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Aim & Scope

Technoarete Transactions on Recent Trends in Internet- of- Things and Cloud Computing (TTRT IoT CC) is a double-blinded peer-reviewed open access International Journal Published by Technoarete Publishing. This journal serves as an excellent platform for research scholars, educationalist, industry professionals to showcase and share their knowledge on recent research trends in the fields of Internet-of-Things and Cloud Computing article are invited in various aspect of IoT and Cloud- Artificial Intelligence for IoT , Edge Computing and IoT , Computer Networking for IoT related applications, Cyber-physical system, Industrial Internet-of-Things, Industry 4.0, Internet of vehicles, cloud architecture and modelling, semantic Web Services, virtualisation, middleware Technologies for cloud computing framework, pricing models and compiling digital turns, virtual reality, Augmented reality, mixed reality and its industrial applications, machine to machine communication strategy, integration of IoT with the sensor Technologies, sensor data management, service oriented architecture in cloud computing, load balancing in cloud architecture, autonomic computing, service level agreements, Cryptography for cloud, Cloud Security, IoT security, mobile Cloud compiling, key distribution of IoT networks, distributed IoT networks, Resource management in cloud company.

Related Topics

Artificial intelligence for IoT

Edge computing and IoT

Networking for IoT related applications

Cyber physical system and IoT

Industrial internet of things (IIoT)

Industry 4.0 and IoT

Internet of vehicles IOV

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Cloud architecture and modelling

Semantic Web Services

Virtualization

Middleware Technologies for cloud computing

Digital twins

Machine to machine communication strategies

Virtual reality (VR) Augmented reality (AR),Mixed reality(MR), Extended reality(ER)

Integration of IoT with sensor Technologies

Sensor data management

Service oriented architecture in cloud computing

Load balancing strategies in cloud architecture

Autonomic computing

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Contents

Application of IOT Based Networks for Smart City Development

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ABSTRACT

Internet of things has become an integral part of the development of cities especially the smart cities. Its importance as well as the application has been discussed here in this research in five distinct section and those are introductory, methodology, results, discussion and conclusion part. In the introductory part a background about the research topic has been provided which is the application of IoT based technology for the development. In the past decade the smart city project has been increased significantly and country like China had the highest number of smart cities which is over 100. The next part is the material and methodology part here it has been discussed various types of methodologies that has been used here for performing this research has been discussed. Qualitative research type has been chosen for performing this research and data has been on the basis of the secondary data collection. Data analysis method that has been used here is thematic data analysis with preparing themes based on the research topic. The next section has discussed about the results section where a detailed rationale regarding the research topic has been provided. Findings has been discussed in the discussion part and ended with conclusion part.

Keywords: Internet of Things, Smart City, Technology

INTRODUCTION

IoT technology or the internet of things is the special type of technology that has been often used in the modern times for the purpose of the communication network. In other words it can be said that the internet of things are those physical objects which have sensors, special types of software and processing ability which basically used to exchange the data with other devices through the internet [1]. The term Internet of things was coined by the computerscientist Kevin Ashton in the year 1999. The main purpose behind its invention was to exchange data from one system to the other through the internet. Data can be transferred without the interaction as well but using the technology of IoT has certain benefits and those benefits have been given. It basically helps to reduce the cost involved in transferring the data. Using the internet of things in data transfer becomes easier and it is done with the help of technology with high efficiency and productivity. Increasing the opportunity of the business becomes important and hence when it comes to the internet of things it provides more and more business opportunities. Final benefit of using the technology of the internet of things is to improve the experience of the customers.

Smart city is a broad term but it has a significant meaning when it is compared to the capital city or the financial city. A smart city is a modern urban area which basically uses different types of electronic methods and sensors for the collection of data. It is not as advanced as the capital city or the financial city but it is a technological advanced city and they are either planned or modernized using different techniques. Some of the popular smart cities are like Singapore, Helsinki, Zurich, Oslo and New York. China is the country which has the highest number of smart cities and that is 100 plus [2]. In a smart city the things which are required are: good technological infrastructure, environmental initiatives, proper city planning and highly skilled youth population who are employable. In this the most significant thing that is required in a smart city is a good technological infrastructure and hence for that purpose the technology of internet of things is crucial. The high data transfer through the internet helps to increase the business opportunity and attracts the foreign investments [3]. Getting high customers is yet another thing which a company wants to improve and with the help of the IoT it can be very much possible. Countries like China, Singapore, and Taiwan have been using this technology to make the best possible infrastructure for the smart city and Singapore is seen as the best city for Smart city from all over the world. The location of the smart city is also very impartial and it is always preferable to choose the location which is under the special economic zones.

MATERIALS AND METHODS

Research methodology is important for any of the research and in this section those methodologies that have been taken for performing this research have been discussed. It has been broadly categorized into four categories: the research design, research type, data collection & analysis and finally the exclusion & inclusion of this research. The research design that has been taken here is qualitative research design. The research type that has been used here is the secondary research type that is mainly done with the help of theoretical literature. The data collected for this research is based on the basis of the secondary data collection method. After collection of the data it had been further analyzed with the help of thematic data analysis. Qualitative research type is the type of research design which includes the research which includes the theories, concepts and the qualitative data has already been prepared already by other research and those data are interpreted [4]. Secondary data includes similar things like as it includes the data from the journals, articles, and websites. It also includes some of the quantitative and statistical data just for the purpose of interpretation not the actual calculation. After the successful collection of data it is important that the data should be analyzed with the proper data analysis method and hence the thematic data analysis method has been chosen.

In thematic analysis a data is analyzed with the help of the preparation of themes and those are based on research topics and here the research topic is based on the application of the technology of the internet of things in making smart cities. It will include the data of the concepts of internet of things and smart

cities. It will include the data of the concepts of internet of things and smart cities along with the recent trends that have been going across the world [5]. For that purpose the secondary data will be adequate and along with the secondary research type. Hence, for this research the primary data has been excluded along with the primary research type. Primary research type has been excluded along with the quantitative data from the surveys and interview has been excluded and vice versa has been included. In collection of data from the websites as well as the sources it has been taken is that the authentic data should be used along with the recent data.

RESULTS

Importance of internet of things based technologies in modern cities

Data has become the most significant asset of the 21st century as with the help of data a company can draw its marketing strategy and the government can draw schemes for the welfare of the people. Data storage and its fast transfer areimportant and for that the technology of the internet of things can be remarkable. Artificial intelligence and machine learning has been increasingly developed along with the technology of the internet of things.

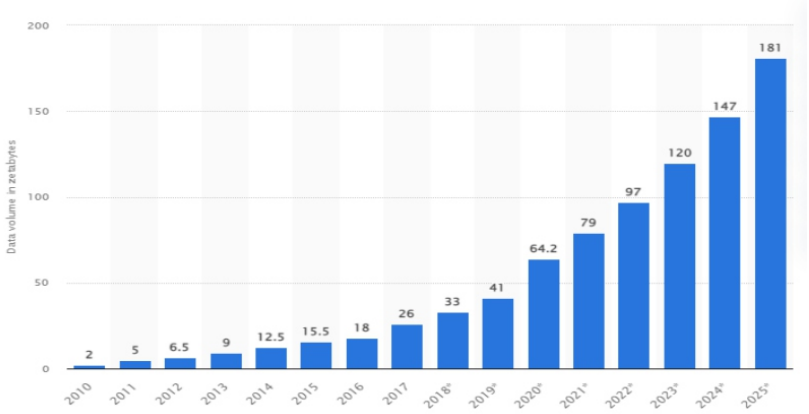

Figure 1: Amount of data consumed and created every year from the year 2010 to the year 2025

The figure 1 it had discussed about the data consumed as well as data that has been created annually globally. According to the graph that has been provided in the year the overall data that was created as well as created globally was only 2 zeta bytes [6]. Since the year 2010 the data consumption as well as its creation shot up and in the year 2020 after one decade it had ceased to 64.2 zeta bytes [6]. The growth is significant as it is around 3100% increase of the data globally. Currently the global data consumption has reached up to 120 zeta bytes and it has been projected that it will rise further in the year 2025 by 181 zeta bytes [6]. The data is enormous and its transfer is also needed with the best possible technology and for that purpose the internet of things can be a useful tool. Today most of the smart cities are filled with high quality digital infrastructure with the fastest internet connectivity.

