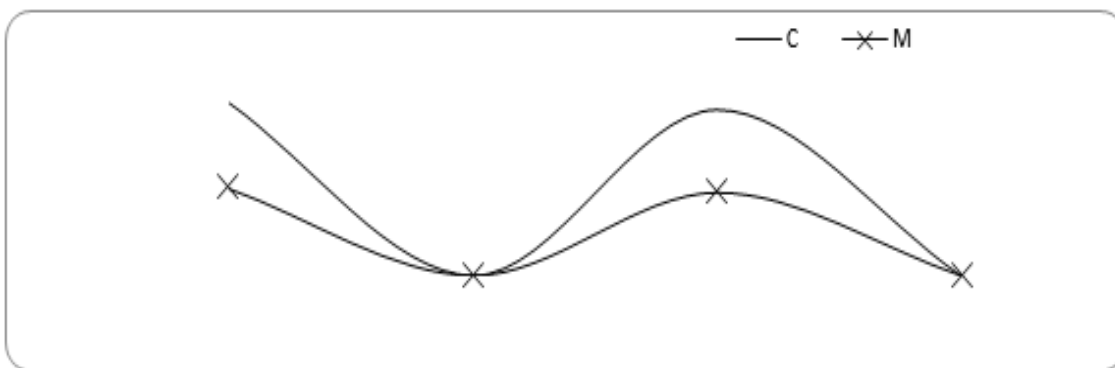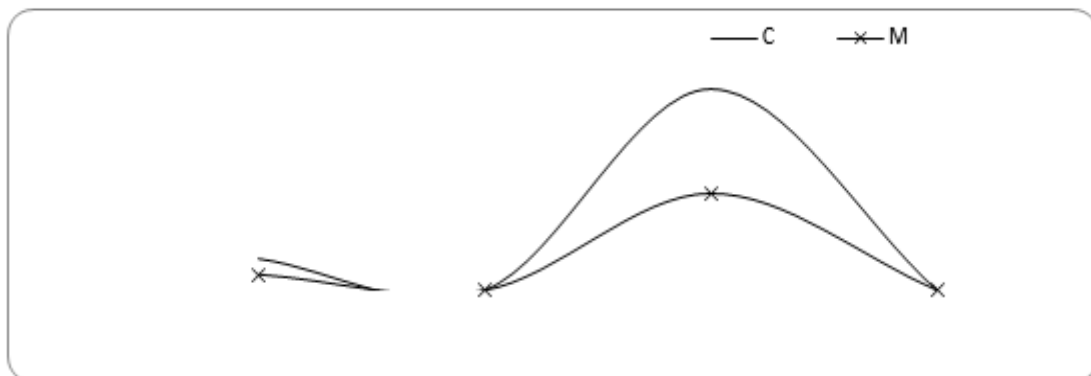
One-way slab:
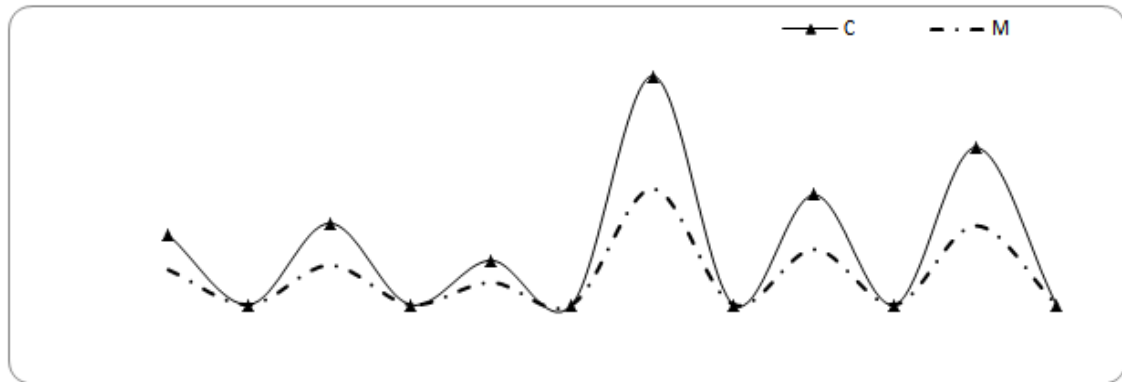
Fig.5: Comparison of Effective length and SF.

Fig. 6: Comparision of calculated manually and computer for pdepth, overall depth, required depth, Ast and spacing

Fig. - Input

Fig.-Output

4. CONCLUSION

❖ C programming helps to reduce lengthy calculations. Values obtained very accurately with minimum time by using C programming.

❖ The programrun successfully with reasonable speed and reliability, thus achieving the basic aim of carrying out this work.

❖ The C coding is sufficient for design of RCC Simply supported Slab and Beam.

❖ As engineer, our knowledge about programming will develop, which prove to be value addition for us. Now a day world is getting faster day by day, to survive in competitive world programming skill is very useful.

❖ Satisfied results are obtained for this programming when compared to manual calculations.

❖ With the help of basic knowledge of C language, new software can be invented by user. The programming environment selected in the project work, is found quite user friendly due to manual errors are avoided.

5. ACKNOWLEDGEMENT

6. REFERENCES

❖ Jitendra M. Joshi, Aakash S. Pawar,"Analysis of standard beam conditions by C programming", Cikitusi Journal For Multidisciplinary Research, Volume 6, Issue 4, April 2019.

❖ Shrikant M. Harle,"Analysis by STAAD-PRO and Design of Structural Elements by MATLAB", Asian Journal of Scientific Research, January 2017.

❖ Computational analysis of RCC slab (simply supported) using c software language, International Journal Of Recent Technology And Engineering,Volume 8, Issue 4, November 2019.

❖ Analysis of standard beam conditions by c programming, Cikitusi Journal For Multidisciplinary Research, Volume 6, Issue 4, April 2019.

❖ IS: 456-2000 Bureau of Indian Standards, New Delhi.

❖ Karve and Shah, "Limit State Theory & Design", Structures Publications, Pune.

❖ Punmia B.C. "Reinforced Concrete Design, Vol. I, II", Laxmi Publications.

❖ E. Balagurusamy, "Programming in ANSI C", Tata McGraw-Hill Publication.

CIVIL AVIATION HIJACK- SMART WEAPON

Gireeshan. P[1] and Dr. Beulah Shekhar[2]

[1]Research Scholar, Department of Criminology and Criminal Justice, MS University, Tirunelveli

[2]Emeritus Professor, Department of Criminology, School of Arts, Media & Management, Karunya Institute of Technology & Sciences, Coimbatore

ABSTRACT

Civil aviation remains a golden target for the terrorist. Since the first hijacking incident, in Peru in 1931, a number of terrorist attacks have happened against civil aviation. However considering all terrorist attacks against the civil aviation, hijacking places a significant role. The hijacked plane was used for extraordinary purposes including in the form of a missile in the September 11, 2001, World Trade Centre (WTC) attack. The stringent security measures at the airport often cause inconveniences and many passengers, at some point, might question the importance of such measures. So it is better to have an idea about why security agencies are so resolute in their procedures at the pre-embarkation security point and insist on removal of a number of items from the possession of the passenger. This paper gives an outline of materials used as a weapon to capture commercial flights on different occasions.

Keywords: Civil aviation, Hijack, Weapons, Pre-embarkation Security check, Stringent security, Passengers Support.

I. INTRODUCTION

We are living in a mobile society and many people are traveling via the fastest and competitively priced transportation, the airplane. In this fast-moving society, we are experiencing a growing fear, among public, towards utilizing the air transportation. One cause of this concern is terrorism. There can be few regular airline travelers who have not worried about them being hijacked. Civil aviation is always a silver bullet target for the terrorist due to countless favorable reasons. Since the first hijack incident in Peru, in 1931, numerous terrorist attacks happened against civil aviation in different ways and modes. However, among all terrorist acts against civil aviation, study shows, a

challenging truth that hijacking constitutes a substantial number. Hijacking is a serious threat to air safety and is carried out using approaches which are even unheard among normal passengers. Most of the passengers express their resentment and frustration during the security check. Sometimes they raise their concern, underestimating the security threat and perceiving screening as a breach of their privacy.

An aircraft is also highly vulnerable due to technical reasons. A mild asymmetry may cause the center of gravity which will make the function of aircraft critical and difficult to stay afloat in the air (Srivastava, 1998). It is said that a small volume of explosives is adequate to blow up an aircraft at cruising altitude where the air pressure inside the aircraft is three to five times that outside the aircraft. The hijackers usually attempt to exploit this vulnerability and insist on continuing a flight in unsafe conditions. There have been events when the lives of passengers have been put at greater risk by the captain not being totally in command of the aircraft because of direct violent threats by the hijacker(s).

II. HIJACK

The term hijack originates from two words Hi and Jack. Probably during the days of prohibition in the USA, bootleggers utilized to address their companion as a hijack. Thus hijack become a pseudonym for bootleggers and the same embraced for illegal detention of aircraft or other vehicles. Afterward, the word evolved as skyjacking, and these days both are utilized alternatively. Aircraft hijacking is the unlawful seizure of an aircraft by an individual or a group and is not a new phenomenon. After the primary capture in 1930, a number of incidents have been reported. However, during those days it was not considered so critical since they were not committed with any criminal or terrorist intention but for political reasons. Formerly, many countries offered political asylum to the hijackers; they even showered them with honors and bravery awards. As an end result of this hijack, menaces soared to towering statures. Even 1968 designated as the year of terrorism in air, as 38 endeavors were made to hijack various aircrafts. Finally, the International Civil Aviation Organization took a serious view and developed a range of precautionary measures to safeguard civil aviation which became the catalyst for Hague Convention in 1970.

Hijack remains the foremost serious and obvious risk to civil aviation security. The strategy and weapons used for hijacking differs from one incident to the other. In most hijacking cases, the pilot is constrained to fly, following threats and orders from the hijackers. Motives of the hijackers shift from demanding the release of certain inmates, to spotlight the grievances of a specific community, for ransom, or for a few political or administrative concessions by the authorities. Occasionally, the hijackers have flown the aircraft themselves, as in the case of the WTC attack in 2001, and used the aircraft as a weapon to target specific locations, strikingly during the 9/11 attack (Whitney, 1988). So it is imperative to a passenger to know why such rigid security measures are necessary in civil aviation.

III. WEAPONS USED IN HIJACK.

A number of hijacking incidents had happened in the history of civil aviation using different weapons. To limit the size of the study here we consider only one incident in which a particular weapons is used, even though, multiple examples could be found for the use of a particular weapon.

i. Pistol

On February 15, 2007, an Air Mauritania Boeing 737 flying from Nouakchott to Las Palmas with 87 passengers on board including crew were hijacked by lone gunman brandishing two pistols shortly after it took off from Nouakchott. The man wanted to fly to Paris, but the plane landed in an airbase near Las Palmas. The pilot, realizing that the hijacker cannot understand French, outwitted him by instructing the crew and passengers in French, over the intercom, on how to capture the hijacker on landing (Harding, 2007).

Indian Airlines Flight 814, commonly known as IC 814, was hijacked on Friday, 24 December 1999 while flying over Lucknow from Tribhuvan International Airport in Kathmandu, Nepal, to Indira Gandhi International Airport in Delhi, India. The pilot confronted by a man, pointed a pistol, and held a grenade in the other hand. Eventually landed in Kandahar, Afghanistan, after being flown to several locations (Sharma, 2011).

ii. **Kirpan**

An Indian Airline aircraft traveling from New Delhi to Srinagar carrying 111 passengers, and a crew of six was hijacked on September 29, 1981, by a knife-wielding supporter of a separate Sikh homeland forcing it to land in Pakistan. The five hijackers overpowered by Pakistani commandos, and all the passengers, and crews were released off without any casualties (Banka, 2018).

iii. **Bomb**

Seven young Sikh hijackers seized a jetliner from Indian Airlines (IA) flying from Delhi to Srinagar on 24 August 1984 and took it to the UAE. The hijackers were members of the banned All-India Sikh Students Federation and armed with bombs, pistols and Sikh daggers threatened to kill all the passengers and blow up the aircraft if their demands were not met. Five passengers were reportedly released on a first refueling stop in Lahore, Pakistan, and two more during another stop in Karachi. The other 79 passengers and 6 crew members were freed in Dubai more than 24 hours after the aircraft was hijacked (Goo, 2004).

iv. **Kirpans and Long Needles.**

An Indian Airlines Boeing 737 with 79 passengers on a board bound for Jammu. Hijacked by Sikhs displayed their kirpans, long needles that Sikhs use to adjust their turbans, and fire axes and fire extinguishers were taken from the aircraft. They charged down the aisle and yelled pro-Khalistan slogans. The flight shuttled between Lahore and Karachi, and finally landed in Dubai airport after a tension-packed thirty-six hours (Santhanam, 1984).

v. **Pistol and Hand Grenade.**

The Indian Airlines flight from Mumbai to New Delhi was taken over by a Sikh militant who was armed with a pistol and a hand grenade on August 22, 1982. The security forces killed the hijacker and all passengers were saved (Inamdar, 2014).

On 13 October 1977, Lufthansa flight LH 181, took off from Palma de Mallorca en route to Frankfurt with 86 passengers and five crews. About 30 minutes later, the aircraft was skyjacked by four militants. The hijackers were brandishing a fully stacked pistol and hand grenades. He forcibly expelled the co-pilot out of the cockpit, sending

him to join the passengers and flight attendants, leaving the pilot to take over the flight controls. The hijackers demanded the release of their compatriots from a German prison, together with two Palestinians held in Turkey. Additionally, they wanted 15 million dollars in trade for the lives of the passengers. It was Canada's first successful plane hijacking (Koerner, 2013).

On 14 June 1985 Trans World Airlines (TWA) flight 847, carrying 153 passengers and crew, was hijacked shortly after take-off from Athens en route to Rome by two Shia Muslim terrorists armed with a pistol and hand grenades. The hijackers intended to force the pilot to fly to Algiers, Algeria. However, when told by the captain that the aircraft did not have sufficient fuel to fly to Algiers, the hijackers changed their destination to Beirut (Choi, 1994).

vi. Handgun and a Grenade

Patrick Dolan Critton, boarding Air Canada DC-9 Flight 932, in Thunder Bay, Ontario, on Dec. 26, 1971. He threatened the cabin crew with a pistol and a grenade as it left for Toronto. On his way to Havana, he released all passengers in Toronto, and the plane returned to Toronto safely with the crew on board (Celona, 2001).

vii. Handguns

Continental Airlines Flight 54 from Los Angeles to Houston with scheduled stops in Phoenix, El Paso, and San Antonio. On August 3, 1961, Bearden, the hijacker, hijacked the flight with two loaded handguns hidden in their carry on pockets. There was absolutely no screening of baggage at US airports at that time. On the way to El Paso and the aircraft would go south-east to Havana (Sofrep, 2020).

viii. Revolver

5th July 1984 an Airbus aircraft belongs to Indian Airlines hijacked by Khalistani hijackers with a revolver and knives during the flight from Srinagar to Delhi and taken to Lahore. After the negotiation with Pakistan government officials, the hijackers relinquished flatly and ended up the ordeal of 264 passengers including the crew (Srivastava, 1998).

ix. Mentally Ill.

A man who was mentally unstable shouting the plane has been hijacked Indian Airlines Avro jetliner flying from Mangalore to Bangalore on 10th August 1984. The pilot convinced the hijacker by promising a meeting with India's top film actress. The hijacker told the passengers and pilot, that he was outfitted with dynamite and a loaded pistol and would blow up to the plane unless he was given a meeting with actress Sri Devi. The hijacker had been undergoing treatment at the Bangalore mental hospital and was carrying a document identifying him as an outpatient. (Srivasatava,1998)

On 10th August 2018, 29-year-old Richard Russell of Horizon Air ground service agents took empty Horizon dash 8Q400 aircraft which was in maintaining position in Seattle-Tacoma international airport and sail it for 75 minutes finally crashed, killing employee without any further casualties. Fortunately, he was with no wrong intention to hurt anymore human beings. (Broderick, 2018).

x. Cake of Soap.

On September 13, 1990, a man identified as T. Mahalingam using a bar of soap claimed a grenade trying to hijack a domestic Indian airline to Australia. The Boeing 737 was carrying 91 passengers and six crews on Coimbatore- Bangalore flight. The man brandished a handkerchief-covered object and started screaming that he had a grenade 10 minutes after the plane took off from Coimbatore. He barged into the cockpit and demanded that the captain, fly to Perth, Australia, by means of Colombo. The captain kept on talking to the man as the plane approached Bangalore, and assured he could be taken to Colombo after Bangalore. Soon after the plane landed, the hijacker surrendered, and the object turned out to be a bar of soap (Prasad, 2004).

On 10th November 1990, Two Burmese understudies carrying a fake bomb made of bars cleanser seized a Thai Aviation routes Airbus A300 amid a flight from Bangkok to Yangon with 219 travelers and team on board in an endeavor to center world consideration on military restraint in Myanmar (Mukherjee, 1990).

xi. Pomegranate

On 4 February 1991, youth made an unsuccessful endeavor to hijack an Indian Airlines flight which flying from Calcutta to Agartala. The youth went to the cockpit with two

spherical objects wrapped in the hanky claimed to be a grenade. He coerced the pilot to fly to Calcutta. The skeptical pilot has convinced the hijacker the flight is moving to Calcutta. In the meantime crews with the help of some passengers overpowered the hijacker. Later sphere-shaped object in the handkerchief found that pomegranate (Srivastava, 1998).

xii. Ball of Wheat Flour

On January 22, 1993, an Indian airline flight from Patna to Delhi via Lucknow hijacked by a solitary person. Upon Lucknow's departure, the hijacker threatened that he had a bomb with him and cautioned to blow up the plane. Later after the influence of Vajpayee who managed to assuage the hijacker, surrendered before authorities. The alleged bomb was found to be a ball made of wheat flour wrapped in thread (Srivastava, 1998).

xiii. Hair Dryer

On 27th March 1993 Indian Airlines domestic Flight 439, an Airbus A 320 with 192 passengers and 11 crews, was hijacked during a flight from Delhi to Madras via Hyderabad. A passenger, who claimed to have explosives strapped to his body, insisted to flown to Lahore. The authorities in Lahore denied the aircraft permission to land which finally landed in Amritsar airport. After much negotiation, the hijacker eventually surrendered and all passengers and crew members were released. A search of the aircraft found no explosives. The bomb that the man claimed to have strapped to his body was a hairdryer which he had covered up beneath his belt (Dabas, 2018).

xiv. Rubber Solution

On 10th April 1993 The New Delhi-bound Boeing 737, carrying fifty-two other passengers and seven crew members, was commandeered in no time takeoff from Lucknow. The four students, from an adjacent college, brandished a bottle they claimed contained an explosive. They later admitted to passengers that it was a combustible liquid that could only cause limited fire. One student read a 10-minute petition of grievances about their college and said the plane would be blown up unless the hijackers could meet the governor of the Uttar Pradesh state (Max, 1993).

xv. **Box-Cutters, Mace, Pepper Spray, And Noxious Chemicals**

Diverse weapons are used to target various locations on September 11, 2001. The hijackers however sprayed mace or pepper spray on flight crew members and passengers to hold them away from the cockpits and used knives in their coordinated aircraft takeovers. Hijackers used box-cutters to kill flight attendants, passengers, and crew members, including the captain of Flight 11. Harmful chemical spray, such as tear gas or pepper spray was used, and also some people were stabbed. Black box recordings of United Airlines Flight 93 showed that crew and passengers attempted to seize control of the plane from the hijackers in response to which one of the hijackers ordered the pilot to roll the plane. Soon afterward, the aircraft crashed into a field near Shanksville in Pennsylvania. (Angerer, 2018).

xvi. **Toy Guns**

Bholanath Pandey and his companion Devandar Nath Pandey had hijacked IA flight IC 410 on December 20, 1978, demanding the release of Indira Gandhi and withdrawal of all cases against her son Sanjay Gandhi. After keeping 132 passengers hostage for some hours, the pair, who were carrying only toy weapons, later surrendered (Haider, 2016).