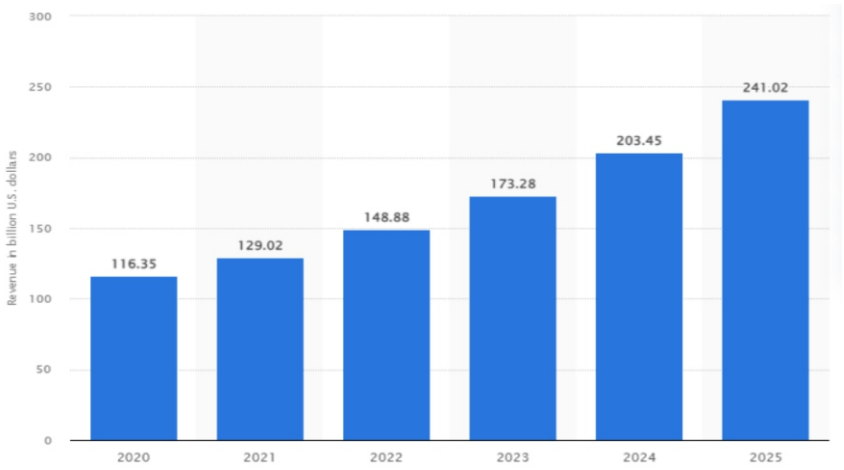

Figure 2: Smart cities revenue from the year 2020 to the year 2025

Counties are investing a huge amount in the development of the smart cities and as the revenue have been increased from the year 2020 to the year 2023 and in future it has been expected that it will rise further in future. According to the figure, in the year 2020 116.35 billion US dollars and in the year 2023 it is around 173.28 billion dollars [7]. According to statista in the year 2025 it had been expected to reach the mark of 241.02 billion US dollars and it is pretty much evident that the most of the operation in smart cities are based on technology and tonnes of data [7]. Smart cities had been expected to rise further in future with the rise of the technological infrastructure. Some of the popular and most common uses of the internet of things are voice assistants, smart televisions and heating and cooling systems [8]. Data consumption is expected to raise further in future due to the introduction the 5g technology. These are some of the common uses of the technology but at the same time this technology can be used in the traffic management in a smart city. Along with this it can also be used in effective environment monitoring smart buildings, helps the country to reach the carbon neutral targets in the nearest possible time. Lastly, the benefits have been with industrial, agricultural and commercial management. All of these will be discussed further in the next section.

Application of IoT in smart cities and its increasing demands

Addressing the significance of the technology of internet of things technology has been applied in various areas in smart cities like the smart buildings, energy efficiency & reduction of carbon emission. Its application in the industrial sector and commercial has made it an important tool of the 21st century in terms of management and its transfer to proper destination. The application of the technologyinternet of things in a smart city has been given below:-

Traffic managementA smart city has been known for its best and effective traffic management and for that gadgets as well as digital appliances are used. They are like cameras, traffic lights, parking and other sensors for the prevention of accidents [9]. With the technology of the internet of things all the

the data will be used and helps to manage the traffic from the control in the computers. There are many countries in the world that are technologically and economically advanced but the problems with traffic management have always appeared for them.

Industrial and commercial management

Internet of things has been used exclusively in the industrial as well as commercial sector to improve the security facilities and production control. In a manufacturing company like the industrial internet of things can be used to track any of the wear and tear in the process, as well as for effective movement of the worker [10]. As it is now quite clear that the work pressure is different therefore according to that the workforce will be managed. The data regarding the quality and control management is also important and the management of the industry would need to examine to draw their future strategy and this data transfer can be effectively transferred through the industrial IoT.

Supply chain management

Supply chain is the most significant part of the supply of goods and services especially in a smart city hence in a smart city all these developments can be boosted with the help of the internet of things. Supply chain data helps in many ways like increasing the actual output, improving the quality of the raw materials, decreasing the energy consumption and ensuring the profitability of the company [11]. The best example is the Shenzhen city of China which is one of the smart cities of China and is the largest manufacturing smart city. Also sharing the real time data helps to better operate the overall operation. Due to its exclusive usage of IoT technology in the supply chain it has seen some of the optimistic developments and those are like the optimization of the route, tracking of the goods throughout the process, it helps a company in reduction of the fuel cost as well as the maintenance cost. Warehouse management has always been the biggest concern for the supply chain company hence they needed to manage the warehouse. Therefore, with the help of real time data sharing helps to locate the goods to the right places. Also getting the final review from the customer is one of the parts of the IoT technology implementation in supply chain management.

Smart buildings and smart homes

In making smart homes and smart buildings the technology can be remarkable as it helps a person to build homes in an energy efficient way with proper water management. In constructing a building or home it is important to make sure that the building should have temperature controlling facilities, it should have security with the devices like the mobile and computer if the building is dedicated to the commercial or information technology office [12]. With the help of the internet of things some of the developments in smart buildings can be possibly included like the proper lighting management with

proper power consumption facilities. Along with these garden management, home safety protection, air as well as the water quality and smart switcher. By including all these technologies the smart homes and smart bulging can be built most effectively.

Smart grids

Smart grids are a totally new technology that has been used in digital and other advanced technologies for monitoring and managing the transport of electricity from the electricity generation source for meeting the demand. It could be understood with the help of an example as if US and Canada forms an official grid alliance then if due to any cause the electricity demand rises in Canada then it can take the help of the US electric companies to fulfil its demands. It is totally a new concept and currency. It is in its developmental stage and more research and development is needed to be done [13]. The technology of IoT can be seen as the most significant technology which can not only help to boost this infrastructure but also help to make the process fast and secure. Some of the practical uses of the Internet of things technology in smart grids are like real time data analytics & visualization, uses of the advanced algorithms, and overall process automation. Countries like Germany had made significant progress in this field and it had developed IoT infrastructure for the smart grid in Mannheim.

Issues regarding the IoT technology and best methods for its application in smart cities

Instead of all these positives there are some of the issues regarding the usage of the technology of Internet of things and all those issues has been given. Lack of encryption, it has been said that all the technology that has been used today is based on encryption as both the ends are connected with a certain type of algorithm [14]. For hackers it is important to break those algorithms and it has been often said the Internet of things uses less strong encryption as it uses the internet to send the data. Due to its access to the internet it became vulnerable to cyber attackers. The data can easily be altered as well as manipulated and therefore by breaking the algorithms. Insufficient testing, with the increase of the demand of the internet of things technology the company is focusing to produce more and more IoT based software without actually checking the security issues [15]. Companies' negligence has created a vulnerable infrastructure of the IoT technology which can be hacked easily. Therefore, it has become significant for the companies to make improvements in the security problems. Any of the devices and software becomes vulnerable if it is not treated well when it comes to the passwords. Weak passwords give an edge to the hacks to attack on the system and take the important data. The other risk or the challenge for using the IoT technology is the default passwords that are often offered by the software itself.

Apart from all these challenges the challenges of using the IoT technology is the high cost of the market as well as too much time consumption. The overall operation of the IoT technology appears lucrative

and quite helpful but at the same time it is one of the expensive technologies and it takes much of the time in its effective operation. Due to the increase of the use of the internet of things technology has paved the way to make the system vulnerable to malware and those malware. In future, the possibility of the increase of the malware if high as the technology has been increasing. Finally the overall security problem has been and this is with the designing part and its implementation so the system can be made robust and reliable to secure the cryptographic algorithms. Minimizing such risks it is important to make the encryption more and more secure and it can only be achieved with the help of complex algorithms.

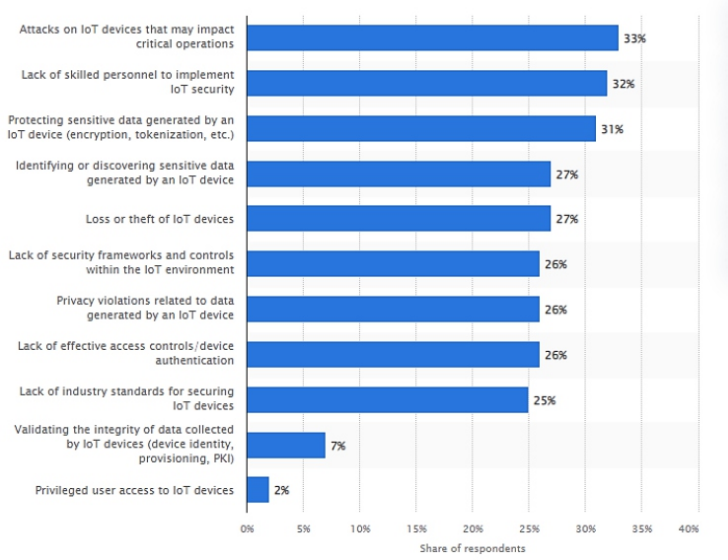

Figure 3: IoT security threats and concerns worldwide in the year 2019

Regarding the security threats and concerns that are often posed by the IoT in the year 2019 worldwide have been covered exclusively in the graph that has been provided above. According to the figure globally 33% of the respondents have reported that the security challenges have been posed by the IoT technology [16]. The most significant reason for the increase of this risk is the lack of the skill that has been posed by professionals regarding the technology of the IoT. Along with this the other important factor that needed to be considered here is the effective implementation of the data encryption. The best ways for minimizing the risk of the IoT technology is to make the process more and more compatible as well as better algorithms should be used. Algorithms which are difficult to break and to build such a complex network a company requires a professional which has the creativeness to build more complex algorithms. Skilled workforce is also required which have the adequate knowledge of the latest technologies like the IoT [17]. Innovation is also needed as the cost of the technology is high as compared to the technology that has been considered parallel. As the demand for the IoT has increased the company has been producing the products and services without actually caring about the security of the system. It has therefore become important for them to monitor and test all its products against all the odds.

DISCUSSION

Technology of the internet of things has been used in many areas like in the education, industries, commercial and the financial sector. In the development of cities, the role of data transfer has become significant and for that the various technologies have been explored. In exploration the IoT is seen as the most significant and easily implemented. Unlike the financial city and the capital city, a new kind of city has been developed by many of the counties and this type is a smart city. A smart city is termed as the city which is technologically advanced and it has the best transportation system, its governance is of the best in the entire country and overall health care of the city is of world class level. The best examples are Singapore, Newyork and Amsterdam. In the development of a smart city many things are required like better skilled people, good infrastructure, transportation and good connectivity from one part of the city to the other. Technology of IoT can be used exclusively in many ways like in the supply chain management, building smart homes, building of the smart grids, better and effective transport management, and in the industrial and commercial sector.

The data consumption has risen in the last decade as in the year 2010 the over data creation as well as transfer globally was 2 zeta bytes. Due to the technological development since the year 2010 and people become more and more aware of creating data. Some of the popular data creating platforms are getting access to social media, working software like the Microsoft office and Google documents. After the year 2010 all the sectors whether it is manufacturing sector, public sector or the private corporation had included the computer in their offices and performed their daily operation through the internet. In this process the technology like Microsoft had played a critical role but still the data transfer was quite slow at that time and it needed to be fast. With help of internet data transfer becomes easier but still it is slow and it needs to foster the process. With the technological transformation it can be improved and there are many of the challenges and those challenges can only be resolved by the IoT technology. In a smart way many of the industries operate, especially the manufacturing there. Real time data tracking in the traffic, supply chain management and other implementation. The concept of the smart cities has gained its popularity and in the future it seems to rise further in future.

CONCLUSION

IoT technology has been becoming popular day by day worldwide and countries like Singapore, Hong Kong, US andUK have been benefited with this. Due to increase of the global data consumption and creation the data transfer has become common these especially though the internet. As of the year 2023 the annual data consumption and creation is expected to reach the mark of 120 zeta bytes and as of the year 2023 the revenue that is generated through the smart cities is expected to rise up to 173.28 billion US dollars. Considering both of these aspects, the role of Internet of things technology can be crucial in raising the revenue of the smart cities. The reason is quite clear as most of the operations in smart cities

are done through digital mode and for that use of the internet has been increased. In the future the use of the internet seems to rise and the speed is also expected to rise further with the introduction of 5g technology. Today most of the nations of the world have been thinking to improve grid technology and for that the IoT can be a game changer. The result part has covered all this and it can be and the data has been collected on a secondary basis and it is a qualitative research. After a brief discussion in the discussion part it can be figured out that for the rapid development of the smart cities the IoT technology is significant.

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Digital Twin for Processes and Products

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ABSTRACT

A virtual representation of a system is referred to as digital twin technology. Digital twin technology helps a company to enhance their rate of production and profitability in global market. Temperature and vibration sensors are used by an organisation with help of this digital twin technology. Manufacturing sector, healthcare, automotive and energy related industries are benefited by this digital twin technology. Importance of digital twin technology is mentioned in this study. Everyone can easily gather a brief idea about this process. Every industry tries to implement digital twin technology in workplace. Implementation process of digital twin technology is discussed critically here. Quality and quantity of products are managed by this digital technology. Digital twin uses several types of technology like: IOT and AI. Proper internet connectivity is needed for this particular process. For this reason every company may not be able to maintain this process. High amount of money is required for an organisation to implement this process. Small companies cannot be able to use digital twin technology. Importance of AI and IoT is also mentioned in this study for using this particular technology across the world.

Keywords: Digital twin technology, IoT, products, process.

INTRODUCTION

A virtual representation of an object or framework is referred to as digital twin technology. A physical object is reflected by this digital twin work within an industry. This digital twin technology helps a company to manage several types of sensors. Temperature and vibration sensors are available in market, by which a company can use modern technology within a workplace. These sensors are effectively beneficial for an organisation to produce data related to different aspects of a physical object's performance, such as: temperature, energy output and weather condition [1]. Digital twin technology helps a company to manage span of an object's life cycle and uses of real time data sent from various kinds of sensors globally. Every company has a goal to supervise their operational management in a modern way. This digital twin technology helps a company to monitor operations and stimulate behaviour of an employee [2].

Several real world items are replicated by this digital twin technology from single pieces of equipment in a factory to full installation process. Digital twin technology allows overseeing performance of an asset in a significant way to maintain proper process and strategy of work within a company. Various kinds of potential faculty are identified by a company with help of this digital twin technology in market [3]. In case a firm identifies their potential faults, this is beneficial for this company to mitigate

those issues significantly to enhance their performance. Digital twin technology helps a company to make better informed decisions about lifecycle and maintenance process in workplace. Several types of industries are benefited by this digital twin technology such as: manufacturing, construction, energy, healthcare and automotive. Residential, commercial and infrastructure projects plans are made by construction companies. Entire manufacturing sector lifecycle of an industry from designing and planning to maintain existing facilities is managed by using digital twin technology [4]. Better and modern plans for those projects are supervised by this digital twin technology.

MATERIALS AND METHODS

A blueprint of a study is gained by research design to finish a research work within a given deadline. Relevant and authentic framework of a research methods and techniques are chosen by researcher with help of research design. Various types of questions are available related to a research work; this research design helps to answer all questions in a simple way [5]. Researcher can make decisions related to a research work by this research design. In this study, these individuals use "qualitative" research design to collect accurate and authentic information related to this study. This qualitative research design helps researcher to gather in depth knowledge and data related to this study [6]. Various forms of qualitative research designs are available such as: narrative model, historical model, ethnographic model and case study model. This is advantageous for a researcher to conduct a particular research work. Researcher can easily provide unique insights related to a study by this qualitative research design.