On February 25, 2019, Birman Bangladesh Airlines Flight BG 147 with 156 passengers and crews had been traveling to Dubai from Dhaka. After the 25-minute flight, when the plane was at an elevation of 15,000 feet, the anonymous suspect took at least two members of the crew as hostage using a toy gun and demanded to speak with Bangladesh Prime Minister. He tried to create a panic among the cabin crew and claimed that he wanted to enter the cockpit. Security forces took control of the Boeing 737 after it landed at the Shah Amanat International Airport in the southeastern city of Chittagong. The suspect refused to yield and was shot (Regan, 2019).

xiv. **Cloth Pieces**

Gurbaksh Singh had hijacked a Delhi-Srinagar flight with 70 foreigners on board on August 4, 1982, by claiming he had a bomb and proposed to take Lahore but later flight compelled to land it in Amritsar. The hijacker, hijacked the plane to express his resentment against the Indian government in contrast to the directive that Sikhs not to

carry kirpans (ceremonial dagger) onboard flights. The material which he claimed as bomb, in fact, was a ball made of cloth pieces (Thukra, 2013).

xv. Knives

On May 1, 1961, the first U.S. Airline flight hijacked to Cuba. A National Airlines Convair 440 flight from Marathon, Florida, to Key West, was hijacked by a man using a knife held against the pilot's throat, and announced that he had been assigned to assassinate Fidel Castro, and wanted to go to Havana. The hijacker took over the co-pilot's seat and held a gun and knife against Captain, ordering him to fly to Cuba (Mars, 2014).

xvi. Unlawful Seizure of Aircraft

The first incident of commandeering in the history of civil aviation took place on February 21, 1931, at the city of Arequipa in Peru when a group of local revolutionaries surrounded an aircraft and demanded that the pilot fly them to wherever they wanted. He refused, and the revolutionaries terminated their seizure on March 2, without any damage to the plane (Abela, 2001).

On September 25, 1932, a Brazil Sikorsky S-38, was seized from the company's hangar by three men. None of the hijackers were qualified pilot but managed to take off the plane. However, the aircraft crashed miles away from Sao Paulo killing all on-board. The incident is considered to be the first Brazilian plane hijacking (Newman, 2017).

xvii. Gun and a homemade bomb

The hijacker, identified as Manjit Singh, an electrician from Amritsar, boarded the Indian Airlines Flight 492 on August 20.1982. Soon after the plane took off from Jodhpur, he slipped into the cockpit, brandished a gun and a handcraft bomb, and ordered Captain to fly to Lahore. Hidden in his turban, the hijacker brought the gun inside and the bomb in the two-in-one he brought with him. Passengers recall that he had replaced his turban with a black cloth wrapped around his head. Unable to land at Lahore as the authorities had effectively blocked the runway with trucks. Finally, running short of fuel, the plane touched down at Amritsar (Raina, 2013).

xviii. Explosives

On October 14, 2000, a Saudi Arabian Airlines Flight 115, flying from Jeddah to London was hijacked en route by two men who claimed they were armed with explosives. The hijackers commandeered the Boeing 777-200 to Baghdad, Iraq, where all were safely released (Faleh,2006).

xix. Cigarette Lighters.

Singapore Airlines flight SQ 117 was hijacked on 26 March 1991 without further ado after it took off from Kuala Lumpur en course to Changi Airport in Singapore. The hijackers were four passengers who claimed to be members of the Pakistan People's Party. The plane landed at Changi Airport. Commandos of Singapore Armed Forces mounted a rescue operation, killing all four hijackers and bringing the passengers and crew to safety. The plane was carrying 114 passengers and 11 crew members. The hijackers were outfitted with large cylindrical sticks, cigarette lighters, and knives. The large cylindrical sticks, which were first accepted to be deadly explosives, were later identified as sparklers (Sof, 2019)

xx. Replica Grenade and Pistol.

An Air Afriqiyah flight with 111 passengers and six crew members on board after it was intercepted and seized in Libyan airspace on December 23, 2016, and diverted to Malta. The hijackers hijacked the flight using a replica of hand grenade and two replicas of pistols, which were later seized from the Libyan hijackers (Muscat, 2006).

xxi. Roll of Toilet Paper.

A Boeing Air India 405 Hijacked by nine hijackers, on July 6, 1984. There were 264 passengers and crews on board, en route to Delhi from Srinagar airport. The nine hijackers screamed into the aisles, shouting slogans. The hijackers had only one.22 pistol and a toy gun and kirpans. Initially, Lahore Airport denied permission to land but with the fuel dangerously low, permission was given. One of the hijackers then produced a round object wrapped in a towel which he claimed was a bomb. It later turned out to be a roll of toilet paper (Stevens, 1984).

xxii. **Sharpened Objects.**

June 29, 2012, six people endeavored to hijack Tianjin Airlines Flight GS7554 from Hotan to Urumqi. Six people attempted to hijack the aircraft 10 minutes after take-off. The hijackers used aluminum canes with honed tips to attack the members of the crew. The police officers and civilians on board subdued the hijackers, all of whom were of Uyghur ethnicity. The plot was thwarted, and the plane returned to Hotan in 22 minutes after take-off (Yiu, 2012).

xxiii. **Intoxicated Person.**

On Feb 7, 2014, Pegasus Airlines flight PC-751 was en route from Kharkiv, Ukraine to Istanbul, Turkey. A Ukrainian traveler rose from his seat 2F, yelled that there was a bomb on board, and tried to enter the cockpit. He fizzled to enter the flight deck and stated that he wanted to be flown   to Sochi, Russia where the Winter Olympics were being held. He was led to believe that the flight diverted to Sochi. However, after landing at Istanbul, he surrendered and was confined by the police. The man was in a state of extreme intoxication with no weapons, or explosives were found on him (Hradecky, 2014).

xxiv. **Fake Explosive Belt.**

On March 29, 2016: Flight MS181, an Egyptair Airbus A320 carrying 81 passengers from Alexandria to Cairo, was taken over after a passenger said he was wearing a suicide explosives belt and was redirected to Larnaca International Airport. The hijacker surrendered after hours of negotiations and no casualties were reported later authorities confirmed the belt was fake. The hijacker's motives remain unclear, but the Cypriot president said the incident was not terrorism-related (Iyengar, 2016).

xxv. **Fountain Pen.**

An airplane of Air China, flight CA1350, took off from Changsha was hijacked and made theemergency landing in Zhengzhou Xinzheng International Airport on April 15, 2018. The Civil Aviation Administration of China, a man on board, tried to hijack the flight with a pen. The man who is mentally ill tried to hold a flight attendant hostage using a fountain pen as a weapon, forcing the flight to make an unscheduled landing (Bianchi, 2011).

xxvi. **Nail-Clipper**

A man with a knife tried to hijack an Alitalia flight from Paris to Rome On April 24, 2011, demanding it is flown to Libya, but was quickly overpowered and arrested when the plane landed, officials and witnesses said. The hijacker held a small knife to the throat of a female flight attendant and held her for a few minutes. He grabbed the from her back and pointed the knife. Italian media reported that the man brandished a nail-clipper in the assault (Reid, 2015).

xxvii. **Sharpened Wooden Stakes**

A man armed with two sharpened wooden which takes from his pocket tried to hijack and crash a Qantas domestic jet1737 with 47 passengers aboard shortly after take-off from Melbourne on May 29, 2003 (Reynold, 2003).

xxviii. **Railroad Flares.**

On December 21, 1978, a 17-year-old Robin Oswald hijacked TWA Flight 541 flying from Louisville to Kansas City claiming she had three sticks of dynamite that was strapped to her body. The plane landed at Williamson County Regional Airport. FBI's negotiators induce her to surrender with no injuries or deaths. The dynamite that was strapped to her chest later emerged to be a set of rail-road flares. (Blyston, 2000).

xxix. **Gun Hide in a Fake Plaster Arm Cast.**

A TWA Flight 2, Boeing 707 with 101 passengers and crew members Los Angeles to New York was hijacked by a shady adventurer with a history of mental illness using a gun hidden in his fake plaster arm cast on January 28, 1972. No metal detection device was used when the passengers went to board in Los Angeles. The hijacker Garrett Trapnell hijacked the flight while over Chicago. He demanded $306,800 in cash, the release of imprisoned Angela Davis, and clemency from President. FBI took control of the aircraft during a crew switch at Kennedy Airport. The hijacker was shot and wounded, by an FBI agent who disguised as a crew (McFadden, 1972).

xxx. **Plastic Knife**.

A Sudanese passenger unsuccessfully tried to hijack an Egyptian flight flying from Istanbul to Cairo and demanded re-direction of flight to Jerusalem on October 23, 2009. After 30 minutes from take-off, the hijacker took hold of plastic knife provided with

meals and threatened the crew. However, the flight marshal overpowered the hijacker and restored the ability to continue the flight without any hindrance (Bence, 2009)

IV. CONCLUSION

In the history of civil aviation, there have been many cases where aircraft have been hijacked and in some cases, the plan was sabotaged as well. The strategic, physical, the extrinsic, intrinsic, tangible, and intangible benefit of civil aviation is enormous. Securing civil aviation from hijacking menace requires the highest carefulness since even a single lapse in security has far-reaching consequences, which may affect thousands of passengers, loss of hundreds of millions of dollars, a negative impact on the economy and the confidence of the public. Security measures are put in place for the sake of all, and security personnel are performing their duty based on the knowledge of previous incidents and probable materials used for the hijack. The need for strict adherence to security procedures cannot be over-emphasized. In the early seventies when security checks were introduced in some airports to address the menace of hijack, there was considerable opposition from different corners. However over the years, aviation community and public realized to certain extend the importance of screening. But even today a sectional among the passengers expresses their frustration and resentment over the stringent security measures even making it a prestige issue and feel that the security threat is inflated. This attitude needs to be changed and all concerned should cooperate with the security staff in ensuring a safe air journey (Lederer, 2016). The best place to stop terrorism against civil aviation from occurring is at the airline terminal. International airport terminals are utilized by large numbers of people from nearly every country of the world. It is possible to produce a terror-proof airport, but this would require procedures and restrictions which could be very frustrating to travelers. Such procedures, however, would stop terrorists from carrying in and/or checking in luggage containing explosives, and subsequently not boarding the airplane. Terrorists always try to defeat the security systems, but it is the responsibility of all to keep such anti-social elements at bay.

REFERENCES

1.　Abela, T. (2001). Aircraft Hijacking in Malta. Maltese History and Heritage.

2. Angerer, D. (2018). September 11 Attacks. History.

3. Banka, R. (2018). Delhi Court acquits two Sikh separatists over 1981 Air India plane hijacking. New Delhi: Hindustan Times.

4. Bence, D. (2009). Plastic Knife Used in Foiled Hijacking Attempt. Peter Greenberg Worldwide.

5. Bianchi, A. (2011). Man overpowered trying to hijack Alitalia flight. Reuters.

6. Blyston, R. (2000). Saudi Air Flight Hijacked en Route to London. CNN.Com.

7. Broderick, B. C. (2018). Taking Stock of the Insider Threat. Aviation Week Network.

8. Celona, L. (2001). TEACHER BUSTED IN '71 HIJACK. Newyork: Newyork Post.

9. Choi, J.-T. (1994). Case Studies of Selected Incidents. Springer, 109-141.

10. Dabas, M. (2018). In 1993, A Truck Driver Got So Angry At Communal Violence That He Hijacked An Indian Airlines Plane! India Times.

11. Faleh, W. (2006). Saudi Plane Bound for London Hijacked. abc News.

12. Goo, S. K. (2004). 9/11 Hijackers Used Mace And Knives, Panel Reports. Washington, D.C.: The Washington Post.

13. Haider, S. (2016). Lahore to Pathankot, via Kandahar. The Hindu.

14. Harding, B. (2007). Mauritania plane passengers beat up hijacker. Reuters.

15. Hradecky, S. (2014). Incident: Pegasus B738 near Sochi on Feb 7th 2014, suspected hijack attempt. The Aviation Herald.

16. Inamdar, N. (2014). India's tryst with plane hijacks. Mumbai: business-standard.

17. Iyengar, J. M. (2016). EgyptAir Hijacker Arrested in Cyprus After Standoff. Time.

18. Koerner, B. I. (2013). Patrick Dolan Critton hijacked a plane. Then he became an SAT tutor. Newyork: Slate.

19. Lederer, E. M. (2016). 'U.N. calls for stepped up security for planes and airports. Liberty St.,   Wooster' The Daily Record.

20. Mars, R. (2014). A History of Skyjacking and the Evolution of Airport Security. The Slate.

21. Max, A. (1993). Disgruntled Students Hijack Plane; Quickly Overpowered. AP News.

22. McFadden, R. D. (1972). Hijacker is Shot at Airport Here After Freeing 93. New York Times: New York Times.

23. Mukherjee, M. (1990). Thai jet hijacked, passengers released. UPI.

24. Muscat, J. (2006). All passengers and crew freed from hijacked plane in Malta. DW.

25. Newman, T. J. (2017). Panair Do Brazil, S.A.: First hijacking of an Airline. First in Aviation.

26. Prasad, V. J.-M. (2004). Hijacking of Singapore Airlines flight SQ 117. Singapore Infomedia.

27. Raina, G. T. (2013). Amritsar electrician hijacks Indian Airlines aircraft to Lahore, shot dead. India Today.

28. Regan, S. G. (2019). Bangladesh plane hijacker shot dead by special forces. New York City: CNN.

29. Reid, J. (2015). Attempted hijackings in our skies. startsat60.

30. Reynold, G. (2003). A Pack , Not Herd. P J Media.

31. Santhanam, R. (1984). Indian Airlines airbus hijacking to Lahore adds bizarre twist to Punjab saga. New Delhi: India Today.

32. Sharma, A. (2011). US saw IC-814 trade-off with hijackers as defeat: Wiki. New Delhi: India Today.

33. Sof, E. (2019). Rescue of Singapore Airlines flight SQ 117 over in 30 secs flat. special-ops Magazine.

34. Sofrep. (2020). German Commandos Save Lufthansa Flight 181. Sofrep.

35. Srivastava, B. K. (1998). Aviation Terrorism. New Delhi: Manas Publication.

36. Stevens, W. K. (1984). Indian Jet Carrying Z264 Hijacked to Pakistan. The Newyork Times.

37. Thukra, G. (2013). Amritsar electrician hijacks Indian Airlines aircraft to Lahore, shot dead. India Today.

38. Whitney, C. R. (1988). The Crash of Flight 103; Jetliner in Crash Blew Apart in AIR, Officials Report. Newyork : Newyork Times.

39. Yiu, K. (2012). Chinese Passengers, Crew Thwart Attempted Plane Hijacking. abc News.

INTERVAL VALUED INTUITIONISTIC FUZZY D-IDEAL IN D-SUBALGEBRA

R. G. Keerthana[1] and K. R. Sobha[2]

[1]Research Scholar, Sree Ayyappa College for Women, Chunkankadai, Nagercoil-629001, Tamil Nadu, India

[2]Assistant Professor, Department of Mathematics, Sree Ayyappa College for Women, Chunkankadai, Nagercoil

[Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli-627012, and Tamil Nadu, India]

ABSTRACT

In this paper, we define fuzzy translation and fuzzy multiplication of interval valued intuitionistic fuzzy d-ideal in d- subalgebra.

Keywords: d-subalgebra, fuzzy-α-translation, fuzzy-α-multiplication, intuitionistic fuzzy d-ideal, interval valued intuitionistic fuzzy ideal, interval valued intuitionistic fuzzy d-ideal.

1. INTRODUCTION

Fuzzy set theory was discovered by Zadeh in 1965 [11] as an extension of the classical notion of the set. Fuzzy logic is based on the observation that people make decisions based on imprecise and non- numerical information. Fuzzy models or sets are mathematical means of representing vagueness. These models have the capability of recognising, representing, manipulating, and using data and information that are vague and lack certainty[9]. Fuzzy mathematics is the branch of mathematics including fuzzy set theory and fuzzy logic that deals with partial inclusion of elements in a set.

Atanassov introduced intuitionistic fuzzy sets [2]. Atanassov and Gargov further proposed interval-valued intuitionistic fuzzy sets on the basis of intuitionistic fuzzy sets[3]. Several mathematicians applied the notion of interval-valued intuitionistic fuzzy sets to algebraic structures. Atanassov added a new direction to the fuzzy algebra by introducing the concepts of intuitionistic fuzzy set. Kumbhojkar and Bapat discussed on Correspondence theorem for fuzzy ideals [5]. J. Negger, Y. B. Jun and H.S. Kim

discussed ideal theory in d-algebra [6]. Y.B. Jun , H.S.Kim and D.S. Yoo in introduced the notion of intuitionistic fuzzy d-algebra [4].

2. Preliminaries

Definition : 2.1

A d-algebra is a non-empty set X with a constant 0 and a binary operation $*$ satisfies the following axioms:

i. $x * x = 0$

ii. $0 * x = 0$

iii. $x * y = 0$ and $y * x = 0 \Rightarrow x = y$, for all $x, y \in X$.

Definition: 2.2

A non-empty subset of a d-algebra X is called d-subalgebra of X if $x * y \in X$, for all $x, y \in X$.

Definition: 2.3

An intuitionistic fuzzy set $A = (\mu_A, \vartheta_A)$ in X is called intuitionistic fuzzy ideal of X if it satisfies the following axioms:

$$\mu_A(0) \geq \mu_A(x)$$

$$\mu_A(x) \geq min\{\mu_A(x * y), \mu_A(y)\}$$

$$\vartheta_A(0) \leq \vartheta_A(x)$$

$$\vartheta_A(x) \leq max\{\vartheta_A(x * y), \vartheta_A(y)\}$$

Definition: 2.4

An intuitionistic fuzzy set $A = (\mu_A, \vartheta_A)$ in X is called intuitionistic fuzzy d-ideal of X if it satisfies the following axioms:

$$\mu_A(0) \geq \mu_A(x)$$

$$\mu_A(x) \geq min\{\mu_A(x * y), \mu_A(y)\}$$

$$\mu_A(x * y) \geq min\{\mu_A(x), \mu_A(y)\} \, for \, all \, x, y \in X.$$

$$\vartheta_A(0) \leq \vartheta_A(x)$$

$$\vartheta_A(x) \leq max\{\vartheta_A(x * y), \vartheta_A(y)\}$$

$$\vartheta_A(x * y) \leq max\{\vartheta_A(x), \vartheta_A(y)\} \, for \, all \, x, y \in X.$$

Definition: 2.5

An interval valued intuitionistic fuzzy set $A = (\bar{\mu}_A, \bar{\vartheta}_A)$ in X is called an interval valued intuitionistic fuzzy ideal of X if it satisfies:

$$\bar{\mu}_A(0) \geq \bar{\mu}_A(x)$$

$$\bar{\mu}_A(x) \geq r \, min\{\bar{\mu}_A(x * y), \bar{\mu}_A(y)\}, for \, all \, x, y \in X$$

$$\bar{\vartheta}_A(0) \leq \bar{\vartheta}_A(x)$$

$$\bar{\vartheta}_A(x) \leq r \, max\{\bar{\vartheta}_A(x * y), \bar{\vartheta}_A(y)\}, for \, all \, x, y \in X.$$

Definition: 2.6

An interval valued intuitionistic fuzzy set $A = (\bar{\mu}_A, \bar{\vartheta}_A)$ in X is called an interval valued intuitionistic fuzzy d-ideal of X if it satisfies:

$$\bar{\mu}_A(0) \geq \bar{\mu}_A(x)$$

$$\bar{\mu}_A(x) \geq r \, min\{\bar{\mu}_A(x * y), \bar{\mu}_A(y)\}$$

$$\bar{\mu}_A(x * y) \geq r \, min\{\bar{\mu}_A(x), \bar{\mu}_A(y)\}, for \, all \, x, y \in X$$

$$\bar{\vartheta}_A(0) \leq \bar{\vartheta}_A(x)$$

$$\bar{\vartheta}_A(x) \leq r \, max\{\bar{\vartheta}_A(x * y), \bar{\vartheta}_A(y)\}$$

$$\bar{\vartheta}_A(x * y) \leq r \, max\{\bar{\vartheta}_A(x), \bar{\vartheta}_A(y)\}, for \, all \, x, y \in X.$$

3. Fuzzy Translation and Fuzzy Multiplication:

Definition: 3.1

Let μ_A be a fuzzy subset of X and $\alpha \in [0, T]$. A mapping $(\mu_A)_\alpha^T: X \rightarrow [0,1]$ is said to be a fuzzy-α-translation of μ_A if it satisfies

$$(\mu_A)_\alpha^T(x) = \mu_A(x) + \alpha, for \, all \, x \in X.$$

Theorem: 3.2

Let $A = (\overline{\mu_A}, \overline{\vartheta_A})$ be an interval valued intuitionistic fuzzy d-ideal of X. Then fuzzy- α - translation $(A_{\overline{\alpha}}^T) = [(\overline{\mu_A})_{\overline{\alpha}}^T, (\overline{\vartheta_A})_{\overline{\alpha}}^T]$ of A is also an interval valued intuitionistic fuzzy d-ideal of X.