Research approach refers to a framework by which researcher can easily maintain their strategy and process of a research work. Several types of research approaches are available such as: "inductive", "deductive" and "adductive". In this study, researcher uses an "inductive" research approach to provide a rich description of complex phenomena. Relevant and authentic process of a research work is maintained by this "inductive" research approach [7]. Researcher has a responsibility to collect, analyse and interpret data related to this particular study. These individuals can easily provide different meanings of a research work by this inductive research approach. Inductive research approach helps a researcher to achieve aims and objectives during research process from start to end [8]. Several types of theories, patterns and observations are used by a researcher to find answers of research questions.

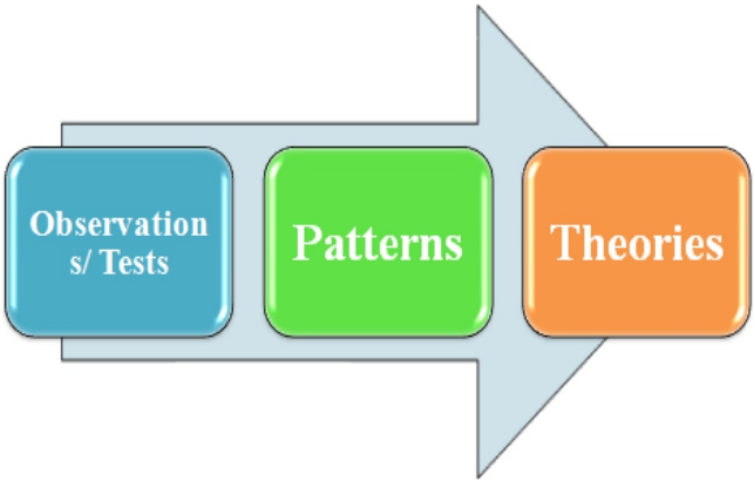

Figure 1: Inductive research approach

Data is collected by researcher to maintain a proper strategy of work. In this study, these individuals collect secondary data from several types of newspapers, online journals and websites. A certain amount of time and money are required for a research work. Hence, a secondary research type helps a researcher to save money and time significantly. Two types of secondary data are available such as: internal and external secondary data sources [9]. Internal secondary resources include databases containing reports from prior research. This research type is economically sound for a researcher to provide their better performance. Quick and faster process of a research work is managed by this particular research type. In this study, researcher includes qualitative research design and inductive research approaches. These individuals collect existing data related to this study with help of qualitative research types. Researcher excludes quantitative research design and deductive research approaches.

RESULTS

A brief idea about digital twin for processes and products

Digital twin technology is effectively beneficial for a company to enhance organisational performance and financial condition. Construction, manufacturing, energy, healthcare and automotive industries are benefited with help of this digital twin technology in market [10]. Existing projects are enhanced by this particular technology significantly. 2D designs are made by architectures for a construction industry. Digital twin technology helps a company to make 3D modelling of buildings. Commercial building managers use digital twin technology to monitor emperature, occupancy and air quality within rooms. Digital twin technology helps a manufacturing company to monitor their machines on a daily basis to maintain their process and strategy of work. This digital twin prototype technology helps a firm to analyse their performance in a simple way. Strategic project planning of an energy sector is overseen by this particular digital twin technology [11]. Performance of a company is managed with help of this

digital twin technology in global market

Performance and life cycle of existing assets are supervised by this twin prototype technology. Digital twin technology helps an organisation to maintain their several types of existing assets such as: refining facilities, wind farms, offshore installations and solar projects [12]. Automotive industry is also benefited by this process. Digital models of vehicles are made an industry with help of this digital twin technology in market. Physical behaviours of vehicles are known to everyone by this digital twin technology. This particular prototype technology helps a company to maintain software, electrical and mechanical models significantly. One of essential parts of a healthcare industry is digital twin technology. Usage of several types of modern technologies and machines are known to everyone by this digital twin technology [13]. Digital twin technology helps a healthcare industry to provide modern treatments to their patients, by which these individuals are attracted by this industry. Different types of digital twins are available such as: asset twins, component twins, system twins and process twins.

A single piece of an entire framework is managed by digital presentation of component twins. Operations of a machine are supervised with help of this digital twin technology in market [14]. Operational managers always try to maintain their performance in workplace with help of this particular digital twin prototype technology. Two or more components are used by a company in a digital twin terminology. This digital twin technology helps an industry to manage a comprehensive framework of a work process. Organisational and financial performance of a company is managed by this digital twin terminology in market. System twins are referred to as a higher level of abstraction from asset twins. A system twin shows different assets work together as a part of a single framework. This visibility of an industry helps to enhance their performance and decision making process in an organised manner [15]. Process twins help a firm to show digital environment of a whole object. Various components and assets are used by a company to maintain their economic growth. Various components are used by a firm in a single framework with help of these process twins of digital twin prototype.

Implementation process of digital twin within an industry

Digital twin technology is immensely advantageous for an organisation to enhance their brand value and brand equity. Every company has aims and objectives to maintain their work process. Digital twin technology helps a firm to achieve their aims and objectives in a significant way [16]. Several types of steps are followed by a company to implement digital twin technology prototype technology. A clear vision of digital technology is an essential step to implement digital modern technology. Every company has a responsibility to create a blueprint of work process in workplace. In case a company maintains these blueprint concepts, employees can easily understand their work strategy. For this reason, these individuals provide their better performance within a company. Operational managers

and human resource managers have a responsibility to manage digital twin technology to maximise value and profitability of an industry [17]. Proper process of a firm helps to enhance rate of production in workplace. Consequently, an industry can fulfil demand of markets and customers by this process.

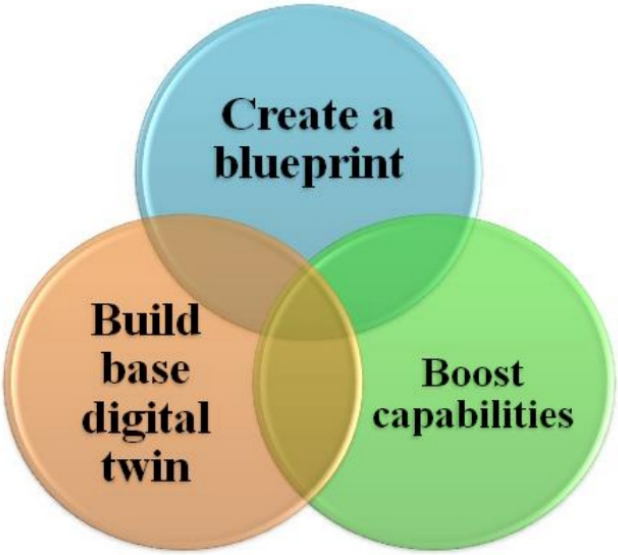

Figure 2: Implementation process of digital twin technology

Second step for implementing digital twin technology is to build a base digital twin during working hours. In case a company implements digital twin technology within a workplace, employees may not be able to use those technologies in an organised way. For this reason, this digital technology is not beneficial for an organisation. Company management team has a responsibility to provide training to their employees about usage of modern digital technology [18]. Basic digital twins are built within a company by this blueprint of work process. Core data products are assembled by this build phase of an organisation. Data team's engineers always try to maintain digital twin technology at time of working. Quality and usability of structured and unstructured data are over seeded by a company by this digital twin technology. This particular process helps a firm to supervise development of visualisations. Digital twin processes help to generate additional data and insights of a company [19]. An early digital twin is supervised by this particular process.

Digital twins help a company to boost their capabilities in a simple way. Consequently, this company can enhance their economic growth by using these digital twin technologies. Smart sensors are used by a company in market to represent real time digital twin technology. Several types of technologies are used digital twins such as: internet of things (IoT) and artificial intelligence (AI) [20]. This IoT helps a company to maintain usage of several types of sensors in workplace such as: vibration and temperature sensors. Those sensors are immensely beneficial for an organisation to gather several types of information and knowledge of work process.

Communication between devices and clouds are managed by a firm with help of this IoT process. IoT

refers to a collective network of various kinds of devices. High bandwidth of digital telecommunication is managed by this IoT framework at time of working [21]. IoT sensor data is transmitted by a firm with help of these digital twins in workplace. Several types of information from real world objectives to digital world objectives are gathered by this digital twin technology. In case a company gathers different types of information and knowledge related to work, relevant work processes are maintained by a firm. AI helps a company to enhance their brand value and brand equity. Every company has a responsibility to maintain their AI, by which a firm can easily earn high profit from market. Sustainability and environmental factors are also controlled by an organisation with help of this AI. AI can adjust to new inputs and perform like human beings within a company. For this reason, AI is immensely beneficial for a company to enhance their performance.

Advantages and disadvantages of digital twin technology

Performance of an organisation is supervised by this digital twin technology. An industry can monitor a constant stream of performance and usage of data in real time. Constant stream of usage and performance of data helps a company to enhance their organisational and financial performance. Digital twin technology helps a firm to enhance their rate of production within a company. End to end asset or product life cycle data is combined with help of these digital twins [22]. Digital threads are managed by an organisation to use digital twin technology during working hours. This digital twin helps to maintain service business models within a workplace. For this reason, a firm can easily enhance their profitability and productivity by using this modern technology [23]. Digital twins help a firm to produce several types of modern products. In recent days, every customer tries to grab better quality and quantity products from market.

In case a company provides better products to their customers, these individuals try to purchase their necessary products from this company.Innovative products are produced by a company within a workplace by these digital twins. Better service business model helps a company to maintain their performance significantly [24]. Manufacturing sector requires innovations in their production. For this reason, modern and unique products are produced by a manufacturing industry. This industry can easily fulfil demand of markets and customers. Supply chain management, services and logistics are supervised by an organisation with help of this digital twin prototype technology. Better supply chain management helps a company to produce several types of products at less time [25]. Green and sustainable raw materials are gained by proper supply chain management within an organisation. Suppliers are an essential part for a company to supply raw materials in manufacturing sector and also provide materials from manufacturing sector to market. Digital twin prototype technology helps an organisation to manage proper supply chains in global market. Sometimes, suppliers may not be able to provide pepper raw materials in proper time, for this reason work process is hampered due to lack of

materials.

Digital twins have various kinds of advantages and also disadvantages, by which a company can easily identify importance of digital twins at time of working. This technology is maintained by proper internet connectivity. In case a company may not be able to maintain proper connectivity of internet, this firm cannot be able to use digital twins [26]. Security process is not managed by these digital twins at the time of working. Company management team has a responsibility to control security of employees in workplace, by which these individuals are attracted by this company. Hence digital twins cannot be able to provide security to employees. Retention of employees is also hampered due to lack of security processes [27]. 3D cad models are needed for an industry to manage digital twin's concepts within a company. 2D designs are not used by a firm for using digital twin prototype technology.

Proper supply chain management is required for a company to use digital technology. However, an organisation cannot be able to manage supply chain in a simple way. Globalisation process and new manufacturing techniques are used by a firm for using digital twins [28]. Every company has a responsibility to control sustainability and environmental factors significantly. Digital twins may not be able to manage design data among all partners and suppliers for maintaining their financial and organisational performance.

Challenges faced by a company to implement digital twin technology

Digital twins are an essential segment of a firm to enhance their performance. Hence every company cannot be able to implement this digital twin technology in workplace to produce better products. A certain amount of money is required for a company to implement this technology [29]. Usage of modern technology is not known to each and every employee in workplace. For this reason, these individuals may not be able to provide better performance. Rate of production and work process is hampered within a company due to lack of knowledge and skills. Every company may not be able to use this technology within a workplace. For this reason, modern strategy and process is not maintained by this company in market. Several types of new designs are available in market; hence a company is not capable enough to implement this particular technology during working hours. Every customer always tries to grab better quality products from market. Consequently, a firm has a responsibility to provide modern products to their customers in a simple way.

This particular technology may not be able to manage relationships between complex objects and simple objects. Physical properties of those objectives are not controlled by a company in global market [30]. For this reason an organisation cannot be able to increase brand value and brand equity. Profitability and rate of production is hampered in workplace due to lack of physical properties of complex and simple objects. Collaboration process is also an essential part of a project work. In case a company fulfils this process, this company can easily enhance their economic growth. Several types of

projects are available market; company management team has a responsibility to identify their necessary project work. A variety of contexts are available, this digital twin technology is immensely beneficial to increase their performance in market. Conflict detection process among employees is not supervised by a company with help of this digital twin technology [31]. Higher authority of an organisation has a duty to maintain their growth and operation process significantly.

DISCUSSION

Digital twins are effectively beneficial for processes and products across the world. This technology helps a company to enhance their rate of production and profitability. Several types of sectors are benefited by this digital twin technology such as: construction, automotive, energy and healthcare. Various kinds of designs are made by architecture with help of this digital twin technology. Only 3D cad models are designed by this technology globally, however customers can easily be attracted by these 3D models. Operational managers of construction industry use this technology to monitor temperature, air quality and occupancy. This particular technology helps a manufacturing sector to monitor their machines in a significant way. Existing assets of a company are controlled by this modern technology. Digital twin technology is advantageous for a healthcare industry to provide better quality treatments to their patients and modern facilities are also available within a company. For this reason, this industry can earn high profit from market and enhance their value and prosperity in an organised way.

Asset twins, system twins, component twins and process twins are available for maintaining this digital twin technology. Various components are used in a single framework by this technology in workplace. For this reason, a company can easily maintain a proper process and strategy of work. Digital presentation of component twins is measured by a single piece of an entire framework. Digital twin technology must be implemented by an industry to maintain their quality and quantity of products. Several steps are followed by a firm to implement this particular technology such as: build a strong base related to digital twin, create a blueprint of work process and boost capabilities of a firm. Every employee must know about digital base technology within a workplace. In case a company engages experienced employees, these individuals can easily build a digital twin base to enhance their performance. Employees get an opportunity to enhance their skills and knowledge related to this digital twin technology.

Digital twins use IOT and AI during working hours to manage their financial growth. In recent days, every company tries to use machines to monitor their work process on a daily basis. Several types of computer systems and machines are controlled by stimulation of human intelligence processes. Four types of AI are available in market such as: limited memory, reactive, self aware and theory of mind. AI helps an organisation to manage cyber security to attract more employees and customers. Digital personal assistants are used by this AI process globally. In case a company gets personal assistants for

using this digital twin technology, a firm can easily maintain usage of this particular technology. Collective networks of connected devices and technologies are referred to as IOT. This IOT process helps to maintain communication between cloud and devices.

This particular concept is beneficial for an organisation to add many devices in a single framework. For this reason, a company can easily collect daily progress reports from workplace by this process. Quality and quantity of products are overseen by a company by this digital twin technology. End to end process can be managed by a firm with help of this particular technology. Every company always tries to control constant stream of performance and usage of data in real time. Business models are immensely beneficial for an industry to attract investments, motivate management and staff. Experienced employees are engaged in workplace to produce several types of modern products within a company.

CONCLUSION

A virtual model of a physical object is referred to as a digital twin. Several types of objectives are available such as: complex and simple objectives. These objectives are immensely beneficial for a company to maintain usage of sensors. Temperature and vibration sensors are used by a company to monitor their work process and strategy. This technology helps a firm to improve their performance. Several types of plants and equipment are used to produce modern quality products. Supply chain management is an essential part of a company for using green and sustainable products. Quality of products is controlled by a company with help of these green and sustainable raw materials.