Proof:

Let (μ_A^L, ϑ_A^L) and (μ_A^U, ϑ_A^U) are interval valued intuitionistic fuzzy d-ideal of X and let $\alpha \in [0, T]$.

Since
$$\mu_A^L(0) \geq \mu_A^L(x)$$

$$\mu_A^U(0) \geq \mu_A^U(x)$$

Therefore
$$\bar{\mu}_A(0) \geq \bar{\mu}_A(x)$$

$$(\overline{\mu_A})_{\overline{\alpha}}^T(0) = \bar{\mu}_A(0) + \bar{\alpha}$$

$$\geq \bar{\mu}_A(x) + \bar{\alpha}$$

$$= (\overline{\mu_A})_{\overline{\alpha}}^T(x)$$

$$(\overline{\mu_A})_{\overline{\alpha}}^T(0) \geq (\overline{\mu_A})_{\overline{\alpha}}^T(x)$$

$$(\overline{\mu_A})_{\overline{\alpha}}^T(x) = \bar{\mu}_A(x) + \bar{\alpha}$$

$$= [\mu_A^L(x), \mu_A^U(x)] + \bar{\alpha}$$

$$\geq [min\{\mu_A^L(x*y), \mu_A^L(y)\}, min\{\mu_A^U(x*y), \mu_A^U(y)\}] + \bar{\alpha}$$

$$= r\, min\{[\mu_A^L(x*y), \mu_A^U(x*y)], [\mu_A^L(y), \mu_A^U(y)]\} + \bar{\alpha}$$

$$= r\, min\{\bar{\mu}_A(x*y), \bar{\mu}_A(y)\} + \bar{\alpha}$$

$$= r\, min\{\bar{\mu}_A(x*y) + \bar{\alpha}, \bar{\mu}_A(y) + \bar{\alpha}\}$$

$$= r\, min\{(\overline{\mu_A})_{\overline{\alpha}}^T(x*y), (\overline{\mu_A})_{\overline{\alpha}}^T(y)\}$$

$$(\overline{\mu_A})_{\overline{\alpha}}^T(x) \geq r\, min\{(\overline{\mu_A})_{\overline{\alpha}}^T(x*y), (\overline{\mu_A})_{\overline{\alpha}}^T(y)\}$$

$$(\overline{\mu_A})_{\overline{\alpha}}^T(x*y) = \bar{\mu}_A(x*y) + \bar{\alpha}$$

$$= [\mu_A^L(x*y), \mu_A^U(x*y)] + \bar{\alpha}$$

$$\geq [min\{\mu_A^L(x), \mu_A^L(y)\}, min\{\mu_A^U(x), \mu_A^U(y)\}] + \bar{\alpha}$$

$$= r \min\{[\mu_A^L(x), \mu_A^U(x)], [\mu_A^L(y), \mu_A^U(y)]\} + \bar{\alpha}$$

$$= r \min\{\bar{\mu}_A(x), \bar{\mu}_A(y)\} + \bar{\alpha}$$

$$= r \min\{\bar{\mu}_A(x) + \bar{\alpha}, \bar{\mu}_A(y) + \bar{\alpha}\}$$

$$= r \min\{(\overline{\mu_A})_{\bar{\alpha}}^T(x), (\overline{\mu_A})_{\bar{\alpha}}^T(y)\}$$

$$(\overline{\mu_A})_{\bar{\alpha}}^T(x * y) \geq r \min\{(\overline{\mu_A})_{\bar{\alpha}}^T(x), (\overline{\mu_A})_{\bar{\alpha}}^T(y)\}$$

Clearly, this can be proved for maximal condition.

Hence $(A_{\bar{\alpha}}^T) = [(\overline{\mu_A})_{\bar{\alpha}}^T, (\overline{\vartheta_A})_{\bar{\alpha}}^T]$ of A is also an interval valued intuitionistic fuzzy d-ideal of X.

Definition: 3.3

Let μ_A be a fuzzy subset of X and $\alpha \in [0,1]$. A mapping $(\mu_A)_\alpha^M : X \to [0,1]$ is said to be a fuzzy-α-multiplication of μ_A if it satisfies

$$(\mu_A)_\alpha^M(x) = \alpha \, \mu_A(x), for \, all \, x \in X.$$

Theorem: 3.4

Let $A = (\overline{\mu_A}, \overline{\vartheta_A})$ be an interval valued intuitionistic fuzzy d-ideal of X. Then fuzzy- α - multiplication $(A_{\bar{\alpha}}^M) = [(\overline{\mu_A})_{\bar{\alpha}}^M, (\overline{\vartheta_A})_{\bar{\alpha}}^M]$ of A is also an interval valued intuitionistic fuzzy d-ideal of X.

Proof:

Let (μ_A^L, ϑ_A^L) and (μ_A^U, ϑ_A^U) are interval valued intuitionistic fuzzy d-ideal of X and let $\alpha \in (0,1]$.

Since $\qquad\qquad \mu_A^L(0) \geq \mu_A^L(x)$

$$\mu_A^U(0) \geq \mu_A^U(x)$$

Therefore $\qquad\quad \bar{\mu}_A(0) \geq \bar{\mu}_A(x)$

$$(\overline{\mu_A})_{\bar{\alpha}}^M(0) = \bar{\alpha} \, \bar{\mu}_A(0)$$

$$\geq \bar{\alpha} \, \bar{\mu}_A(x)$$

$$= (\overline{\mu_A})_{\bar{\alpha}}^M(x)$$

$$(\overline{\mu_A})_{\bar\alpha}^M(0) \geq (\overline{\mu_A})_{\bar\alpha}^M(x)$$

$$(\overline{\mu_A})_{\bar\alpha}^M(x) = \bar\alpha\ \bar\mu_A(x)$$

$$= \bar\alpha\ [\mu_A^L(x), \mu_A^U(x)]$$

$$\geq \bar\alpha\ [min\{\mu_A^L(x*y), \mu_A^L(y)\}, min\{\mu_A^U(x*y), \mu_A^U(y)\}\,]$$

$$= \bar\alpha\ r\ min\{[\mu_A^L(x*y), \mu_A^U(x*y)], [\mu_A^L(y), \mu_A^U(y)]\}$$

$$= \bar\alpha\ r\ min\{\bar\mu_A(x*y), \bar\mu_A(y)\,\}$$

$$= r\ min\{\bar\alpha\ \bar\mu_A(x*y), \overline\alpha\ \bar\mu_A(y)\,\}$$

$$= r\ min\{(\overline{\mu_A})_{\bar\alpha}^M(x*y), (\overline{\mu_A})_{\bar\alpha}^M(y)\}$$

$$(\overline{\mu_A})_{\bar\alpha}^M(x) \geq r\ min\{(\overline{\mu_A})_{\bar\alpha}^M(x*y), (\overline{\mu_A})_{\bar\alpha}^M(y)\}$$

$$(\overline{\mu_A})_{\bar\alpha}^M(x*y) = \bar\alpha\ \bar\mu_A(x*y)$$

$$= \bar\alpha\ [\mu_A^L(x*y), \mu_A^U(x*y)]$$

$$\geq \bar\alpha\ [min\{\mu_A^L(x), \mu_A^L(y)\}, min\{\mu_A^U(x), \mu_A^U(y)\}\,]$$

$$= \bar\alpha\ r\ min\{[\mu_A^L(x), \mu_A^U(x)], [\mu_A^L(y), \mu_A^U(y)]\}$$

$$= \bar\alpha\ r\ min\{\bar\mu_A(x), \bar\mu_A(y)\,\}$$

$$= r\ min\{\bar\alpha\ \bar\mu_A(x), \bar\alpha\ \bar\mu_A(y)\,\}$$

$$= r\ min\{(\overline{\mu_A})_{\bar\alpha}^M(x), (\overline{\mu_A})_{\bar\alpha}^M(y)\}$$

$$(\overline{\mu_A})_{\bar\alpha}^M(x*y) \geq r\ min\{(\overline{\mu_A})_{\bar\alpha}^M(x), (\overline{\mu_A})_{\bar\alpha}^M(y)\}$$

Clearly, this can be proved for maximal condition.

Hence $\left(A_{\bar\alpha}^M\right) = \left[(\overline{\mu_A})_{\bar\alpha}^M, (\overline{\vartheta_A})_{\bar\alpha}^M\right]$ of A is also an interval valued intuitionistic fuzzy d-ideal of X.

4. CONCLUSION

In this article, we have been discussed fuzzy translation and fuzzy multiplication of interval valued intuitionistic fuzzy d-ideal in d- subalgebra. Our future research work will focus on some more algebraic properties.

5. REFERENCES

1. Angelin suba,R & sobha,KR 2019,"Cartesian Product of interval valued intuitionistic fuzzy k-ideals in BCK/BCI-algebras", International Journal of Research and Analytical Reviews,vol.6,pp.639-643.

2. K.T. Attanasov, " Intuitionistic fuzzy sets," Fuzzy Sets and Systems, vol.20,no.1,pp.87-96,1986.

3. K.T. Attanasov and G.Gargov, "Interval valued intuitionistic fuzzy sets," Fuzzy Sets and Systems, vol.31,no.3,pp.343-349,1986.

4. Y.B. Jun, H.S. Kim and D.S. Yoo, " Intuitionistic fuzzy d-algebra", Scientiae Mathematicae Japonicae Online, e-(2006), 1289-1297.

5. Kumbhojkar H.V., Bapat M.S., Correspondence theorem for fuzzy ideals, Fuzzy sets and Systems, (1991).

6. J. Neggers; Y.B. Jun; H.S. Kim, "On d-ideals in d-algebras", Mathematica Slovaca.49 (1999), No.3, 243-251.

7. T. Priya and T. Ramachandran, Homomorphism and Cartesian Product of fuzzy Ps-algebra, Applied Mathematical Sciences, 8, Vol (67) (2014) 3321-3330.

8. T. Priya and T. Ramachandran, Fuzzy translation and Fuzzy multiplication on Ps-algebra, Inter. J. Innovation in Science and Mathematics, 2(5) (2014) 485-489.

9. Robert Babuska," Fuzzy Modeling for Control", Springer Science and Business Media. ISBN 978-94-011-48689.

10. Tripti Bej & Madhumangal Pal (2015),"Doubt intuitionistic fuzzy ideals in BCK/BCI-algebras," International Journal of Fuzzy Logic Systems, vol.5, no.1,pp.1-13.

11. L.A. Zadeh," Fuzzy set", Inform And Control, vol.8 (1965),338-353.

DESIGN AND OPTIMIZATION OF SINGLE ELECTRON TRANSISTOR BASED DIGITAL LOGIC GATES

Shobhika P Gopnarayan[1], Dr. Shriram D. Markande[2] and Dr. Vaishali P Raut[3]

[1]Research Scholar, GHRCEM, Wagholi Pune, (Assistant Professor, Electronics & Telecommunication Department, AISSMS IOIT, Pune)

[2]Principal, Sinhgad Institute of Technology and Science Narhe (SITS Narhe, Pune)

[3]Assistant Professor, Electronics & Telecommunication Department, GHRCEM Wagholi, Pune

ABSTRACT

It can be seen in the improved macro model that an intrinsic flaw in the previous model, such as undesirable DC offset, has been successfully avoided The modified macro model was used to study the I-V characteristics curve of the SET in great detail. The utilization of SET's coulomb oscillation to produce a changeable transconductance area of operations is demonstrated. The single-electron transistor (SET) is an important component of contemporary nanotechnology research because it has a low power consumption and a high working speed. Because single-electron transistors retain their scalability, they are a novel nano scaled switching device. Using a hybrid CMOS gate created by SET. Then there's Gates, who likes NOT,AND,OR. When the suggested Macro model is compared to the existing Macro model of the SET, the proposed Macro model consumes less power and delay.

INTRODUCTION

Single electron devices are the most efficient device that can be utilized in basic circuits for next generation VLSI circuits with high density since they require very little power and have a high package density. The single electron transistor (SET) is a recent nanotechnology advancement. It can be reduced down to virtually atomic proportions. It has the unusual ability to regulate one electron at a time. The number of electrons used in SET logic operations is quite low.

Because of its small size, low power consumption, and ability to make quick and sensitive charge measurements, single-electron transistors (SETs) hold great potential

for future nano electronics circuits. [4] SET could be a charge-sensitive gadget capable of detecting charges as small as one lepton. This exceptional quality makes SET an ideal instrument for investigations requiring extremely high charge sensitivity. They're being increasingly used and projected as activity devices for quantum systems, such as quantum computers and quantum dots, cellular automata, and logic components in their claim to be MOSFET replacements Performance deterioration has been toughened as a result of constant downscaling in feature size in current CMOS technology Due to short channel effects, it's clear that greater down scaling in the technology node won't be maintained (especially in the sub-10 nm region) [9]. The few candidates for replacement or coexistence with CMOS include carbon nanotubes, quantum dots, single lepton semiconductor device (SET), and fin FETs [6]. The use of a group as a prospective building block for future hybrid circuits is confirmed and even, according to recent study and literature investigations. SET has a wide range of applications, the most common of which are SET logic and memory applications. The application basic gate of SET is mentioned in this study. Literature [9, 10] describes ET's operation and creation. Coulomb Blockade and single lepton tunnelling are the two phenomena that allow SET to function as a switch. SET is a p-switch that can be converted to an n-switch by altering the back gate potential of a group. This arrangement, which mimics nMOS and pMOS, is referred to as nSET and pSETLogic circuits made entirely of SETs [6]–[10] as well as hybrid SET-CMOS design and simulation have gotten a lot of attention. Because of SET's drawback of poor driving capability, hybrid SET-CMOS basic gates have been developed to achieve low power and higher performance [11, 14]. The planning and simulation parameters, on the other hand, are limited to either cold, chimerical SET parameters or low output voltages. Fabrication may be difficult in the case of hybrid SET-CMOS circuits because each transistor requires a separate fabrication procedure on a constant IC. The main goal of this project is to design and simulate a basic gate for SET / SETCMOS / CMOS implementation using Tanner tool style environments. The SET parameters are found in the fabrication process using the nanodamascene approach [17], which is summarised in [18]. SETs in operation at temperatures exceptional to a hundred thirty a hundred thirty are obtained thanks to the fabrication of capacitors in sub attofarad (aF) range. The simulation is based on the

Mahapatra– Ionescu–Banerjee model [19] developed by SET. Previous work [17] facilitated the simulation of the SET logic using actual SET parameters. Throughout the study, these settings are maintained. Pure SET basic gates are far more affordable than line – CMOS basic gates in terms of delay, power, and delay for constant CMOS similar output voltage, as determined by proper design, simulation, and optimization of the fundamental gates circuit.

In this work, we explain the fundamentals of existing macro models of SET and I-V characteristics in Section I, proposed macro model equivalent circuits of SET and I-V characteristics in Section II, and Hybrid CMOS Gates design like a NOT,OR,AND in Section III. Explain the results of the existing and suggested macro models in the fourth section.

Section –I

Existing SET Macro model [4]:

The analogous circuit's macro-model representation is summarised here. R1, R2, and R3 are expressed with a cosine Function to explain the Coulomb oscillation, while D2, D3, Vp, and -Vp are expressed to describe the Coulomb staircase in the circuit diagram below. When C = 1.6 aF, Cg = 4.8 aF, Rt = 100M, and T = 300K, the parameter values CF1 = 60, CVp = 0.015, CI2 = 0.2x10-9, CR1 = 300 x 106, and CR2 = 100x106 provide the best match of the current-voltage characteristics.
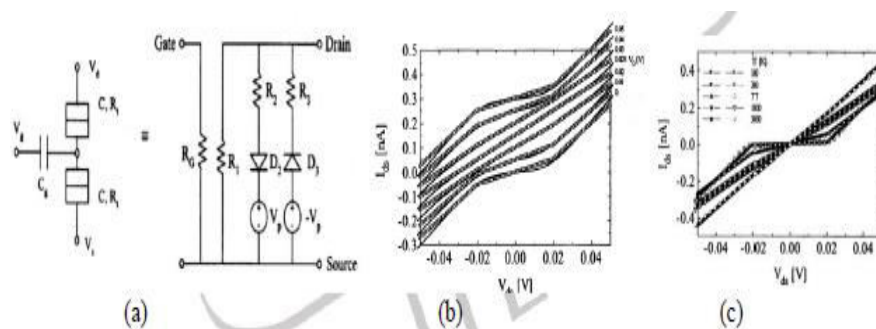

Figure 1: A SET's equivalent circuit (a) and current-voltage characteristics at various gate biases. (b) A SET's macro-modeling. The solid lines represent Monte-Carlo results, whereas the empty symbols represent the macro model proposed. (c) At various temperatures, the current-voltage characteristics of the SET shown in the previous figure.

Section –II

Proposed SET Macro model[5]:

The Gate should be capacitively related to the Island, according to a new proposed better macromodel of SET. As a result, the RG is replaced with a diode (facing each other) to block all conceivable current in the SET. When compared to the Yu model, Ids are higher because of the huge resistance RG, which allowed some current to flow, resulting in higher Id.
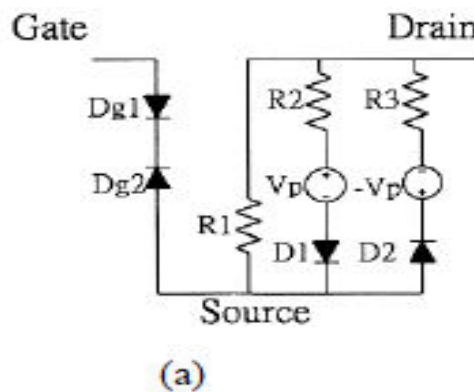

Figure2. (a) Proposed new macro model for SET

Section –III

Design and Simulation Result of Proposed Macro Model of SET:

To design proposed macro model of SET we used four diode , three resistance and two voltage source. Using Tanner tool we design SET circuit and checked all the simulation result and power and delay .
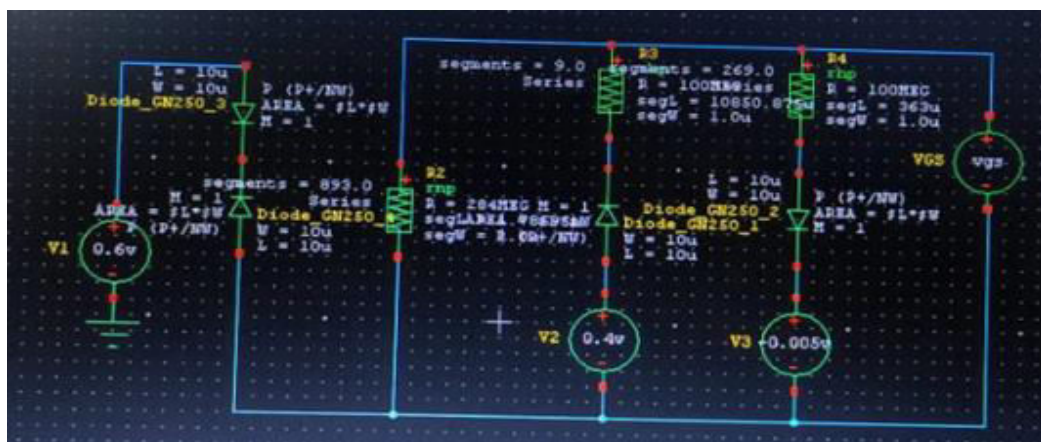
Fig: Proposed macro model of SET using Tanner tool

We retained the Vds voltage source at 0.6 voltage and altered the Vgs voltage source from negative to positive by several voltage steps during the drain current Vs Vgs (gate to source voltage) period. The end outcome is depicted in the waveform below.