Usage of inorganic and synthetic products is educated by a firm due to this digital technology. Modern machines and technologies are advantageous for an organisation to reduce production time of products. Consequently, a firm can easily fulfil demand of markets and customers by this digital twin technology. Modern cars are made by an automotive industry in market with help of this technology. Better treatments are provided by a healthcare industry to manage their better performance. Component, asset, system and process twins are types of digital twins in market. Internet of things (IoT) and artificial intelligence (AI) are an important part of an organisation for using digital twin technology across the world.

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The Similarities and Differences between Edge Computing and IOT

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ABSTRACT

This study is based on differences and similarities between edge computing and IoT. Edge computing and IoT application in technological application; both can form specific processing in data transmission. Distribution of information technology can make nearer sources of business computation. Edge computing and IoT are highly related to each other which create an innumerable advantage in the data transaction process. Sensor connectivity is the major work of Internet of things (IoT) technology that is attached with computation to form active specification of network connectivity and transformation of raw data into final data for reliable result. Both of the technological aspects can make data transmission at a standard rate, though there is better specification in the IoT technology. In addition, IoT operates with sensors, helps in the connectivity of multi purposes of networks and big data analytics without any obstacles, though there are less effective chances in the edge computing technology. Edge computing technology is only specific in mobile phone connectivity and in the operating system which may not handle big data analytics within a confidential formation that can be done with the help of IoT.

Keywords: Data, Edge Computing, Internet of Things, Sensor.

INTRODUCTION

Edge computing is signified as the emergence of computing systems that refer to devices and networks for near users. In other words, edge computing is a distribution of information technology in which data of clients is processed at a periphery network which is nearer to source [1]. IT and every business computing can proceed with the help of reshaping of edge computing. Moreover, edge processing data that is closer to enabling at a greater speed and volume to get greater action that results within a particular timing. On the other hand, the Internet of things (IoT) is a physical object that is mainly connected with the internet which is especially embedded with sensors, various software and technologies [2]. This connects and exchanges a lot of data through the internet and this helps in a better approach to transferring information.

There are various types of IoT such as: IoT connectivity management, mobile connectivity, introduction of IoT, use cases of IoT. On the other hand, edge computing also has various types such as: access edge, network edge, on premise edge and internet of things edge. All these types of edge computing and IoT can strongly be related with each otherand help in managing various facilities with internet activities. “Enhanced data rates for GSM Evolution (EDGE)” is popular for the enhancement

of mobile phone technology which performs the activity of data transmission which is compatible with better extension [3]. IoT is a specified collective network to connect many devices and also make acommunication between cloud and devices. In this concern, the computer chips which have high bandwidth telecommunication are able to connect many machines at once. This needs high connection with peers, in which every computer engineer adds sensors that help in internalconnection.

Edge computing helps in making better transmission and also enhances efficiency. This helps in improving security, increasing uptime with decreasing rate of cost. Edge computing ensures the storage of data and processes reliable connectivity for cloud applications [4]. This computing can allow the major application of IoT at the time of low bandwidth connectivity and bring under normal conditions. On the other hand, IoT allows data to be gathered and proceed within an edge without having to send data back to the datacenter or cloud. Cloud computing or IoT proceedsdata without time-driven, on the other hand, edge computing proceeds with time-sensitivity.

MATERIALS AND METHODS

Secondary data has been gathered with the help of various authentic sources that makes standard information interpretation related to this topic. In this concern, the researcher has chosen qualitative designs that make clear ideas about major topic and can form huge effects on the future study. Qualitative design allows researchers to collect several descriptive informations based on the major topic from authentic sites that immensely help to draw a conclusion [5]. In addition, the researcher also has chosen an inductive approach which helps in gathering appropriate data based on the topic. Moreover, the secondary data collection should be conducted from authentic resources such as peer-reviewed journals that help in evaluating similarities and similarities between edge computing and IoT. The information should be collected from major peer-reviewed journals which are published after 2019. Hence, the researcher should not collect information from other journals that have been published before 2019. The major advantages of an inductive approach are to maintain a huge facility on creating in-depth investigation therefore the researcher should choose this approach. The researcher should not choose a deductive approach which may nor align the topic based on a major framework.

RESULTS

Concept of edge computing

Edge computing originated in 1990 which is an innovative type of computation and allows local processing and data storage capacity. This type of computation helps in making better facilities in Smart manufacturing and in the retail sector with implementation of IoT [6]. There is a wide range of variability which helps in measuring effective computation and this can proceed with closer origin. The

edge helps in verifying major effects on improving security under the circumstances of the internet system. Increasing the rate of uptime can help in connectivity and reliable transmission of data. On the other hand, this computation helps in evaluating cost effectiveness which is advantageous to an authority. Manufacturers of the edge computation can be effective with innovations in Internet of things (IoT) sensors to increase predictive maintenance of tack inventory, major capabilities and monitoring production machinery [7]. This helps in better inventory management and logistics function to have reliable stock.

The edge computing helps in making transmission of reliable data with the help of various sensor connections that improve internet security and make fastest connectivity.Internet of things edge is a type of Edge computing which makes better facility in covering almost all devices that havebeen connected with private and public networks [8]. This can appear with a smart approach with data processing through major mobile phones and simple sensors. On premier edge is also a type of data aggregate device which stores and analyzes requests using the data to localize data processing. Access edge can be defined as the traditional Radio Access Network (RAN) which mainly fixes the function of devices [9]. RAN is a major crucial point that is able to connect every wireless device. On the other hand, the network edge is accessed with IoT edges that specifically connect centralized data and can span a vast set of regions. All of the types of edge computing help in betterment in network transmission which helps to confirm vast centralized data processes.

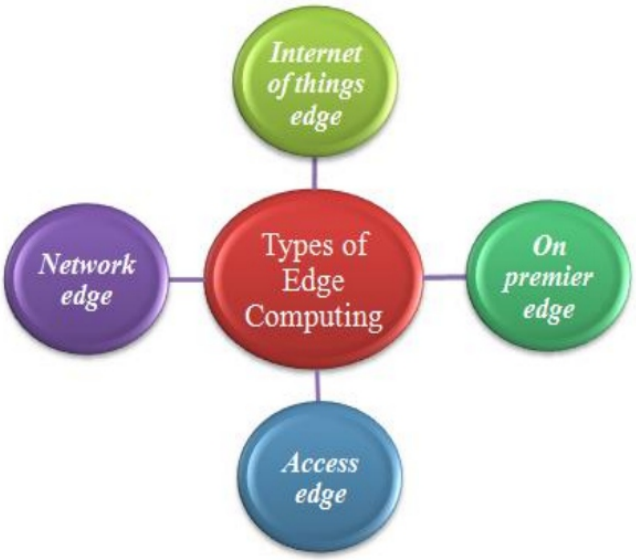

Figure 1: Types of Edge computing

Concept of IoT

Kelvin Asthin is the major inventor of sensors and coined the term “Internet of thing (IoT)” which helps in the description of network connection. The sensor helps in making various transmissions with other machines that make a better effect on the data centralization. There are features of IoT such as: connectivity, scalability, endpoint management, dynamic nature, integration, compact nature of

devices and artificial intelligence [10]. IoT systems are designed with the help of several devices. This can handle workload and can form a demand in a normal state. This system has an active sensor which should be dynamic in nature and able to transform according to major usage. On the other hand, IoT systems make connections between devices and products with cross-domain technology. This major technological aspect is actively engaged with artificial intelligence, block chain technology, cloud computing and more advanced technological upgradation [11]. The raw data can easily proceed with the help of various applications and thus help in verifying the effects of new connections.

IoT integrates several cross-domain technological effects which make a better approach in big data analytics. The entire ecosystem can lead to wonderful experience and strategic development which become more efficient with quality of living. In recent times every technology has come under thedegree of automation that makes business easier. IoT develops various automated technologies which help in easier business that lead to high cultural impact. Security is referred to as the major concern of IoT users that are able to carry out sensitive information and data flowing is the foremost vitality in this system [12]. The resources and investment require being the major conduction in the IoT system. Consumer internet of things helps in application of consumers and major devices which consist of smart phones, wearable smart assistance. This can help in distributing connections and transmission within offices and homes.