Fig: Drain current v s the Gate voltage.

Characteristic of the drain current Vs Vds voltage time we kept the Vgs voltage source 0.6 voltage constant and changed Vds voltage source from negative to positive by some voltage steps. the result is shown in below waveform.

Fig: Drain current Vs Drain Voltage for the proposed model.

Section –IV

Basic Logic Gate Design and simulation using hybrid CMOS SET circuit.

NOT GATE Design:

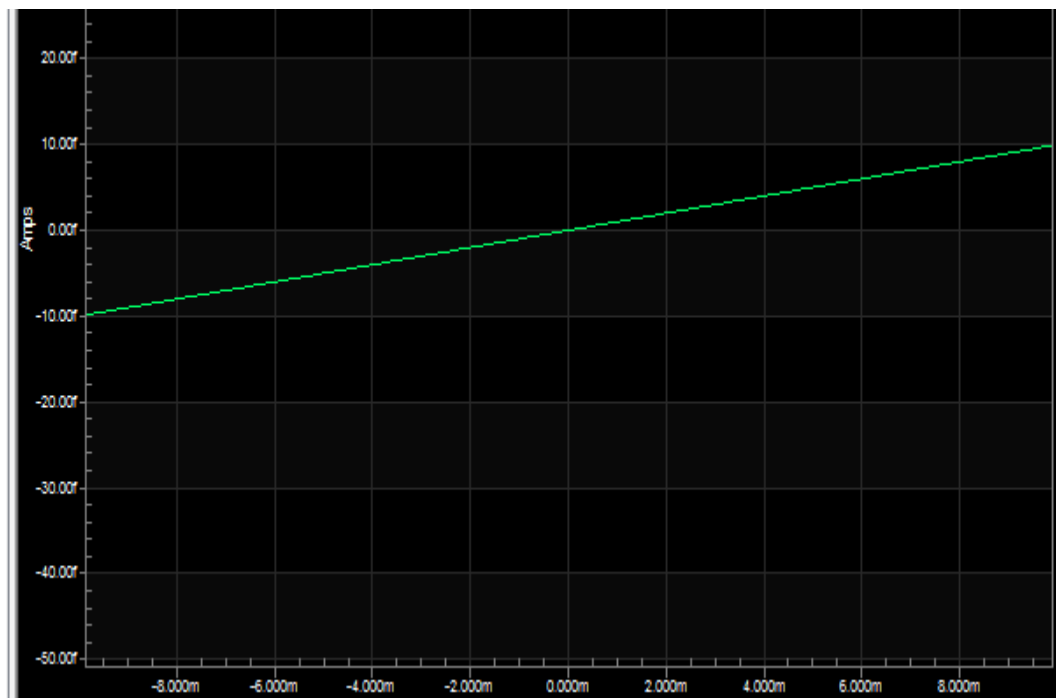We needed one SET circuit that acts as an NMOS to create a NOT gate using SET, therefore we changed the SET circuit into one SET symbol with three terminals: gate, source, drain, and one PMOSWe used two voltage sources in this example, one for VDD and the other for the input signal. The maximum VDD voltage is 300mV, and the maximum input signal pulse voltage is 300mV with a pulse width of 10ms. We used the voltage display command in the circuit to show the input and output voltages. After that, we used the Tanner tool to build up some simulations and load some supporting files.

Fig: NOT gate design using hybrid CMOS SET.

NOT GATE Simulation Result: In the waveform below, the first red colour waveform represents the output of the not gate, while the green colour waveform represents the input to the not gate with a period of 10 milliseconds. W-edit is used to generate the outcome. T-edit was then used to check power and delay.

Fig: Not gate input and output waveform

OR GATE Design:

To create an OR gate using SET, we needed three SET circuits, one of which acts as an NMOS and three of which act as PMOS. We also needed three voltage sources, one for VDD and two for input signal In this case, the maximum VDD voltage is 300 mV, and the maximum input signal pulse voltage is 300 mV, with a pulse time of 5 ms for A input and 10 ms for B input signal. We used the voltage display command in the circuit to show the input and output voltages. After that, we used the Tanner tool to build up some simulations and load some supporting files.
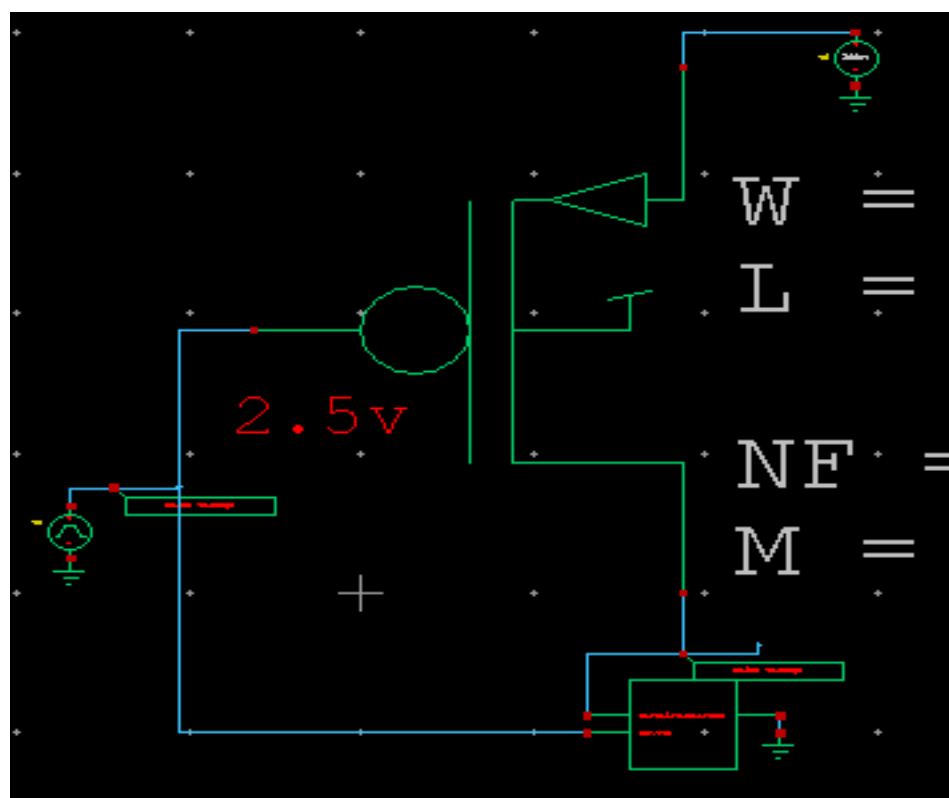

Fig: OR gate design using hybrid CMOS SET.

OR GATE Simulation Result: In the waveform below, the red colour waveform represents the output of the OR gate, while the green and blue colour waveforms represent the input to the OR gate, respectively, with 5 ms and 10 ms periods. The result was generated in W-edit. T-edit was then used to check power and delay.
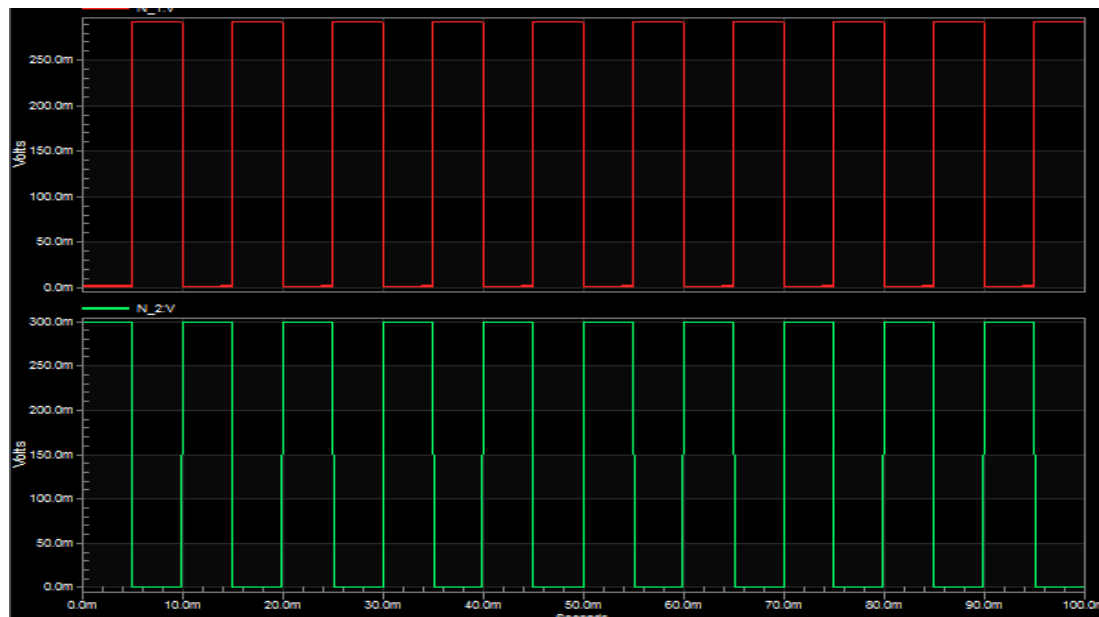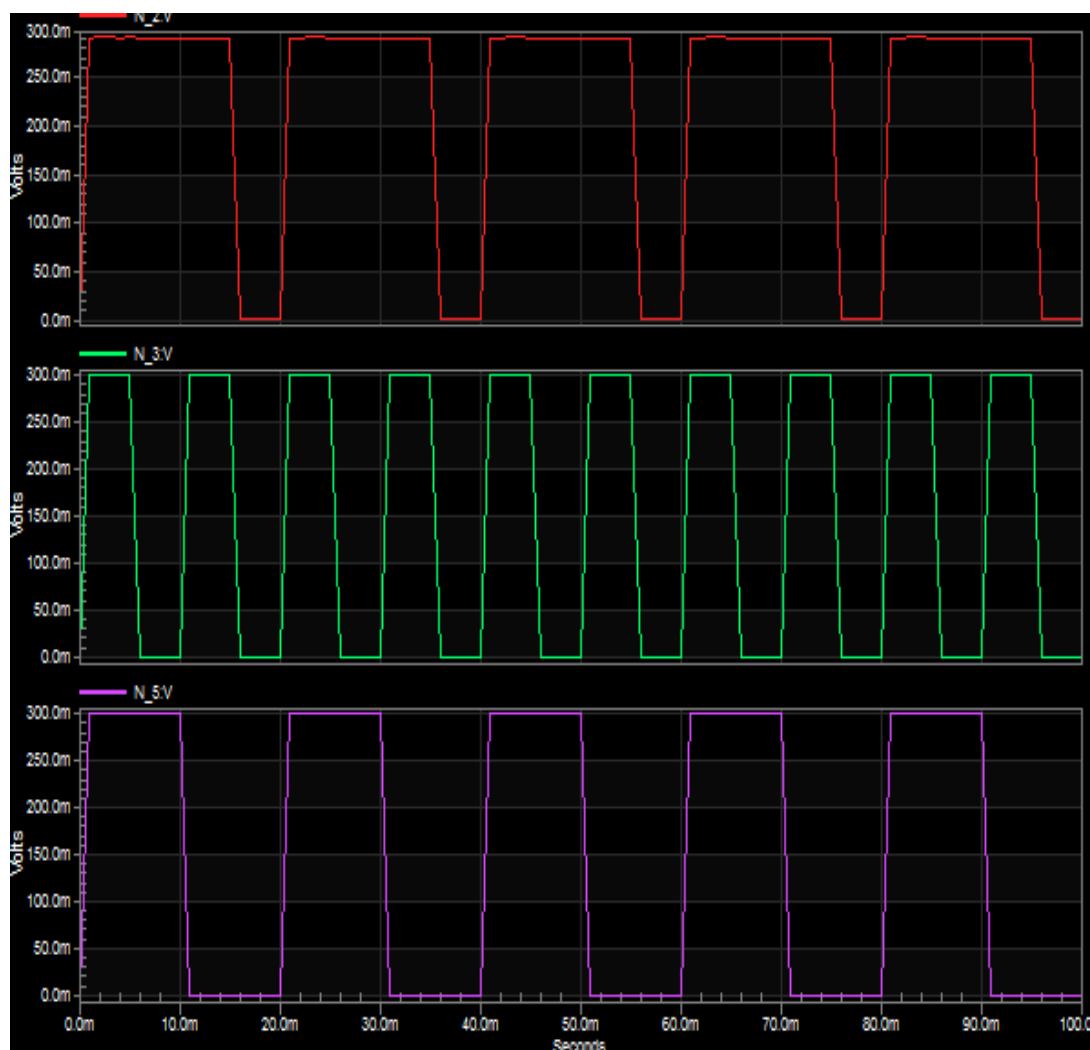

Fig: OR gate input and output waveform

AND GATE Design

To create an AND gate using SET, we needed three SET circuits, one of which acts as an NMOS and three of which act as PMOS. We also needed three voltage sources, one for VDD and two for input signalIn this case, the maximum VDD voltage is 300 mV, and the maximum input signal pulse voltage is 300 mV, with a pulse time of 5 ms for A input and 10 ms for B input signal. We used the voltage display command in the circuit

to show the input and output voltages. After that, we used the Tanner tool to build up some simulations and load some supporting files.
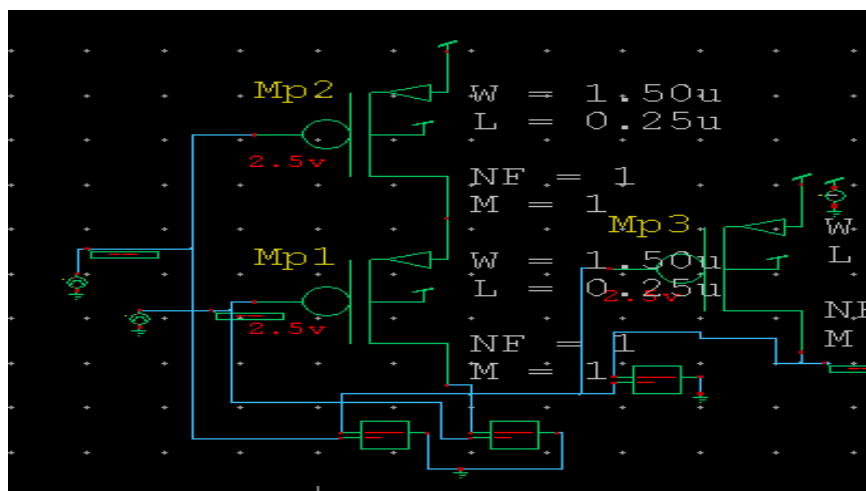

Fig: AND gate design using hybrid CMOS SET.

AND GATE Simulation Result

The output of the AND gate is indicated by the red colour waveform, while the input to the AND gate is indicated by the green and blue colour waveforms with 5 ms and 10 ms periods, respectively. W-edit is used to generate the results. T-edit was then used to check power and delay.
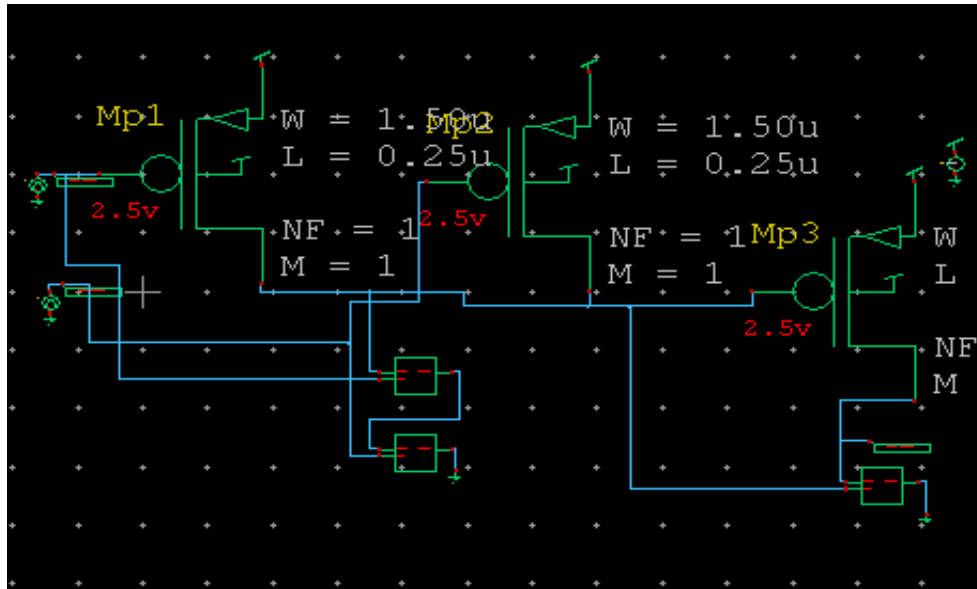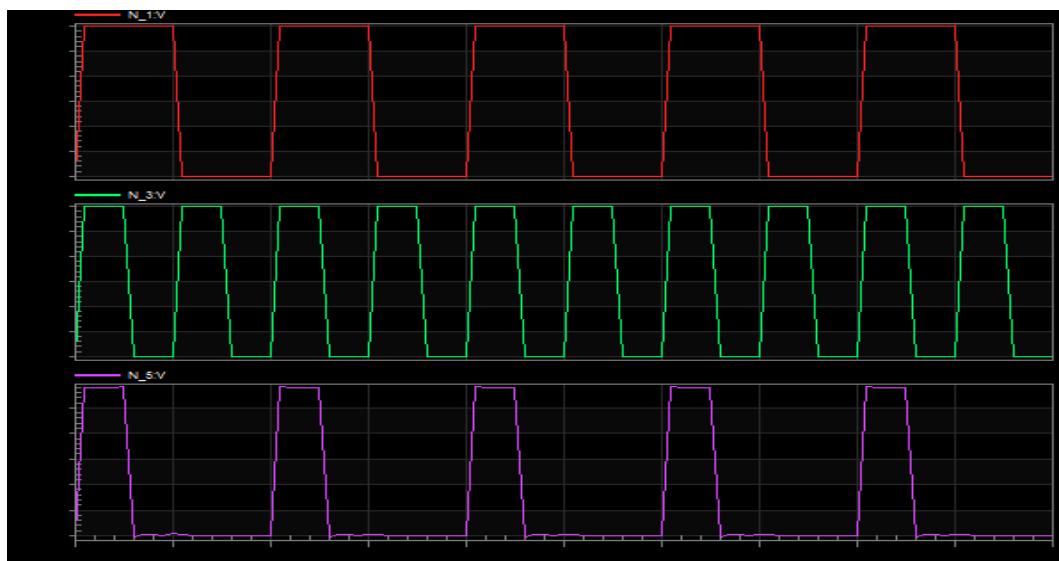

Fig: AND gate input and output wavefrom.

Comparison of gate design using hybrid CMOS SET and Existing gated of power and delay.

Using Hybrid CMOS SET	Logic Gate	Power(Watt)	Delay(sec)
	NOT	0.46n	2.6n
	OR	2.11n	33.5u
	AND	1.127n	4.99n
Existing CMOS SET result	NOT[2]	0.73	1.02p
	OR[1]	2.26n	24 p
	AND[1]	0.49n	19p
	NOT[3]	1.8n	7.2p
	AND[3]	2.4n	23p

CONCLUSION

To summarise, while hybrid circuits improve driving capability and therefore delay, pure SET circuits with optimal parameters are more efficient and less complex to construct than hybrid circuits. As a result, SET logic circuits can be employed to improve power and delay performance. The power and latency of NOT [2],NOT[3]gates in existing papers utilising CMOS SET are 0.73n,1.8n watt and 1.02ps,7.2n resp. However, the NOT gate power and delay in the proposed hybrid CMOS SET are 0.46n watt and 2.6 ns, respectively, The suggested circuit's power is reduced, but the latency is slightly increased. OR[1],AND[1],AND[3] are similar AND and OR gates employing CMOS SET power and delay of 2.26n,0.49n,2.4n watt and 24ps,1ps,23ps respectively However, when utilising the proposed circuit for AND and OR gates, the power and delay are 2.11n,1.127n watt and 33.1us,4.99us, respectively. We can see that the power is lowered in the proposed circuit, but the latency is somewhat increased.

REFERENCES

[1]　Mohammad Javad Sharifi1 Mehdi Ahmadian1 Mohammad Javad Sharifi1 Mohammad Javad Sharifi1 Mohammad Javad Sharifi1 Mohammad Java "A comprehensive set of logic gates with identical singlestage structures based on the periodic nature of singleelectron devices" Springer Science+Business Media,

LLC, a division of Springer Nature 2020, 14 September [2] Rashmit Patel, Yash Agrawal, and Rutu Parekh, "Single-electron transistor: a review in terms of theory, modelling, design, and fabrication." The date is August 10, 2020Springer Nature 2020 is a project of Springer-Verlag GmbH in Germany.

[3]　"Design and Optimization of Single Electron Transistor based 4-Bit Arithmetic and Logic Unit at Room Temperature Operation," 2017 IEEE International Symposium on Nanoelectronic and Information Systems, Rathin Joshi, Yash Agrawal, Rutu Parekh.

[4]　"QUANTUM MECHANICAL MODELING AND IMPLEMENTATION OF SINGLE ELECTRON TRANSISTOR CIRCUIT" by Mohammad Riazur Rahman Mazumder 10th of August, 2011.

[5]　Pankaj Kumar, Sanjay S2 Sinha, "Single Electron Transistor and Simulation Methods." 2014 IJEDR

[6]　Hybrid CMOS Single electron transistor device and circuit design, S. Mahapatra and A. M. Ionencu. 2006, Artech House.

[7]　Zahid Ali Khan Durrani, Imperial College, UK, Single-Electron Devices and Circuits in Silicon, 2010.

[8]　"Design and implementation of single electron transistor N-BIT multiplier," International Conference on Circuit, Power and Computing Technologies (ICCPCT), 2014, pp. 1099–1104

[9]　S. Mukherjee, T. S. Delwar, A. Jana, and S. K. Sarkar, "Hybrid single electron transistor based low power consuming 4-bit parallel adder/subtractor circuit in 65 nm technology," International Conference on Computer and Information Technology (ICCIT), December 2014, pp. 136–140

[10]　M. A. Bounouar, A. Beaumont, K. E. Hajjam, F. Calmon, and D. Drouin, "Room temperature double gate Single Electron Transistor based standard cell library," 2012 IEEE/ACM International Symposium on Nanoscale Architectures (NANOARCH), pp. 146-151. [11] H. Zhong, Y. Chi, H. Sun, C. Zhang, and L.

Fang, "Macromodeling of realistic single electron transistors for large-scale circuit simulation," in Proceedings of the INEC, 2010, pp. 193–194.

[12] D. Samanta and S. K. Sarkar, "A simple SET-MOS universal hybrid circuit for realisation of all basic logic functions," in D. Samanta and S. K. Sarkar, "A simple SET-MOS universal hybrid circuit for realisation of all basic logic functions," in D. Samanta and S 336–339 in 2012 International Conference on Advances in Engineering, Science, and Management (ICAESM).

Pervasive Computing (ICPC), pp. 1–6. V. Raut and P. K. Dakhole, "Design and implementation of four bit arithmetic and logic unit using hybrid single electron transistor and MOSFET at 120nm technology," 2015 International Conference on Pervasive Computing (ICPC), pp. 1–6.

[14] "Design and performance analysis of reversible logic based ALU using hybrid single electron transistor," 2014 Recent Advances in Engineering and Computational Sciences (RAECS), pp. 1 - 4. B. Jana, A. Jana, S. Basak, J. K. Sing, and S. K. Sarkar, "Design and performance analysis of reversible logic based ALU using hybrid single electron transistor," 2014 Recent Advances in Engineering and Computational Sciences (RAECS), pp

[15] "Simulation and Design Methodology for Hybrid SET-CMOS Integrated Logic at 22-nm Room-Temperature Operation," Electron Devices, IEEE Transactions on, vol.59, no.4, pp.918-923, 2012. R. Parekh, A. Beaumont, J. Beauvais, and D. Drouin, "Simulation and Design Methodology for Hybrid SET–CMOS Integrated Logic at 22-nm Room-

[16] S. Vaidya and D. Dandekar, "Delay-power performance Comparison of multipliers in VLSI circuit design," International Journal of Computer Networks and Communications (IJCNC), Vol.2, No.4, July 2010.

[17] R. Parekh, J. Beauvais, and D. Drouin, "SET logic driving capabilities and enhancement in 3-D integrated SET–CMOS circuit." 11087–1092 in Microelectronics Journal 45 (2014).

PERFORMANCE EVALUATION OF QOS PARAMETERS OF HYBRID TLPD-ALB SCHEDULING ALGORITHM IN CLOUD COMPUTING ENVIRONMENT

Vijay Mohan Shrimal[1], Prof. (Dr.) Y. C. Bhatt[2] and Prof. (Dr.) Y. S. Shishodia[3]

[1]Ph.D. Research Scholar, Jagannath University, Tonk Road, Jaipur-302022

[2]Emeritus Professor, Jagannath University, Tonk Road, Jaipur-302022

[3]Former Pro_Vice-Chancellor, Jagannath University, Tonk Road, Jaipur-302022

ABSTRACT

The goal of cloud computing is to provide dynamic stability and processing over a wide range of resources. In the Hybrid TLPD scheduling method, the virtual machines are arranged using MIPS and Granularity size, while the cloudlets are sorted based on the credits assigned using the three parameters credit length, priority, and deadline time [1]. Each cloudlet that has been sorted is then assigned to a virtual computer. However, the idea of load balancing, or whether the virtual machine that will be mapped to the cloudlet is going to be overloaded or underloaded, is not taken into account in this scheduling. Therefore, the load balancing issue needs to be handled in order to ensure efficient utilization of cloud resources. An adaptive load balancing (ALB) method based on deadlines is added to the TLPD scheduling algorithm in order to accomplish load balancing while taking efficiency, resource optimization and time into account.

Keyword: Hybrid TLPD-ALB, FCFS, SJF, Cloudsim, TLPD

INTRODUCTION

The process of distributing jobs to available resources according to their quality and need is called scheduling [7]. Optimizing resource efficiency while reducing the impact on cloud resources is scheduling main goal. Cloud computing, which is now used to deliver sophisticated services including software, data, memory, bandwidth, and IT services, makes use of the internet. Task scheduling is only one of many variables that affect how dependable and effective cloud services are. Depending on the task, resource, or workflow stage, scheduling may be necessary.

An adaptive load balancing (ALB) method based on deadlines is added to the TLPD scheduling algorithm in order to accomplish load balancing while taking efficiency, resource optimization, cost, and time into account. In the interim, a few servers will become heavily filled as a result of on-demand load arrival, while other servers will either be idle or very minimally burdened. Workload balancing will be forced to pass the incoming consumer request to another server if the number of consumers to the suitable virtual system exceeds that point. This migration approach will function better with a uniform load distribution [2].

Simulation Tool

A simulation application called Cloudsim enables you to do cloud computing experiments. CloudSim is a simulation platform that enables seamless modeling, simulation, and testing of cloud computing and application services. Due to a problem, existing distributed system simulators could not be used in the cloud computing environment. Under various device, user, and requirement combinations, it is challenging to evaluate the performance of cloud provisioning rules, facilities, application workload models, and resource performance models. This issue may be resolved with CloudSim [5]. Additionally, CloudSim assists you in modeling the system and behavior of cloud system components including data centers, virtual machines (VMs), and resource allocation strategies. Cloudsim employs generic device provisioning techniques that are easy to modify and take little time. [6]

Proposed Hybrid TLPD-ALB Scheduling algorithm & Flowchart

The jobs are scheduled either in the EDF queue or the AEDF queue depending on the utilization time (Ui) of each work. The job in the task set should be completed by the deadline of the associated task in order for scheduling to be effective. The minimal utilization valued jobs will execute according to standard EDF scheduling based on the threshold value circumstance. Tasks are scheduled in the AEDF queue depending on the deadline of the related tasks when the task utilization rate exceeds the threshold value [3].

Algorithm Hybrid TLPD-ALB:

- Initialize the Cloudsim package by creating the datacenter, broker, virtual machines and cloudlets

- Initialize the virtual machines list

- Initialize the task list.

- Sort the virtual machines using QOS parameters (MIPS and Granulaity size).

- Sort the task list using priorities calculated using credits by using following procedure:

- In this credit to task is assigned using 3 parameters which are credits based on task length, priority of the task, deadline of the task.

Total_Crediti = Credit_Lengthi * Credit_Priorityi * Credit_deadlinei

Procedure 1: Credit based on Length of task [4]

For all requested tasks in the set; Ti

Task_length_difference (TLD) = absolute_value (average_length – task_length)

If $TLD_i \leq value1$

then credit =5

else if $value1 < TLD_i \leq value2$

then credit =4

else if $value2 < TLD_i \leq value3$

then credit =3

else if $value3 < TLD_i \leq value4$

then credit =2

else $value4 > TLD_i$

then credit =1

End For

---

where

value1=high_len / 5;

value2=high_len / 4;

value3=value2+value1;

value4=value3+value2;

Procedure 2: Priority credits assigning to task

For all requested tasks in the set: Ti

Find out highest priority task (Priority_Number)

Choose division_factor_value

For priority of each task (Tpri)

Calculate Pri_frac_i=Tpri /division_factor

Set priority credit as Pri_frac

End For

End For

Procedure 3: Deadline of the task [1]

For all requested tasks in the set; Ti

Find out MAXMIPS of the VM from the virtual machine list

Deadline_Taski = (Credit_Lengthi * Credit_Priorityi) / MIPSMAX

Calculate $Total\_Credit_i$ = $Credit\_Length_i$ * $Credit\_Priority_i$ * $Credit\_deadline_i$

End For

Procedure 4: Adaptive Load balancing based on the deadline time

For all submitted tasks in the set; T_i

Find the execution time E_i of Task T_i and deadline time D_i of Task T_i

Initialize: NT, ST =0;

Calculate Load of Task U_i = E_i / D_i

Assign Threshold (TH) = 0.5

If ($T_i(U_i)$ < threshold)

Insert T_i into EDF_List

Else

Insert T_i into AEDF_List

End If

End For

For all submitted tasks in the EDF_List; T_i

Schedule Task using EDF Queue

End For

For all submitted tasks in the AEDF_List; T_i

Schedule T_i with Min (Di)

Calculate NT = Ei + ST

If ($T_i (E_i)$ + NT) $\leq D_i$

Schedule T_i

Else

$T_i = T_{i+1}$

End If

End For

Total credits are calculated from my hybrid TLPD algorithm that is already published paper so the flow chart is added after that existing flowchart:

Calculate Total Credit by $Total\_credit_i = Credit\_length_i + Credit\_priority_i + Credit\_deadline_i$

Find Execution time E_i and Deadline time D_i of Each Task i

Initialize New time NT and Service time ST=0

Calculate workload of Task T_i by $U_i = E_i / D_i$

Assign the static value of Threshold of server

$T_i(U_i) < $ Threshold

Yes

No

Insert T_i into AEDF List (Overloaded Task)

Insert T_i into EDF List (Underloaded Task)

Schedule the AEDF task Queue according Min (D_i)

Schedule Task using EDF

Calculate $NT = E_i + ST$

Figure 1: Flowchart of proposed Hybrid TLPD-ALB Scheduling Algorithm

QOS parameters

In this paper I have considered Total Execution Time and Makespan QOS parameters in analyzing the performance of scheduling algorithms.

(a) Total Execution Time: Execution time refers to the CPU time or burst time used by the computer system to complete a job, as well as the time used to offer system services.

Total Execution Time = cloudletExecStartTime - cloudletFinishTime

Makespan: The length of time needed to complete a series of tasks from beginning to end. The maximum time of all tasks may be completed is called the makespan. The minimum makespan of the scheduler is required for improved system performance [8]. The goal of any effective scheduling method is to minimize the Makespan.

Makespan= CTn

Simulation Setup

The configuration of host contains 5 numbers of Hosts, size/processing speed is 5000 (in MIPS), RAM is 5048 (in MB). Configuration of virtual machine contains varying number of virtual machines from 5, 10, 20, 25 and 30 implemented respectively for varying number of cloudlets 30, 50, 100, 150, 200. The details of general simulation parameter are depicted in Table. Finding Metric is Total Execution Time and Makespan. The experimental data are shown in tables as well as graphs [2].

RESULT AND ANALYSIS

This section presents the simulation results of the proposed methodology implemented with the help of Cloudsim and Net beansIDE8.0.

In this paper, we tested and evaluated the traditional algorithms and my proposed algorithm using different scenarios where varying number of cloudlets (jobs/tasks) are mapped to varying number of virtual machines (VMs). The performance of the proposed algorithm Hybrid TLPD-ALB is evaluated against the traditional algorithm FCFS, SJF and Task Length & Priority, Hybrid TLPD and the comparative analysis is described.

A. When 5, 10, 20, 25, and 30 virtual machines are assigned, together with 30, 50, 100, 150, and 200 cloudlets/tasks, respectively. Total Execution Time is the evaluating parameter

Total Execution Time				
Scenarios	**FCFS**	**SJF**	**Priority**	**HYBRID TLPD**	**HYBRID TLPD-ALB**
[30,5]	46.356	44.0826	45.578	42.615	35.537
[50,10]	76.786	74.998	74.755	72.58	62.476
[100,20]	154.521	154.635	145.0292	144.394	138.879
[150,25]	229.902	229.662	221.889	221.32	209.126
[200,30]	305.6464	302.806	302.795	300.101	287.39

Table 1: Evaluating parameter - Total Execution Time in different scenarios

Table 1 shows the performance analysis of the existing scheduling algorithms (FCFS, SJF and Task length & Priority scheduling, Hybrid TLPD) and proposed scheduling algorithm (HYBRID TLPD-ALB) on the basis of different tasks mapped to different number of virtual machines. The table contains the result value of the parameter "Total Execution Time" of the proposed and the traditional scheduling algorithms.

The analysis is done between the available resources (VMs) and requesting task in order to show the scheduling of the task with load balancing and resource utilization in best manner.

In this table the five different scenarios are taken by using cloudlets/tasks and virtual machines. The results of traditional scheduling algorithms and proposed scheduling algorithm are shown.

With the help of resultant values I have designed two types of graphs which represent the different-different perspective of analysis. The performance analysis is further illustrated graphically:

Figure 2: Graphical Representation of Total Execution Time in different scenarios

In this graph we evaluated and analyzed that the minimum total execution time has been achieved in different scenarios of proposed algorithms compared to traditional algorithms. When the ALB algorithm is added in the HYBRID TLPD scheduling algorithm we achieved better result in the form of minimum total execution time compared with traditional algorithms and proposed algorithm represents the best resource utilization and optimized allocation of resources to the requesting tasks.

Makespan					
Scenarios	**FCFS**	**SJF**	**Priority**	**HYBRID TLPD**	**HYBRID TLPD-ALB**
[30,5]	405.63	405.64	405.88	405.65	401.93
[50,10]	996.31	910.41	888.07	806.85	812.96
[100,20]	5288.73	4640.97	4158.03	3013.09	2996.11
[150,25]	6090.75	6670.7	6618.01	5147.34	5103.96
[200,30]	10145.46	9643.88	9027.98	7612.7	7582.25

Table 2: Evaluating parameter - Makespan in different scenarios

Table 2 shows the performance analysis of the existing scheduling algorithms (FCFS, SJF and Task length & Priority scheduling, Hybrid TLPD) and proposed scheduling algorithm (HYBRID TLPD-ALB) on the basis of different tasks mapped to different number of virtual machines. The table contains the result value of the parameter "Makespan" of the proposed and the traditional scheduling algorithms.

The analysis is done between the available resources (VMs) and requesting task in order to show the scheduling of the task with load balancing and resource utilization in best manner.

In this table the five different scenarios are taken by using cloudlets/tasks and virtual machines. The results of existing scheduling algorithms (FCFS, SJF and Task length & Priority scheduling, Hybrid TLPD) and proposed scheduling algorithm (HYBRID TLPD-ALB) are shown.
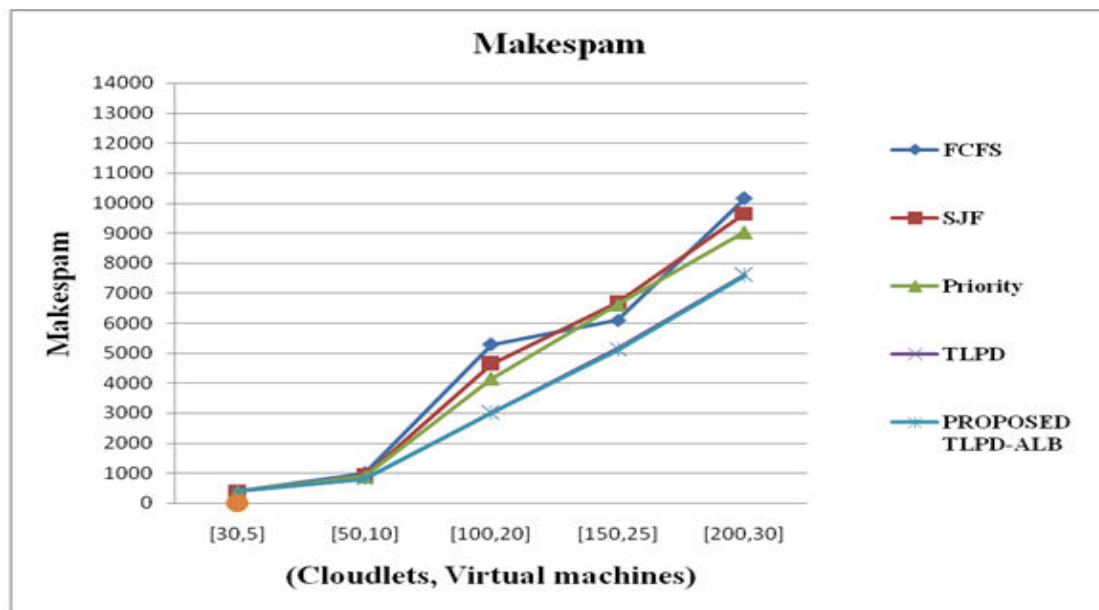
Figure 3: Graphical Representation of Makespan in different scenarios

In this graph we evaluated and analyzed that the minimum makespan has been achieved in different scenarios of proposed algorithm compared to existing algorithms. When the ALB algorithm is added in the HYBRID TLPD scheduling algorithm we achieved better result in the form of minimum Makespan compared with traditional algorithms.

CONCLUSION

In this paper, traditional and proposed scheduling algorithms are presented. The traditional algorithms we analyzed the FCFS, SJF and task length & priority and Hybrid TLPD in different scenarios. In this proposed hybrid approach we have added Adaptive load balancing algorithm in previous exiting algorithm Hybrid TLPD [1] and we achieved better result in the form of minimum total execution time and Makespan compared with traditional algorithms. From the results it is concluded that, the proposed hybrid TLPD-ALB algorithm works efficiently than the other traditional methods. Total Execution Time and Makespan of the proposed approach is lesser when compared with the other algorithms. In future we can add more algorithms to find better results in form of efficient utilization of resources.