Commercial internet of things can make better value with augmenting personal and home environments. This helps in the corporate facilities and utilization of data storage. Industrial internet of things can be defined as the major effect within the association with health care, automotive technologies and logistics function [13]. The infrastructure of the internet of things has a better effect on reliabletransmission. On the other hand, internet of military thingscan be explained as the battlefield objectives that use military setting and situation of the battlefield and this can be interconnected with transmission of various informations toassessing huge responses. This system leverages militaryinformation which is more confidential and may store and transmit easily.

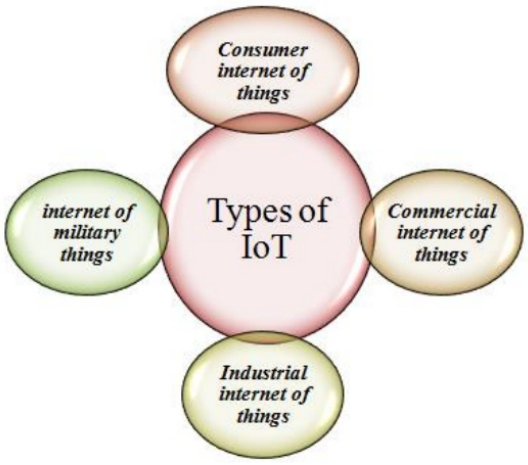

Figure 2: Types of IoT

Relationship between edge computing and IoT

There are various benefits of edge computing in IoT such as: operation optimization, cloud security, employee productivity, condition based optimization, energy optimization, sustainability use, space optimization, personal comfort and asset tracking. Cloud security is one of theaspects of localized analytics that help edge computation and allow reduced data transmission [14]. The data transmission with the help of cloud security can be done with the help of reliable security and IoT devices that are sent between a device and a centralized cloud. Computation helps in making a huge range of data transmission with the help of advanced technologies and better effects of implementation in sensors.On the other hand, device security can be closely related to edge computing that improves data integrity [15]. This is also related to major data connection and greater facility in usage of sensor and cloud technology.

IoT and edge computation both can represent a major shift of data gathering and major analysis of data and information. Edge computation strategy can make localized formation data that can determine proper location based on major connections. In the way of data analytics and big data computation both edge computation and IoT is a vital aspect.This helps in making better identification of high level risksand computation. Edge computation with IoT helps in betterment of various organizational developments and this helps in data transmission to have proper transfer. A normal IoT is referred to as the continuous sending and receiving of data that can easily access various data and information. Latency-sensitive applications can make better placement under the circumstances of beneficial nature of productivity [16]. Edge computing can make better expectations on usageof IoT sensors which perform huge potential impact across the major needs of confidential transactions. This increases data security which needs huge scalability that can form feasible nature in transmission of confidential data or information.

IoT is beneficial with usage of computation and has an impact on closer physical devices that can exist in near location. Edge computing is the local sourcing that helps in betterment of transmission and can produce huge data sources which help in getting faster migration related to IoTsecurity [17]. IoT and edge computing can lead to beneficial activity in transmission which can reduce latency communication between IoT devices and the central IT networks. The combination of both edge computation andIoT can make faster responses within a particular time which can perform operational efficiencies and also improves network bandwidth [18]. Local data processing is also able to be implemented with the help of various integrations and thisallows the taking up of rapid decision making through analytical algorithms. A gateway of IoT can transfer data from edge to cloud centralization which processes local data at a huge rate.

The cloud computing model can help in easy computation resources and services that lead to large centralized data centers. Cloud can provide better facility in the portion of development of network

infrastructure which requires making a connection between IoT and internet [19]. Edge devices in this concern help in making centralized locations for different purposes that allow remote management. Edge computation helps in the automation instruction which forwards network telemetry and this needs more traffic for connecting more peers that leads to high transmission. This sends data sources which are analytically stored in a less time consuming way for accomplishing business objectives. Inthis computation system IoT technology can perform greatly to have better cloud services that transfer data from one device to another devices through proper transformation of data from raw one. The edge device sending is a log of decisions that back to datacenters for managing data with big data analysis.

Differences between edge commuting and IoT

There are various differences between edge computation and IoT which can form quite different from each other in the way of device capacity, software, IoT edge, data processing and bottom line. In the device capacity, IoT applications must be enabled with internet capability and there are IoT devices that also have sensors that can transmit and receive several pieces of information [20]. This is the optional edge computation device which focuses on the major data gatherings. The IoT device has a particular function that can be handled with the normal computers and easily create data analysis. Another side, IoT cannot manage with the normal computers that lead high resolution devices which can make sensor connectivity.

Software in the IoT system cannot have a better facility with having an operating system. The IoT software is not required with memory management as this is hardware association with operating systems. On the other hand, the edge computation has PCs with an operating system along with memory management and major processors [21]. Cyber attack and vulnerabilities have fewer chances in the application of IoT, though there is the highest chance of having a prone attack in cyber with the usages of edge computation. In this concern, the major transmission can lead data processing under the systemic power of many functions with the help of combining IoT and edge computation. The data processing in the IoT localization is specified withdifferences between two technologies. This happens locally to gain a better effect on computation. On the other hand, edge computation cannot require internet enabled which is a must in IoT.

Edge computation can be used within the multipurpose variability that can easily proceed with a positive impact onthe data transmitting. There is high resource efficiency in the IoT rather than edge computation. The resource efficiency in edge computation is moderate which uses or usage of device [22]. In addition, cloud data processing is used in IoT and local data processing is used in edge computing .In the storage and processing, the IoT has centralized storage facility and edge computing has decentralized storage capacity. Hence, centralization can cause vulnerability and huge cyber

attacks which may confirm the major effects on huge competition. Moreover, the centralist formation cannot allow any attacks in cyber as data protects at a high storage capacity with strongest key codes. The edge computation cannot make hardcore pass code which may not be created a better facility in the way of highest storage capacity. The IoT performs specific functions which help in managing proper transaction and data transmission.

Edge computing cannot lead to a high priority of issues though there are huge effects on the operating system. On the other hand, IoT is mainly used in confidential formation which makes better facility and major perfection with data variability and transmission. IoT software devices are able to run at a single execution which can run a single amount of programme that may form machine technologies to get betterrequirements with the management of supporting activity with high prioritization impact on the data transmission. On the other hand, small edge devices can bring considerable effects on reaching internet facilities in which the sensor is a vital part which takes to the real world.

Cloud computing is common in recent days which create a new dimension and which traditionally means data storage and major service provision. On the other hand, edge computing is rapidly emerging within various fields which have conventional application in business operations.

Resource limitation, efficiency in transmission, functionality and another networking edge can form huge complex network based factors that form better cloud computation [23]. The "Internet of things" mainly depends upon wearable sensors attached in the edge computation for effective computation. Edge networks can make significant power that takes place with usage of large numbers of wearable sensors with computational power. There are some edge computing paradigms: distributed deep learning, big data analytics and IoV (internet of vehicles) [24]. The network representation technology has significantly contributed various edge tasks that are useful to the major business operation.

Internet of things edge is the type of edge computing which combines workout with the sensor system which has made different conditions in connection between public networks. Access edge and network edge is especially defined as specification between different devices that assist in vast development throughout the environment. In this concern, RAN is a major and crucial thing in the connectivity that helps in the networking ability and also creates a mobile networking system.

DISCUSSION

Edge computing is an innovative type of computing which can form local processing and transferring data with huge storage capacity. This helps in active and many manufacturing facilities in data transmission to get better connection between human and machine. This innovative girth can help in the wide range of variability that creates an impact on improving security under the circumstances of reliable transmission. Manufacturing of edge technology in computation develops innovative internet connections that form a better culture in the working environment and also conduct monitoring

facilities. This is active in the formation of sensor connection and computation to get better data processing. Logistics function can be grown up with the help of the application of sensors which regards the profitable effort to get fruitful results [25]. Mobile phone technology and transmission process through the internet can be depicted with several public networks that simply use sensors.