REFERENCES

[1]. Vijay Mohan Shrimal, Prof. (Dr.) Y. C. Bhatt and Prof. (Dr.) Y. S. Shishodia, "Performance Evaluation of QOS Parameters of Hybrid TLPD Scheduling

algorithm in Cloud Computing Environment" International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), ISSN: 2278-1021 (Online), Volume-11, Issue No-8, August 2022, pp 93-103.

[2]. Vijay Mohan Shrimal, Prof. (Dr.) Y. C. Bhatt and Prof. (Dr.) Y. S. Shishodia," A New Hybrid TLPD Algorithm for Task Scheduling in Cloud Computing" International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), ISSN: 2394-4099 (Online), Volume-9, Issue No-4, July-August 2022, pp 460-467.

[3]. S. RamKumar, V. Vaithiyanathan and M. Lavanya," Towards Efficient Load Balancing and Green it Mechanisms in Cloud Environment", World Applied Sciences Journal 29 (Data Mining and Soft Computing Techniques): 159-165, 2014

[4]. Antony Thomas, Krishnalal G and Jagathy Raj V P, "Credit Based Scheduling Algorithm in Cloud Computing Environment", International Conference on Information and Communication Technologies (ICICT 2014), Procedia Computer Science 46 (2015) 913 – 920

[5]. Rodrigo N. Calheiros, Rajiv Ranjan, Anton Beloglazov, César A. F. De Rose, and Rajkumar Buyya CloudSim: A Toolkit for the Modeling and Simulation of Cloud Resource Management and Application Provisioning Techniques" http://dx.doi.org/10.1002/ spe.995

[6]. Prof. S.M. Ranbhise and Prof. K.K.Joshi,"Simulation and Analysis of Cloud Environment", International Journal of Advanced Research in Computer Science & Technology, Vol. 2, Issue 4 (O ct. - Dec. 2014), pp 206-209.

[7]. L. Wang, G. Laszewski, Scientific cloud computing: Early definition and experience, in Proceedings of 10th IEEE International Conference on High Performance Computing and Communications (Dalian, China, 2008), pp. 825–830

[8]. Syed Arshad Ali and Mansaf Alam, "Resource Aware Min-Min (RAMM) Algorithm for Resource Allocation in Cloud Computing Environment" International Conference on Information and Communication Technologies (ICICT 2014)

ENHANCING EDUCATIONAL ATTAINMENT RATE USING BIG DATA ANALYTICS METHOD

[1]Dr. Anita Pati Mishra, [2]Mani Dublish, [3]Dr. Pooja Bhardwaj [4]Ms Sakshi Vardhan and [5]Mr Prakhar Trivedi

[1, 3, 4, 5]Faculty IMS Noida

[2]Faculty, ABES Engg College Ghaziabad

ABSTRACT

Tutors can understand individually scholar's single desires, identify zones where they fight or succeed, and generate individualised learning strategies through the usage of big data analysis. The education sector can efficiently employ generated data to uncover new study fields by using big data analytical techniques. The data would have an impact and enhance both operational effectiveness and each student's learning experience. Students can also select their own educational pathways thanks Big Data supports teachers in monitoring student accomplishment. Understanding the performance on both a separate and a set level is made easier by the analysis. Tutors will gain vision into scholars' comforts through the statistical analysis of individual scores. What ways can big data support education? Schools can gather and analyse student data using big data to monitor their academic progress Professors can realise every pupil`s particular needs, pinpoint regions wherein they conflict or succeed, and create individualised gaining knowledge of plans thru the usage of large statistics evaluation. The schooling zone can effectively rent generated statistics to discover new examine fields via way of means of the use of large statistics analytical techniques. The statistics might have an effect and decorate each operational effectiveness and every pupil's gaining knowledge of experience. Students can also select out their very own educational pathways manner to this. Big Data supports professors in monitoring student accomplishment. Understanding the general overall performance on every a specific and a set level is made much less complex thru manner of approach of the assessment. Teachers will gain notion into students` hobbies through the statistical assessment of individual grades. What methods can big information useful resource

schooling? Schools can gather and look at student information the usage of big information to show their educational development

Keywords: Big Data, Analytical techniques, educational pathways, Statistical Analysis & performance.

1. INTRODUCTION

Business is extremely reliant on on the analytics which incline to find unseen features and drifts. Over a hardly any periods, the rise of big data analytics supports businesspersons to discover the information physically to convey out valuable designs in the marketplace. Big data analytics has deduced colourful openings for the institutions, policy makers, educationalists, directors and learners. The openings are enhanced knowledge inflow and literacy success over the association, cross collaboration over the institutions come comfortable and learning effectiveness would be enhanced, cost reduction over organizing fiscal performance come possible and academic threat would be lowered. Through traditional operation software, big data wo n't be reused. Hence, it requires pall- grounded technologies like Hadoop and Spark to mine huge quantum of data. This big data approach offers associations with effective way to stay strong and active in the business. In addition to this, Hadoop platform has entered amenities as it renders colourful advantages to the institutions and learners. This study aims at the influence of big data in the education and how the education system will be enhanced by using big data analytics. The world is changing fleetly due to the emergence of creative technologies (Chae, 2019). presently, a large number of technological biases are used by individualities (Shorfuzzaman, Hossain, Nazir, Muhammad, & Alamri, 2019). In every single moment, an enormous quantum of data is produced through these bias (ur Rehman etal., 2019). In order to feed for this massive data, current technologies and operations are being developed. These technologies and operations are useful for data analysis and storehouse (Kalaian, Kasim, & Kasim, 2019). Now, big data has come a matter of interest for experimenters (Anshari, Alas, & Yunus, 2019). Experimenters are trying to define and characterize big data in different ways (Mikalef, Pappas, Krogstie, & Giannakos, 2018). According to Yassine, Singh, Hossain, and Muhammad (2019), big data is a large volume of data. still, De Mauro, Greco, and

Grimaldi (2016) appertained to it as an instructional asset that's characterized by high volume, speed, and diversity. also, Shahat (2019) described big data as large data sets that are delicate to reuse, control or examine in a traditional way. Big data is generally characterized into 3 Vs which are Volume, Variety, and velocity (Xu & Duan, 2019). The volume refers to as a large quantum of data or adding scale of data. The size of big data can be measured in terabytes and petabytes (Herschel & Miori, 2017). In order to feed for the large volume of data, high- capacity storehouse systems are needed. The variety refers to as a type or diversity of data. The data can be in a structured format(databases) or unshaped format (images, videotape, emails). Big data logical tools are helpful in handling unshaped data. haste refers to as the speed at which big data can pierce. The data is nearly present in a real- time terrain (Internet logs) (Sivarajah, Kamal, Irani, & Weerakkody, 2017). presently, the conception of 3 V's is inflated into several V's. For case, Demchenko, Grosso, De Laat, and Membrey (2013) classified big data into 5vs, which are Volume, haste, Variety, Veracity, and Value. also, Saggi and Jain (2018) characterized big data into 7 V's videlicet Volume, haste, Variety, Valence, Veracity, Variability, and Value.

Big data demand is significantly adding in different fields of bid similar as insurance and construction (Dresner Advisory Services, 2017), healthcare (Wang, Kung, & Byrd, 2018), telecommunication (Ahmed etal., 2018), ande-commerce (Wu & Lin, 2018). According to Dresner Advisory Services (2017), technology (14), fiscal services (10), consulting (9), healthcare (9), education (8) and telecommunication (7) are the most active sectors in producing a vast quantum of data. still, the educational sector isn't an exception in this situation. In the educational realm, a large volume of data is produced through online courses, tutoring and literacy conditioning (Oi, Yamada, Okubo, Shimada, & Ogata, 2017). With the arrival of big data, now preceptors can pierce pupil's academic performance, learning patterns and give instant feedback (Black & William, 2018). The timely and formative feedback motivates and satisfies the scholars, which gives a positive impact on their performance (Zheng & Bender, 2019). Academic data can help preceptors to assay their tutoring pedagogy and affect changes according to scholars' needs and demand. numerous online educational spots have been designed, and multiple courses grounded on individual pupil preferences have been introduced

(Holland, 2019). The growth in the educational sector depends upon accession and technology. The large- scale executive data can play a tremendous part in managing colourful educational problems (Sorensen, 2018). thus, it's essential for professionals to understand the effectiveness of big data in education in order to minimize educational issues. So far, several review studies have been conducted in the big data realm. Mikalef etal. (2018) conducted a methodical literature review study that concentrated on big data analytics capabilities in the establishment. Mohammad & Torabi (2018), in their review study on big data, observed the arising trends of big data in the oil painting and gas assiduity. likewise, another methodical literature review was conducted by Neilson, Daniel, and Tjandra (2019) on big data in the transportation system. Kamilaris, Kartakoullis, and Prenafeta- Boldú (2017), conducted a review study on the use of big data in husbandry. also, Wolfert, Ge, Verdouw, and Bogaardt (2017) conducted a review study on the Baig et al. International Journal of Educational Technology in Higher Education (2020) 1744 runner 2 of 23 use of big data in smart husbandry. also, Camargo Fiorini, Seles, Jabbour, Mariano, and Sousa Jabbour (2018) conducted a review study on big data and operation proposition. Indeed, though that numerous fields have been covered in the former review studies, yet, a comprehensive review of big data in the education sector is still lacking moment. therefore, this study aims to conduct a methodical review of big data in education in order to identify the primary studies, their trends & themes, as well as limitations and possible unborn directions. This exploration can play a significant part in the advancement of big data in the educational sphere. The linked limitations and unborn directions will be helpful to the new experimenters to bring encroachment in this particular real.

The exploration questions of this study are stated below:

1) What are the trends in the papers available on big data in education?

2) What exploration themes have been addressed in big data in education sphere?

3) What are the limits and thinkable unborn guidelines?

The remainder of this study is organized as follows

Section 2: enlightens the review methodology and exposes the SLR results;

Section 3: reports the verdicts of exploration questions; and eventually,

Section4: offerings the discussion and conclusion and exploration counteraccusations.

REVIEW METHODOLOGY

In order to accomplish the forenamed ideal, this learning employments a methodical literacy review system. An actual analysis is grounded on analysis of literacy, find the limitations and exploration gap in a specific zone. A methodical review can be defined as a procedure of analysing, penetrating and understanding the system. It describes the applicable exploration questions and area of exploration. The essential purpose of conducting the methodical review is to explore and conceptualize the extant studies, credentials of the themes, relations & gaps, and the explanation of the unborn directions consequently. therefore, the linked reasons are matched with the end of this study. This exploration applies the Kitchenham and Charters (2007) strategies. A methodical review comprised of three phases Organizing the review, managing the review, and reporting the review. Each phase has specific conditioning. These conditioning are

1) Develop review protocol

2) Articulate addition and rejection conditions

3) Define the hunt strategy procedure

4) Describe the selection procedure

5) Accomplish the quality evaluation technique and

6) Data birth and conflation. The explanation of each exertion is handed in the ensuing segments.

REVIEW PROTOCOL

The review protocol offers the groundwork and machinery to assume a methodical literacy review. The important determination of the review protocol is to minimalize the research bias. The review protocol contained of contextual, research questions, exploration approach, assortment procedure, excellence valuation, and withdrawal of information and fusion. The review protocol supports to keep the uniformity of review

and easy inform at a later phase when novel discoveries are merged. This is the utmost important feature that discriminates SLR from additional literature reviews.

Inclusion and Exclusion Criteria

The end of describing the addition and rejection criteria is to be rest assured that only largely applicable inquiries are included in this study. This study reflects the published papers in journals, shops, conferences, and council. The papers that correspond of prolusions, tutorials and bills and summaries were excluded. still, complete and full-length applicable studies published in the English language between January 2014 to 2019 March were considered for the study. The searched words should be present in title, abstract, or in the keywords section. Table 1 shows a summary of the addition and rejection criteria. Search strategy process the hunt strategy comprised of two stages, videlicet S1(automatic stage) and S2(homemade stage). originally, an automatic hunt(S1) process was applied to identify the primary studies of big data in education. The following databases and search machines were explored Science Direct, SAGE. Journals, Emerald Insight, Springer Link, IEEE Xplore, ACM Digital Library, Taylor and Francis and AISe-Library. These databases were considered as it held loftiest impact journals and germane conference proceedings, shops and council. Conferring to Kitchenham and Charters (2007), electronic databases give a broad perspective on a subject rather than a limited set of specific journals and conferences.

Inclusion and exclusion criteria Table 1

Comprehensive and full-length lessons Partial and full length is not accessible to download

Published between January 2014 and March 2019 Published outside this dated

Published in the English language Published other than English

Appropriate and hunted words existing in not relevant

Title Not relevant and searched words are not present in the thesis

Data Extraction and Synthesis

The data uprooting and conflation procedure were carried by analysis the 65 primary lessons. The lessons were completely studied, and the needed details uprooted

consequently. The ideal of this phase is to find out the demanded data and figure from primary studies. The facts were together through the features of exploration ID, titles of writer, the title of the exploration, its publishing time and place, exploration themes, exploration environment, exploration system, and data collection system. Data were uprooted from 65 studies by using this feature. The history of each item is given in Table 3. The data uprooted from all key studies are tabularized. The process of data synthesizing is presented in the coming section.

Findings what are the trends in the papers published on big data in education?

Figure 3 presented the allocation of studies grounded on their publication sources. All publications were from high impact journals, high- position conferences, and shops. The key lessons are contained of 21 journals, 17 conferences, 1 factory, and 1 council. still, 14 studies were from Science Direct journals and conferences. An aggregate of 5 primary studies were from the savant group, 1 primary study from SpringerLink. Whereas 6 studies were from IEEE conferences, 2 studies were from IEEE council and factory. also, 1 primary study from AISeL Conference. Hence, 4studies were from Emraldinsight journals, 5 studies were from ACM conferences and 2studies were from Taylor and Francis. The summary of published sources is given in the following Table.

Summary of publication source	Publications Sources
9	Science Direct journals
5	SAGE Journals
1	SpringerLink Journals
6	IEEE conferences
5	ACM conferences
1	IEEE Symposium
4	Emraldinsight journals
5	Science Direct Conferences
1	IEEE Workshop

| 1 | AISeL Conference |
| 2 | Taylor and Francis Journals. |

Research Implications

This study has dual gathered counteraccusations for stakeholders and experimenters. originally, this review discovered the trends issued on big data in education realm. The linked trends uncover the studies allocation, publication sources, successional view and utmost cited papers. In addition, its highpoints the exploration styles used in these studies. The defined leanings can give openings and new thoughts to experimenters to prognosticate the accurate direction in unborn studies.

Secondly, this exploration explored the themes, sub-themes, and the procedures in big data in education sphere. The classified themes, sub-themes, and the methodologies present a comprehensive overview of being literature of big data in education. The defined themes and sub-themes can be supportive for experimenters to identify new exploration gap and avoid using repetitive themes in unborn studies. In the interim, it can help experimenters to concentrate on the combination of different themes in order to uncover new perceptivity on how big data can ameliorate the literacy and tutoring process. In addition, illustrated methodologies can be useful for experimenters in the selection of system according to nature of the study in future. linked exploration can be a recrimination for stakeholders towards the holistic expansion of educational capabilities. The linked themes give new sapience to universities to plan mixed literacy programs that combine conventional literacy with web- grounded literacy. This permits scholars to negotiate focused literacy issues, absorbing exercises at an ideal pace. It can be helpful for preceptors to seize the ways to gauge scholars learning geste and station contemporaneously and advance tutoring strategy consequently. Considerate the rear most trends in big data and education are of rising educational sphere. **Table 3**

II.PROBLEM STATEMENT

Nowadays big data analytics has been used in the education. Besides various opportunities the educationalist experience some challenges to deploy big data analytics. The challenges are enunciating data flow, training practitioners and decision making and actions. Retaining data for the analysis is significant challenge for the

deployment of educational analytics. It is difficult to access required data from the incorporated database system and hard to create data warehouse for all institutions. Unstructured data and lack of quality can lead to essential issues. In order to create understanding of the system among the educators, the trainees need to involve in learning the system and takes more time. It would be difficult for educators and learners to offer information in an informative way. However, the big data influence the education sector in an effective. To sort out these challenges, this study will be proposed.

III.RELATED WORK

Big data analytics offer actual assurance to the society in order to usage the data to regulate new pitch in the business. This mining will grow novel openings and improve smart business. This data analytics has been performing in gains, real processes and client relationship. Initiative can suitable to gain price rewards as this pall- grounded analytics concentrate on particular issues. It's important to sign that operation of Hadoop in associations work briskly and make effective opinions as this platform has capability to determine source of data [1]. As per the client needs, the new products and services can be produced by using analytics. Hence companies are fastening on the requirements by enhancing services to fulfil the client needs.

A. Shaping the Education Sector

Educational institutes like universities, sodalities, seminaries have approved vast quantum of data. It can be regulated to concentrate on which improve the functional efficiency of the educational institutions [3]. Pupil test results and growth of educational supplies is largely reckoned on altering educational conditions will be reckoned by using statistical analysis. Big data offers a way for the innovative system where the scholars can learn in advanced ways. Education segment has espoused big data fashion where the educational institutions, scholars and parent acquires effective advantages. It's used to estimate the academic performance of the pupil over examinations. Each pupil produces a unique data which can be estimated for determining the pupil geste to develop literacy terrain [5]. Bigdata analytics administer the pupil exertion like classroom performance, curricular exertion interests, favourite subjects and time to

complete the test. Because of processing data driven system the preceptors can admit advantages from bigdata analytics. This data driven method helps the institutions grow a literacy experience grounded on pupil competence, learning competence and partiality. Numerous plans will be prognosticated which will inspire person to regulate what they need to acquire. Numerous reports will be formed about their forthcoming and prognosticate what they want to do in future. After entering response from the literacy experience for scholars the preceptors can improve tutoring chops.

B. Career Prediction

Big analytics helps to regulate the pupil concert report will improve the specialist to know about the pupil strong point and dimness. similar statement will interlace some results to pupil about the areas to be concentrated in impending. However, the pupil must be inspired and choice should be suggested to prefer what they want to follow [6], If the pupil focuses on learning specific subject. Big data is set up in all different fields and render precious information to mortal beings. still, the significant decision will be taken to enhance the present script and determine prophetic bigdata analytics. Educational data mining defined as evolving conception focus on the creating styles for determining type of data which obtains from the educational settings. This system is used to understand scholars in which they learn. Educational datamining deals with applying and probing the motorized styles to estimate the patterns in the educational data. Due to high volume of data the patterns would be delicate tantalize. The process involves in educational data mining systems is data mining, data accession, pre-processing and confirmation. These styles are attained from data mining, psychometrics and machine literacy, information visualization and modelling [3]. Educational data mining and literacy analytics are analogous in the aspects of processes, data sources, data types and objects. Educational data mining and literacy analytics are still differed in the methods in the process of applying data analysis. It also highlights the operation of data mining approaches which includes association rule, bracket, clustering. These methods provide scholars and preceptors in literacy and assaying the process.

Optimising Learning

Learning analytics has entered improved care as it offers colourful advantages to the institutions of advanced education and increase pupil retention, pupil success and give responsibility. Learning analytics concentrate on managing the size of the analytics similar as acting on prognostications and cast geste. The ideal of learning analytics is to enhance the vatication over time. It allows seminaries and preceptors to use the educational openings to the position of necessities. It increases the effectiveness of methods in interpretation, mining to increase the understanding of literacy and tutoring [8]. It tends to enhance the education to each pupil effectively. It aims at managing large quantum of data generated by the scholars in academic conditioning. This literacy analytics concentrate on pupil success in their education. It's the miracle of collecting, analysing and reporting the data about learners in terms of understanding the literacy. An increased development of big data analytics becomes significant for the association to manage the dimension and operation processes [9]. The educations sector has come significant to determine the data for the improvement of academic and learning conditioning. Learning and academic analytics are the process of analytics in the education sector. This literacy analytics is the process of collecting data about the learners and tends to learn further effective. It deals with enhancing the learner success. Academic analytics aims at growth of the processes, coffers and workflows of the institution over use of academic, learner and institutional data. It also emphases on increase the organizational effectiveness [7]. Due to enhance delegation, competition, regulations the relinquishment of the academic analytics is increased. In the education sector, a large quantum of data has been collected but they aren't analysed duly. This advanced education leadership is largely concentrated on significant and serious result as per inadequate information when that could be attained by analysing the data. The business analytics, prophetic analytics and action analytics are taken into consideration of the big data analytics [11]. In the academic sphere, learning analytics concentrated on literacy processes, learners and learning behaviours.

D. **Slow Progress of Big Data in Education**

In the education segment, big data is examined as the gamechanger in the theoretical presentation. The literateness business like Knew ton is serving these analytics in an

effective manner. The company has improved$ 157 million bones to grow a modifiable literacy system which suggest the literacy paths for the scholars over grade and subject situations [10]. There are some walls precluding the relinquishment of these results. preceptors and parents have increased pupil sequestration and stewing that data could be misused. The other challenges like delicate approach of deployment and working in tight deadlines are enhanced. However, the offline conditioning like schoolwork and classroom conversations are complex to gather, If the pupil course will be covered. Big data has capability to enhance academic performance and the machine learning need to enhance the particular literacy path for each pupil.

IV. METHODOLOGY

Qualitative research has been functional to this learning. The qualitative research is used to gain the information of persons details, sentiments and inspirations. It offers wide opinion of the problematic and deliver thoughts for making quantitative research. It also regulates the views and ideas about the problem [2]. However, this qualitative research will add observations to the present problematic statement. Such research is called exploratory research.

Data Collection

In order to gage the outcomes, the researcher may use primary technique and secondary technique.

Primary Technique

The primary research method involves conducting interviews, surveys, and observations to collect data. The researcher will encounter confidentiality concerns if they use these techniques. Additionally, it pursues experiments, observations, and market research. These techniques are not used in this study, though.

Secondary Technique

The method of getting data through publications like articles, magazines, newspapers, and journals comes in second. This approach favours already-published sources from other academics. This technique was used to obtain the data for this study. The information was gathered from researches' literary sources and used to introduce a powerful big data solution for teaching.

The volume of information processed has been growing at an incredible rate over the years thanks to advancements in information technology, artificial intelligence, and machine learning [1].The concept of big data was created as a result of this massive informational dump and the challenges associated with processing it.The method entails the timely, straightforward, and effective analysis of massive amounts of data [2].Today, the usage of big data techniques is becoming more popular across a variety of application fields. Among others, IT firms, small- and large-scale businesses, healthcare systems, sports, and securities have all adopted the idea and methods of big data to improve their operations. Data science has grown to be one of the most popular occupations worldwide for this reason [3]. Big The processing of enormous amounts of data utilizing mathematical and statistical modelling, programming, and computational algorithm approaches is known as big data analytics [4]. Big data applications are designed to extract knowledge from a variety of information within an organization [5], find trends, and spot anomalies. The use of big data analytics in enterprises will, most notably, help managers make better decisions, offer better customer services in the workplace, maximize resources, and have a better understanding of how customers interact with brands [6].Big data has been used for many different types of research across many industries, including business companies tracking their content on various social media networks to perform analysis, public sector organizations, healthcare systems monitoring various networks, and research to evaluate and treat various epidemics.[7]

The availability of data, its relevance, benefit, opportunities, cost, and ownership, as well as its applicability, are some of the topics covered in reports on the use of big data in many fields [8]. The application of big data in the higher education system (HEIs) is covered in a dearth of reports and publications, but [9]. Every organization's essential function—which might be interpreted differently depending on the organization—is decision-making. In general, organizations' primary criterion for excellent management is data-driven decision-making. Every institution in the higher education sector has a distinctive method of decision-making that aims to support its operations. Higher education executives are typically in charge of making decisions, which are typically based on the executives' expertise and intuition [10]. Performed surveying 380 senior

managers in IT departments with the aim of learning how data is used and how it enhances decision-making processes. The outcome demonstrates that using data to inform decisions in higher education is a significant foundation for long-term competitive advantage. Similar to this, [11] undertook a variety of studies, the first of which looked into the usage of student data by academics and administrators at a higher education institution in California. The use and impact of data generally at the institution was the subject of the second research. Both studies showed that while institutions have a data management methodology, they have not yet realized all of its benefits. Because of this, organizational duties, particularly in HEIs, can be optimized with the potential of big data technology. in the fields of strategy and management. Big data analytics has a lot of potential applications, and HEIs are a fantastic place to look for those applications. Universities hold a lot of data, including information about registration, alumni, and course outlines.

Big data mining might make it simple to obtain and process information, which would improve the efficiency of the educational system's workflow. Big data analytics in HEIs are essentially divided into two categories: academic and learning [12].In general, academic analytics refers to approaches of data-driven decision-making that involve analysing institutional data (huge data sets, statistical tools, and predictive modelling) to produce actionable intelligence for operational needs in an educational institution [12].It has the potential to be cost-beneficial to the school, increase student recruitment, and improve education quality, all of which will give institutions a competitive advantage. In contrast, learning analytics is the study of massive student data sets that are generated and gathered.to assess academic achievement, forecast performance in the future, and identify potential challenges [13]. It has a substantial favourable impact on decisions that academicians, administrators, and policymakers often make at the classroom, institution, or policy level, including tutoring, curriculum, assessment, and tutoring. Data gathering and storage have increased dramatically with the advent of big data and its uses. The use of big data has significantly improved the ability to solve practical problems.[14] reported in their conclusions that Facebook will have roughly 500 million users in about two years. Nearly every second, information is processed on social media.[15] noted that businesses worldwide will have data storage reaching seven

exabytes in a short amount of time. Despite the advantages of big data, some certain difficulties with its use and application.[16] identified in his research some important initial challenges to big data, such as the handling of different data types from various sources and people from technological or commercial disciplines that lack the necessary big data skills (unstructured and semi-structured data). Investigated is education. By investigating the applicability of Big Data analytics in higher education institutions, this article aims to close the gap in big data uses in universities. The rest of this essay is structured as follows. The works pertaining to the classification of Quran texts are presented in Section 2, the methodology is presented in Section 3, along with a detailed description of the dataset, the classification experiment, and the evaluation metrics, the experiment results are reported in Section 4, and the section concludes with some suggestions for future research in Section 5.

The Idea of Big Data

The foundation of big data is the idea that massive amounts of data can be processed, analysed, and handled utilizing big data analytics. Big data has not yet been given a clear meaning, according to several experts. The issue of agreement and understanding between an organization and a third party as well as the hesitant choice of approach and methodologies to analyse data in order to overcome these obstacles are some other examples (the hiring of expert outside an organization to manage big data). Additionally, there is the issue of security and privacy when stakeholders collaborate. This essay examines the relevance and effects of big data analytics in higher big data serves their purposes well. Big data, according to [17], is a resource of information (data) that is valued for its large volume, variety, and velocity and requires specialized technology and analytical methods to be transformed into value. According to [2], big data refers to the idea that the volume of data calls for considerably more robust systems. methodologies and experts with the new skills needed to handle, analyse, and analyse huge datasets quickly and simply. As a result, big data technologies can assist firms in maintaining and gaining a competitive edge globally. Big data analytics is backed by statistical analysis and data mining and is associated with business intelligence [17]. Data-driven decision-making serves as the foundation [18]. Recently, in order to better their plans and assist the development of new products and services,

more than 75% of enterprises, particularly private organisations, have already begun using the notion of big data [19]. Organizations can manage vast amounts of data quickly thanks to big data analytics. This gives managers the opportunity to handle data more effectively, giving them a competitive advantage. [20] processing big data analytics have the potential to improve operations and help decision-making to promote innovation in commercial standards' goods and services [21]. The idea also incorporates advanced analytics, data visualisation, and discovery [3]. Organizations commonly utilise MapReduce, Scalable Hadoop, Spark, YARN (for batch processing engine), Apache Kafka, Apache Samsa, and Apache Storm (for distributed stream processing engine) for big data analytics [22].

METHODOLOGY: This study has utilised qualitative research.

Qualitative research is used to learn about people's motivations, beliefs, and reasons for doing things. It provides a thorough analysis of the issue and suggestions for conducting quantitative research. It also establishes opinions and thoughts regarding the issue [2]. However, the problem statement as it is now will include perceptions from this qualitative research.

These studies are referred to as exploratory research.

Data Collection: The researcher may use both primary and secondary methods to assess the findings. Primary approach: The research's primary method involves conducting interviews, surveys, and observations to acquire data. The researcher will encounter confidentiality concerns if they use these techniques. Additionally, it pursues experiments, observations, and market research. These techniques are not used in this study, though. This study has used qualitative research. The secondary method involves acquiring information from secondary sources, such as articles, magazines, newspapers, and journals. This approach favours already-published sources from other academics. This technique was used to obtain the data for this study. The information was gathered from researches' written works, and big data analytics was used to present practical answers for education.

DESIGN OF RESEARCH

The exploratory research design has been used in this study.

Exploratory research can help define the study questions but cannot provide definitive answers to the problems that are currently being faced [2]. The study designs provide a thorough comprehension of the problem in order to determine it. The results of this investigation will allow the researcher to make conclusions based on fresh information and new ideas. In cases where no prior research has been done, this study investigates issues and presents fresh answers. The exploratory research design has been used in this study. Exploratory research can help define the study questions but cannot provide definitive answers to the problems that are currently being faced [2]. The study designs provide a thorough comprehension of the problem in order to determine it. The results of this investigation will allow the researcher to make conclusions based on fresh information and new ideas. In cases where no prior research has been done, this study investigates issues and presents fresh answers. The education industry uses batch and stream processing for data storage to improve the process. The Hadoop platform enables distributed data processing using a single programming model. Hadoop platform has the following qualities: dependability, scalability, flexibility, and affordability [16].

Fig 1
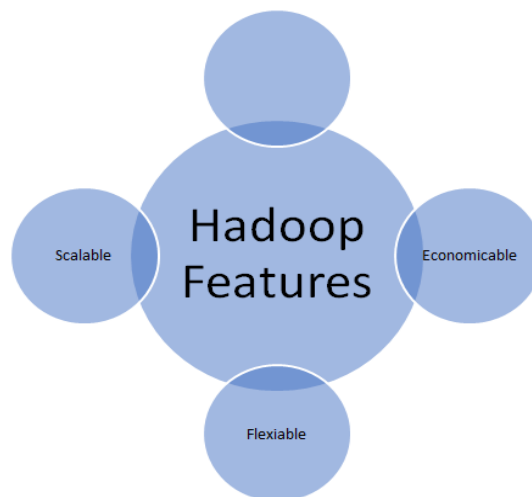
Big Data Technique Proposed Approaches in Education

Apache Hadoop is used in the system process to apply the big data technique for education that has been offered. The processing of the educational data in this suggested approach makes use of batch processing and stream processing. Batch processing is a method for analysing data blocks over a predetermined amount of time. The efficient

platform for batch data processing is Hadoop MapReduce. The stream of data in the educational sectors has been segmented into data blocks, and the Hadoop platform is used to carry out the function [13]. As they can quickly determine the issue, stream processing has a tendency to process data in real time. It allows for data to be input into analytics tools and for analytics findings to be obtained [14].

Fig 2
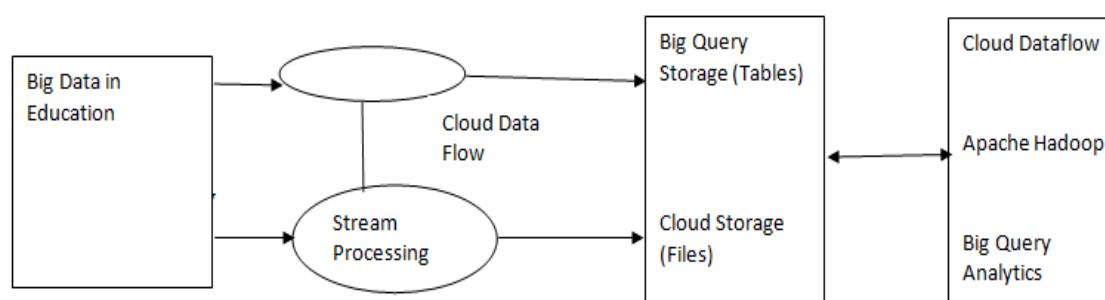
Using Big Data in Education.

employs cloud storage to keep the files safe while storing the data. The cloud can be used to store educational material like files and tables. The files are kept in cloud storage, while the tables are kept in huge query storage. The method of getting knowledge about large data from the cloud and storing it is shown in the diagram below.

A. Learning Framework

The cloud will aid in the effective storage of the data, and pupils prefer the online learning method. The school system will use the aforementioned procedure to access the data.

B. Researching

The massive data Hadoop is utilised in the education sector for responsible, cost-effective, and trustworthy purposes. Enhancing evaluation and monitoring, developing an education system that is industry ready, having instructors trained to improve the quality of instruction, making the system more accountable, and understanding industry demands are some of the issues facing the education sector. Given these difficulties in the educational industry, Hadoop has a chance to resolve them with the use of big data.

Optimization of Student Acquisition

Unemployment is a global issue. The human resources division will respond that they are having trouble locating qualified individuals if we inquire. They can identify hundreds of people through campus drive and fill the positions. Many businesses claim that it is difficult for employers to find the suitable resources. The industry may perform sentiment analysis on the pupils who participated in the drive using the Hadoop system. As they study, many students concentrate on various areas. They are concentrating more on the engineering stream. This desire may result in depressions and unemployment as a result. With the Hadoop solution, they must conduct analysis before choosing a study branch. You can accomplish it by social media data from posts and shares is used to determine. They need to be aware of their interest as well as the professors' opinions.

Effectiveness of instruction: Many teachers are unable to offer their all during class. It is crucial to identify instructors, improve their performance, and reward them. The expressed opinion about the instructor's ineffectiveness as a teacher will enable educational institutions to take the appropriate action. The institution may give professors incentives if their pupils succeed. The educational institutions ascertain market trends with the aid of big data.

Retention of students: Many educational institutions struggled to keep students around for an extended period of time. The issue with students leaving educational institutions too soon affects colleges, schools, and institutes. The To better serve the students, educational institutions should choose the positions and examine feedback and trends. Evaluating how data is saved, processed, and used for future outcomes is one of the major difficulties in education. The number of students who transfer or drop out is a significant problem that educational institutions face. Students' decision-making abilities and business intelligence are the only challenges facing the high education sector. This loses its effectiveness at increasing student retention and has an impact on academic performance.

SUGGESTIONS & SIMULATIONS

Concerns about privacy and security have increased the use of big data in education. There are no barriers to processing, storing, or accessing student learning data when

preventing its misuse or abuse because big data is focused on digitising data. The online learning system, mobile devices, and school district offices all save and gather student learning data. Data security results from the mismatch between these factors since a data security breach in one database will have an impact on the entire data system. It might also prevent different databases from being linked together. The data security protocols create the linkage and minimise unnecessary data in order to strike a meaningful balance between sharing and securing data. Facts or Private information and student learning data that may be exploited against the students even when they move in the educational system or workplace are the other important hurdles in the application of big data in education. By providing learning resources that are improved by adaptive learning algorithms and keeping track of students' academic achievement digitally, it enables students to learn. We shall apply our proposed solution to solve these issues. This Hadoop platform could be used by the educational sector to improve scalability and reliability.

VIII CONCLUSIONS

This report makes it very evident how big data affects the education industry. The education industry has a number of difficulties, including data security and privacy concerns, poor decision-making, and the inability to record, access, or preserve data. a data. Big data and the Hadoop framework can be used to address these problems. For processing the data, batch and stream processing are also used. Data is stored in cloud storage, and the Hadoop platform is utilised to analyse educational data effectively. The education sector can increase teaching efficacy, student retention, decision-making and action, and student acquisition optimization by utilising this approach. In order to improve the performance of the education sector, the practitioner can incorporate Spark and Hadoop for future research.

Summary of Big Data Analytics' Usability in Education:

Descriptions of big data analytics

Beneficiaries, Level of Applicability

Analytics

For better data driven Department, Institution departments, institutions, and as well as predicting and comparing the learner's performance, data evaluation and analysis that enables improvement programmes, assessment, of tutors, Learner, Tutor, can be applied to all levels of the institution. Academic analytics is the process of using information technology to make decisions that are largely related to the operation and finances of the institution (academic challenges). making decisions.
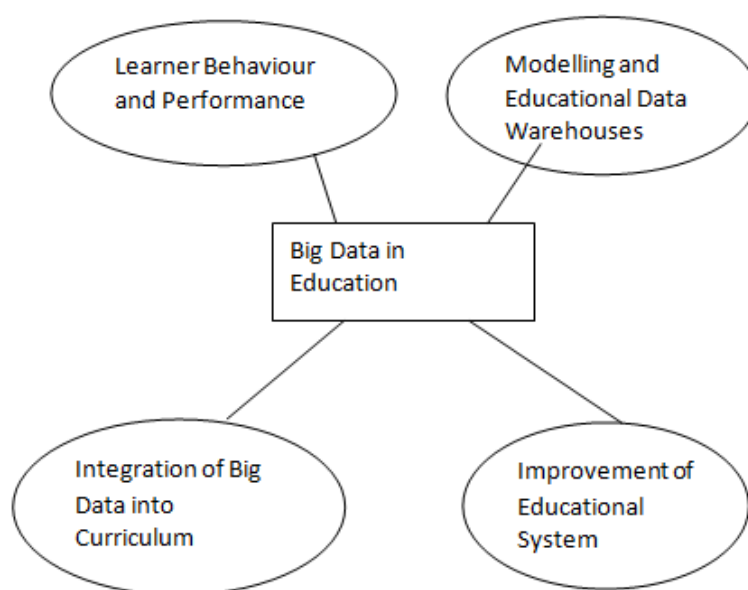

Fig 3: How Big Data working in Educational Domain

The students' institutional profiles, learner profiles, tutor profiles from faculty, enrolment profiles from academics, alumni profiles from researchers, administrator profiles, and stakeholder learning analytics students. The interpretation of institutional data generated and gathered about course recruitment is another name for it. management, effectiveness, and retention of the students' performance in order to forecast future performance and enhance the institution's decision-making for the departments, tutors, and students.

Case Study Success

Examples of analytics use in higher education

In order to make prospective students the centre of attention, increase graduation rates, and attract government financing, certain higher education institutions are gradually

applying analytics, notably the development of curriculum design for the student [5].As an illustration, certain institutions in US universities and colleges are already utilising predictive analytics to align their financial goals with their institutional aims and to optimise key units of the institution, such as student behaviour and activities. Arizona State University has integrated College Scheduler, a service from Civitas Learning, as an analytics tool into their system [1]. Similar to how Sinclair Community College and University of Oregon have used Visual Analytics to deploy analytics. The service provider is SAAS [4]. Analytics were introduced at Arizona State University to improve students' academic experiences, and as a result, the graduation rate rose by 20% [33]. College Scheduler, analytics software, is being used by the university. It is a piece of software that enables pupils to enter private and individual information into a dashboard. The software automatically fills in the required courses for students based on their academic and personal needs [35].The programme helps students manage their time and money by preventing them from enrolling in courses that are unrelated to their majors [36].According to [37], the College Scheduler programme could raise college completion rates by more than 3%.Another university submitted an applicationThe University of Maryland – College Park performs data analytics.

With the implementation, the college gained by assisting in limiting success gaps for low-income students, shortening the graduation process, and ultimately improving graduation rates [38]. The college also targeted management of students' performance, by using analytics to predict student success or failure and forward advising [39].

Big Data Analytics Challenges in the Higher Education Sector

Numerous advantages of big data analytics have a significant impact on resolving important problems in the educational system. However, paired with the benefits are certain drawbacks. Analytical and technical obstacles are a few of the major problems with big data management. The number, storage, analysis, and quality of the data are all aspects of the analytical problems. According to [39], the types of data that are accessible within an organisation include structured, semi-structured, and unstructured data. Managing the ever-growing amount of data would be difficult. Similar to this, [40] emphasised that dealing with diverse data requires a lot of effort and money.

Additionally, there are concerns regarding data ownership, administration, and storage as well as data protection and privacy. may be brought on by the teachers' and pupils' concerns about the security of the data and who has access to it [38]. Another significant issue with using big data in learning analytics is that the analytics may place a greater emphasis on the technological context, specifically in terms of data collection and analysis, rather than demonstrating what data should be gathered and analysed as well as the potential uses of such data [41].There is no question that the use of big data analytics has the ability to affect, transform, and deliver a better outcome, particularly with regard to strategic planning and policy in the education system, given the significant demand on the system to improve the quality of education. As a result, the educational system will be able to create fresh approaches to achieving excellence in both teaching and learning. As a result, it is possible to continuously improve on student activity data, which can then be combined with other educational data to provide a better description of the success and progression of teaching and learning at institutions. Big data analytics offers students valuable resources that support their academic progress. Additionally, implementing learning analytics in universities may help students perform better.

REFERENCES

[1]   A. Picciano, "The Evolution of Big Data and LearningAnalytics in American Higher Education", OnlineLearning, vol. 16, no. 3, 2012.

[2]   B. D'Ippolito, "An Exploratory Review of the Design Literature: Gaps and Avenues for Future Research",SSRN Electronic Journal, 2012.

[3[.   B. Daniel, "Big Data and analytics in higher education:Opportunities and challenges", British Journal ofEducational Technology, vol. 46, no. 5, pp. 904-920,2014.

[4].   B. Daniel, "Big Data and analytics in higher education:Opportunities and challenges", British Journal ofEducational Technology, vol. 46, no. 5, pp. 904-920,2014.

[5]. R. Ellaway, M. Pusic, R. Galbraith and T. Cameron,"Developing the role of big data and analytics in healthprofessional education", Medical Teacher, vol. 36, no.3, pp. 216-222, 2014.

[6]. S. Shahrivari, "Beyond Batch Processing: TowardsReal-Time and Streaming Big Data", Computers, vol.3, no. 4, pp. 117-129, 2014.

[7]. K. Madhavan and M. Richey, "Problems in Big Datain Learning", Journal of Engineering Education, vol. 105, no. 1, pp. 6-14, 2015.

[8]. J. Reyes, "The skinny on big data in education:Learning analytics simplified", TechTrends, vol. 59, no.2, pp. 75-80, 2015.

[9]. Y. Wang, "Big Opportunities and Big Concerns of BigData in Education", TechTrends, vol. 60, no. 4, pp.381-384, 2016.

[10]. R. Desai, "Real Time Analysis using Hadoop",International Journal Of Engineering And Computer Science, 2016.

[11]. R. De Rosa and B. Aragona, "Unpacking Big Data inEducation. A Research Framework", Statistics, Politicsand Policy, vol. 8, no. 2, pp. 123-137, 2017.

[12]. T. Brock, "Performance Analytics: The Missing BigData Link Between Learning Analytics and Business Analytics", Performance Improvement, vol. 56, no. 7,pp. 6-16, 2017.

[13]. S. Bajpai and S. Mani, "Big Data in Education and Learning Analytics", TechnoLearn: An International Journal of Educational Technology, vol. 7, no. 12, p.45, 2017.

[14]. M. Goudarzi, "Heterogeneous Architectures for BigData Batch Processing in Map Reduce Paradigm", IEEE Transactions on Big Data, pp. 1-1, 2017.

[15]. Ozgur, C., Kleckner, M., & Li, Y. (2018). Selection of Statistical Software for Solving Big Data Problems. SAGE.

[16]. D. Dommnguez Figaredo, "Big Data, analiitica delaprendizaje y educacioon basada en datos (Big Data,Learning Analytics & Data-driven Education)", SSRNElectronic Journal, 2018.

[17] C. Jurkiewicz, "Big Data, Big Concerns: Ethics in the Digital Age", Public Integrity, vol. 20, no. 1, pp. S46-S59, 2018.

[18] J. Reyes, "The skinny on big data in education: Learning analytics simplified", TechTrends, vol. 59, no.2, pp. 75-80, 2015.

ALGORITHM FOR DATABASE: FUP GROWTH

Mrs. Shilpa Kumbhar and Dr. V. V. Bag

Department of Computer Engineering, NK Orchid Collage of Engineering, Solapur,

Maharashtra, India

INTRODUCTION

Data mining is the process of analyzing enormous amounts of information and datasets, extracting (or "mining") useful intelligence to help organizations solve problems, predict trends, mitigate risks, and find new opportunities. Data mining is like actual mining because, in both cases, the miners are sifting through mountains of material to find valuable resources and elements. Discovering useful patterns hidden in a database plays an essential role in several data mining tasks, such as frequent pattern mining, weighted frequent pattern mining, and high utility pattern mining. Among them, frequent pattern mining is a fundamental research topic that has been applied to different kinds of databases, such as transactional databases [1] streaming databases [1], [2], and time series databases [2], and various application domains, such as bioinformatics [1], [2], Web click-stream analysis [2], [3], and mobile environments [5], [6].Nevertheless, relative importance of each item is not considered in frequent pattern mining. To address this problem, weighted association rule mining was proposed [4], [6]. In this project frequency based weights of items, such as unit profits, periodicity, quantity and seasonal data of items in transaction databases are considered. With this concept, even if some items appear infrequently, they might still be found if they have high weights. An emerging topic in the field of data mining is Utility Mining. The main objective of Utility Mining is to identify the itemsets with highest utilities, by considering profit, quantity, cost or other user preferences. Mining High Utility itemsets from a transaction database is to find itemsets that have utility above a user-specified threshold. Itemset Utility Mining is an extension of Frequent Itemset mining, which discovers itemsets that occur frequently. In many real-life applications, high-utility itemsets consist of rare items. Rare itemsets provide useful information in different decision-making domains such as business transactions, medical, security,

fraudulent transactions, and retail communities. For example, in medical application, the rare combination of symptoms can provide useful insights for doctors [2].

RELATED WORK

The system can not only decrease the overestimated utilities of potential high utility itemsets [1] but greatly reduce the number of candidates. Different types of both real and synthetic data sets are used in a series of experiments to the performance of algorithm with state-of-the-art utility mining algorithms which show that UP-Growth (utility pattern growth) [1] and UP-Growth+ like other algorithms substantially in term of execution time, especially when databases contain lots of long transactions or minimum utility threshold is set.

R. Agrawal [1] introduced the concept of frequent itemset mining. Frequent itemsets are the itemsets that occur frequently in the transaction data set. The goal of Frequent Itemset Mining is to identify all the frequent itemsets in a transaction dataset.

The mining of association rules for finding the relationship between data items in large databases is a well studied technique in data mining field with representative methods like Apriori [1], [2]. ARM process can be decomposed into two steps. The first step involves finding all frequent itemsets.

H. Yao et al formalized the semantic significance of utility measures in [1]. Based on the semantics of applications, the utility-based measures were classified into three categories, namely, item level, transaction level, and cell level. The unified utility function was defined to represent all existing utility-based measures.

The H.F. Li proposed two efficient one pass algorithms, MHUI-BIT and MHUI-TID, for mining high utility itemsets from data streams within a transaction-sensitive sliding window. Two effective representations of item information and an extended lexicographical tree-based summary data structure were developed to improve the efficiency of mining high utility itemsets [6].

Liu et al proposed Two-Phase algorithm [5]for finding high utility itemsets. In the first phase, a model that applies the "transaction-weighted downward closure property" on

the search space to expedite the identification of candidates. In the second phase, one extra database scan is performed to identify the high utility itemsets.
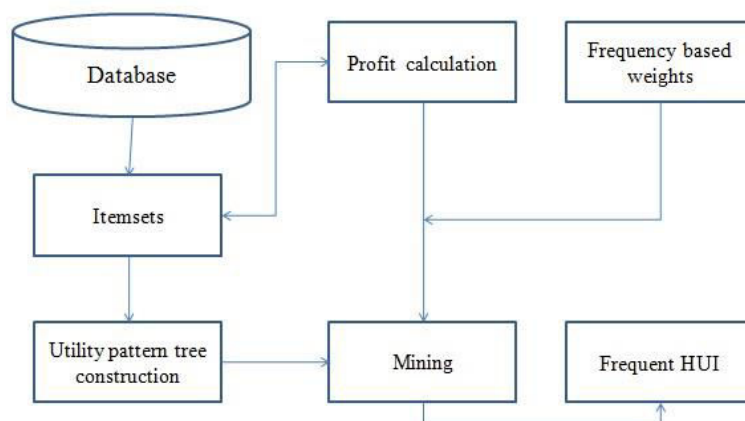

Figure 2.1 Overview of System

PORPOSED MODELLING

In this section we present discovery of itemsets having high uitility with not only profit to obtain frequent itemsets but by weighted frequent itemsets periodically. Given FUP a novel algorithm of frequent utility pattern growth contains weighted frequent itemsets calculations and timewise observations of transactions.

3.1 The Proposed Data Structure: FUP-Tree-

To discover the mining performance and avoid scanning original database repeatedly, we use a compact tree structure, named FUP-Tree, to maintain the information of transactions and high utility itemsets.
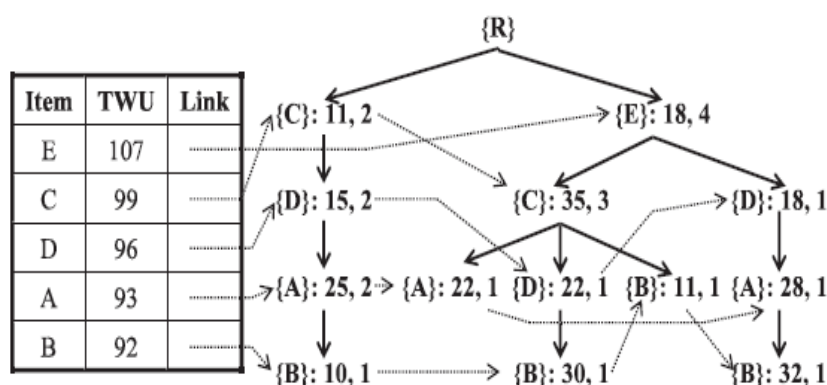

Figure 3.1 Tree generated after using strategies

Two strategies are applied to minimize the overestimated utilities stored in thenodes of global FUP-Tree. In following sections, the elements of FUP-Tree are first defined. Next, the two strategies are introduced. Finally, how to construct an FUP-Tree with the two strategies is illustrated in detail by formulae's.

Item	A	B	C	D	E
Minimum item utility	5	2	1	2	3

Table 3.1 Minimum utility table

Utility (item) <= OEU(item)

Where OEU is the overestimated utility of itemsets which is less than the minimum utility i.e. Utility(item) < min_utl. That means Utility (i) <=OEU(i)<=min_util. Only the supersets of promising items are possibleto be high utility itemsets.

3.2 Discarding Global UnpromisingItems during tree construction-

The construction of a global UP-Tree can be performed with two scans of the original database. In the first scan, TU ofeach transaction is computed. At the same time, TWU ofeach single item is also accumulated. An item ip is called a promising item if TWU>=min. util. Otherwise it is called an unpromising item. Without loss of generality, an item is also called a promising item if its overestimated utility (which is different from TWU in this paper) is no less than min. util. Otherwise it is called an unpromising item. During the second scan of database, transactions are inserted into a UP-Tree. When a transaction is retrieved, the unpromising items should be removed from the transaction. After finding all PHUIs, the third step is to identify highutility itemsets and their utilities from the set of PHUIs byscanning original database once
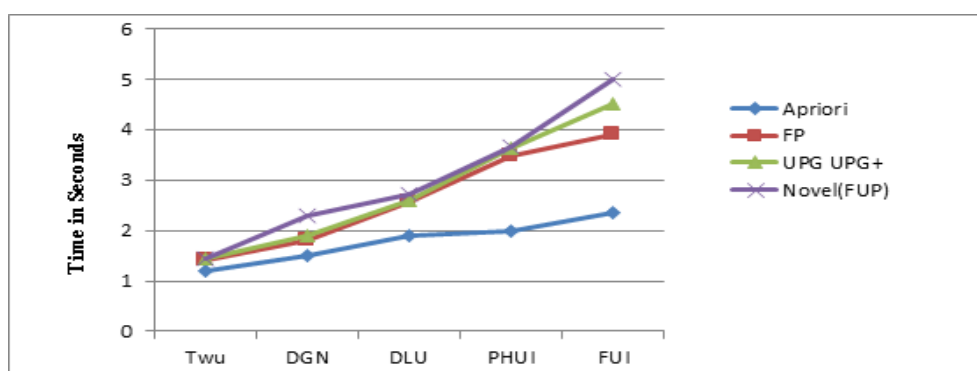

Figure 1: Comparison of Candidates generation with respect to time for transactions

3.3 The Proposed Mining Method-

UP-Growth achieves better performance than FP-Growth by using DLU and DLN to decrease overestimated utilities of item sets. However, the overestimated utilities can be closer to their actual utilities by eliminating the estimated utilities that are closer to actual utilities of unpromising items and descendant nodes which helps to generates global FUP-tree again with the help type of Grid-Based Clustering Method, a grid is formed using the object together. A Grid Structure is formed by quantifying the object space into a finite number of cells. It helps faster time of processing that is The processing time of this method is much quicker than another way, and thus it can save time. This method depends on the no. of cells in the space of quantized each dimension. Which are given by Given two cells with centers c_i, $c_j \in R_d$, and cell density values D_i and $D_j \in R$, we set the similarity between cells i and j to be fsim = fdens ·fspat, with fdens(i,j) = exp $-D_i - D_j$ 2 2·σ^2 dens and fspat(i,j) = exp $-c_i - c_j 2$ 2·σ^2 spat with σdens being the mean euclidean difference between their densities, and σspat the average euclidean distance between centers of two neighbors cells of the grid. The exponentiation is the most natural way to express the similarities. The density D_i is the ratio (p_i/V_i) where p_i and V_i are respectively the proportion of points and the volume of the cell.

3.4 Novel Algorithm for Weighted Frequent Itemsets Mining-

After constructing a global FUP-Tree, a basic method forgenerating PHUIs is to mine FUP-Tree by FP-Growth [4].In this section, we propose an improved method (Novel algorithm) for reducing overestimatedutilities more effectively by pushing morestrategies into the framework of UP-Growth+ algorithm.

1)   Generateconditional pattern bases by tracing the paths in the original tree.

2)   Construct conditional trees (also called local trees inthis paper) by the information in conditional pattern bases.

3)   Mine patterns from the conditional trees..

RESULTS AND DISCUSSIONS

Performance of the proposed algorithms is evaluated in this section & results in this section show that the proposed methods outperform the state-of-the-art algorithms almost in all cases.

Apriori	FP Growth	Upg &Upg+	Novel
1.21	1.41	1.45	1.46
1.51	1.81	1.91	2.31
1.91	2.56	2.61	2.73
1.98	3.47	3.62	3.65
2.34	3.89	4.51	5.03

Table 1 Comparison Table

All the values should be observed by research of other articles with this FUP novel algorithm. We have to use recognized subroutine to calculate frequent items from the transactions.

CONCLUSION

In this paper we propose FUP a novel algorithm which is used to mine database to discover high utility frequent itemset by considering frequency based weights, time with profit as well. The algorithm is applied to discover high utility frequent itemsets. Result will give high utility frequent itemsets after mining with profit, time and frequency based weights.

REFERENCES

[1] Vincent S. Tseng, Bai-En Shie, Cheng-Wei Wu, and Philip S. Yu, Fellow,"Efficient Algorithms for Mining High Utility Itemsets from Transactional Databases", Vol.. 25, No. 8, Aug 2013

[2] Y. Liu, W. Liao, and A. Choudhary, "A Fast High Utility Itemsets Mining Algorithm," Proc. Utility-Based Data Mining Workshop, 2005

[3] V.S. Tseng, C.J. Chu, and T. Liang, "Efficient Mining of Temporal High Utility Itemsets from Data Streams," Proc. ACM KDD Workshop Utility-Based Data Mining Workshop (UBDM '06), Aug. 2006.

[4] Frequent Itemset Mining Implementations Repository, http:// fimi.cs.helsinki.fi/, 2012

[5] ChowdhuryFarhan Ahmed· Syed KhairuzzamanTanbeer·Byeong-SooJeong· Young-Koo Lee,"HUC-Prune: an efficient candidate pruning technique to mine high utility patterns"2009

[6] Sudip Bhattacharya, DeeptyDubey,"High Utility Itemset Mining", Volume 2, Issue 8, August 2012

[7] JyothiPillai,O.P.Vyas,"Overview of Itemset Utility Mining and its Applications",Volume 5– No.11, August

ABOUT THE EDITORS

Sudha Rameshwari is a Biochemist and her native is king maker kamaraj birth town Virudhunagar, Tamilnadu, India. She did her B.Sc. and M.Sc (Biochemistry) from V.V.Vanniaperumal College for Women, Virudhunagar, Tamilnadu, India. She obtained her M.Phil degree in Life Science (2003) from Manonmaniam Sundaranar University, Tirunelveli. She has completed her Post graduate diploma In Bioinformatics (2005) in Bharathiyar University, Coimbatore. She has 24 years' experience in Biochemistry and her Research interests include microbiology, pharmacology, Green nanotechnology and Bioinformatics. She submitted one sequence to GEN BANK on April 2018.

She regularly teaches Techniques, Enzymology, Clinical biochemistry, Microbial biochemistry and Bioinformatics. She also takes classes of Anatomy and Human Physiology in DMLT course since 2016. She is well trained in Microbiology and Molecular Biology Techniques. She has published more than 30 research articles in well reputed International journals which are Scopus indexed, Web of Science and UGC approved. She is interested in participating and has organized workshops. She guided 2 M.Phil students and 25 PG students. She has filed and published one patent (Indian). She is a reviewer in 14 reputed International journals. She also published 2 chapters in edited books. She received grants from TNSCST-DBT, autonomy fund and MRP grant from managing board. She has also been awarded as Honorary Doctorate (D.Litt.(hc)) from University of Central America, CV Raman Prize 2022 from Institute of Researchers, Wayanad, Kerala and Bharat Excellence award 2022, Leading educationist of India award 2022 from Friendship forum - New Delhi, Global Personalities of Asia 2022 from Global brotherhood forum and Outstanding Researcher in Microbial Biochemistry from VIHA, 2018. She is life member (LM052202) in Institute of Researchers, Waynad and also SAS eminent Fellow Membership (SAS/SEFM/077/2021) in Scholars Academic and Scientific society. She has scored 8.7/10 in VIDWAN expert database and National Researchers network.

Dr. Kusuma Kumari B.M. is working as an MCA Coordinator and Assistant Professor in the Department of Studies and Research in Computer Applications at Tumkur University. She was awarded her doctorate from Tumkur University and has 17 years of teaching experience in academics. Her most recent research interests are in digital image processing, Artificial Intelligence and software engineering. She has presented 22 papers at national and international conferences and published more than 25 research papers in reputed refereed journals.

Dr. Manjunatha D is with the Department of Electronics, Tumkur University, Tumkur. He has more than 25 years of teaching experience. He has authored 5 books in electronics. His areas of interest include programming language, Microcontroller and applications, sensors, sensor networks and communication technology

ABOUT THE BOOK

Science and technology (S&T) is widely recognised as an important tool for fostering and strengthening the economic and social development of any country. Given the rapid pace of globalisation, fast-depleting material resources, increasing competition among nations and the growing need to protect intellectual property, the importance of strengthening the knowledge base has become more important.

The order of the day is to strengthen application-oriented research and development (R&D) for technology generation; promote human resource development, especially in terms of encouraging bright students to take up science as a career; encourage research in and application of S&T for forecasting, prevention and mitigation of natural hazards; integrate the developments in science and technology with all spheres of national activities; and harness S&T for improving livelihood, employment generation; environment protection and ecological security.

The aim of this edited book on "Recent Trends and Developments in Science and Technology" is to showcase the Research work being done by the contributors to a worldwide audience. We are very hopeful that the hard work of the researchers will definitely contribute towards the further advancement of Science and Technology.