There are several types of edge computing such as: internet of things edge, access edge, networking edge, on premier edges which are formed to better approach data transmission and connectivity. All of the typos of edge computation are specific and efficient in connectivity, though internet to typing edge is specific with the application of sensors. The RAN technology is the network that creates a connection between different types of devices with the activity of various functional devices. This helps major transmission to make a huge impact on centralized data processing. The data processing leads to the reliable connection between several devices which make feasibility in traction of raw data. On the other hand, IoT can meet better facilities in the way of reliable data processing which assists in the data transition process with low rate of fraudulent activity.

There are some features of IoT which can help in maintaining big data analytics and data transmission. In this concern, scalability can form a better approach in traction porches of data which need high yielding variety and variability to manage the results within a normal state addition, the IoT system can form results which are highlighted with cross border technology. “Internet of things is depicted with the demand of a normal state that actively engages with artificial intelligence. Stimulation of human intelligence with connection within machines and computer systems is determined with artificial intelligence [26]. This has an important connection with the Iota as the sensor connectivity is conducted through specific recognition of machine vision. This intelligence can lead to application of block chain technology and confidential computation facilities to have huge and protective results. In this way, the major technological implementation can form with active processes.

IoT and edge computation can make a representation with a major shift of data gathering that cannot create data overlapping. Edge computation and IoT both can create effective results on advanced technological development which create a feasible impact on large data analytics. The advanced technological innovation can deliberately create detection of high levels of risks. Hence, both edge computing and IoT can highly be initiated in faster responses for centralized formation of local data sets. Cloud computing models can form better chances in the data transmission which assist in the large centralized data formation. There are some differences between IoT and edge computation which is especially depicted with the requirements of cyber security, software usage, data processing and more. In all of the differences, the edge computing technology can not have a proper effectiveness in data transmission rather than IoT.

CONCLUSION

IoT can be of various types which form a major system of connectivity and this leads to better effect on data processing.In this concern, industrial internet of things impacts upon automotive technological application which aims at implementation of reliable connectivity, this connectionleads to betterment on conference calls from faraway commercial internet of things can form authentic and huge responses to have specific leverages. This leads to the effectiveness within social media networks that make huge responses in the data transmission. The Internet of military things is made an interconnection between battlefields and assessing responses within easy transmission. There is a best relationship between various data connections which can make a better debut on localized formation of data. On the other hand, there are various differences between edge computation and IoT.

In IoT the technological processes are sensor effects which are missing in the edge computation. In this concern, the major effects can be highlighted with the help of adoption of technical implantation which needs high resolution back up.

On the other hand IoT cannot make better effects with application edge computation as there is less effective chance on storage facilities. The data processing power in IoT is higher than in edge computation. Cloud processing can make a huge change on the application of sensors and this gets an effective result on data transmission.

IoT performs a specific function which creates a huge effect on the technological requirement that form single execution and variability which is the vital part of the real world. Edge computation mainly operates within an operating system; on the other hand, IoT is not continued with the help of an operating system. “Enhanced data rates for GSM Evolution (EDGE)” is an effective aspect in edge technology which is a popular enhancement in mobile technology. However, this cannot form analytics of large data base; this can be done with the help of IoT in which sensor touch is a major specification.

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Fundamentals of Designing and Building Cloud Environments

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ABSTRACT

This following study is based on the fundamentals of designing and building cloud environments and all types of valid data has been collected to evaluate study in a proper manner. At the beginning of the study, an introduction of the cloud environment has been depicted in proper manner and in this section; the concept has been clarified by collecting valid and reliable sources. Also, several types of data have been gathered which are related with the use of cloud environments in IoT devices and several types of business organizations. The data which has been collected for this study is secondary by nature and the data has been collected by following a qualitative approach. Also inductive research design has been followed in this following study. For this following study, three themes have been developed and first theme is based on the concept of the cloud environment and then the importance of cloud environment in IoT devices and business organizations have been showcased in a proper manner. Also, the use of cloud computing has been discussed with elaboration and the fundamentals of designing and building cloud environments has been depicted with valid insights.

Keywords: Cloud environment, cloud computing, IoT devices, business organization.

INTRODUCTION

Cloud environment has been used in IoT devices in a major way and cloud environment is an important feature which must be developed in each and every IoT device in the present situation. Majorly, in a cloud environment, customers can be able to deploy and conduct their software applications on such infrastructure which would be sophisticated and which would be owned and regulated by a cloud provider such as Google cloud platform, Microsoft azure, amazon web services etc [1]. Cloud environments can be implemented as the sources of cost reductions and one of the greatest cost savings is the inclusion from capital expense to optional expense as well. While developing the traditional environment, the infrastructure and equipment have to be purchased for the future. This equipment for cloud environments have been generally purchased as the segments as the capital budget of a firm. Basically, it is immensely less hectic to get operational costs accepted than to gain approved capital expenses.

In cloud environments, one of the most prevalent and initial issues for firms in illustrating strategies is compliance which has been provided as the physical and virtual infrastructure of the cloud can be trusted easily. Specifically when those infrastructure elements are owned and regulated by external services providers, the physical and virtual of the clouds can be trusted [2]. For several business functions, majorly run within cloud, conducting websites and web oriented wikis, for example- it is

often enough to have a cloud provider vouch for the security of the underlying infrastructure. Also, for critical business processes and sensitive data, however, the attestation of their party generally is not sufficient. Additionally, traditional cloud environments have been constructed by implementing utility storage and utility computation and these are basically more cost effective than specialized elements. It can be stated that the use of cloud environments can be used as retaining all the crucial files with an unencrypted manner.

MATERIALS AND METHODS

As this study is based on the fundamentals of building and designing cloud environments and in this study, some crucial factors have been maintained and implemented to provide the depth of the subject matter. This study has been filled with several insights which are related directly with the following topic and all types of data have been collected from authentic sources which are related with the impact of cloud computing in a certain manner. Also, all the insights are based on these topics which are capable of serving the importance of cloud computing in several kinds of IoT devices. Furthermore, the designing and building process of the cloud environment has been depicted with the help of gathering proper insights.

For the following study, the secondary data has been collected and implemented to bring proper type of execution to the study and all the sensory data are closely related with this topic of the study. Later on, the secondary data has been collected by following an inductive method that is actually appropriate to the subject matter. An inductive method has been generally chosen to execute the secondary data and therefore, this method has been followed within this study. Furthermore, in this following study, the qualitative research design has been selected and used to depict the depth of the subject matter.

The reason behind choosing qualitative research design is based on the type of data that has been gathered for this research work and to execute more than one factor at the same time, this research design has been selected. As secondary data has been collected, the research type is secondary for this research work. There is another criteria which has been followed in this study and it is the inclusion and exclusion criteria for this research work. For this following study, the primary data has been excluded and secondary data has been included to provide proper type of execution to the study. Lastly, the reason for choosing this subject matter as the core topic is to showcase the concept and usages of cloud computing in every aspect of a business.

RESULTS

Theme 1 Concept of cloud environments

Cloud environment intends to depict a shared pool of computing resources which are configurable in a

certain manner and which can be used as storage, servers, applications and services in several types of IoT devices. Also, cloud environments describe a bunch of systems and producers maintaining and acting together to give services in such a manner that are actually not connected with the underlying hardware or software which have been implemented for a certain reason [3]. There is a type of conflict between the microstrategy cloud environment service and the cloud platform license which are known as microstrategy cloud environments service terms.

Generally, there are four types of cloud environments which have been used in uncountable IoT devices. The types are as follows- private clouds, public clouds, hybrid clouds and multi clouds. Also, there are three types of cloud computing services which have been used extensively and the parts are as follows- platform as a service, infrastructure as a service and software as a service [4]. Furthermore, the clouds environment guides to two various types of clouds which are globally recognized as private and public clouds. The public cloud environments are those that give IT services to any consumers with the help of the internet and on the other hand, private clouds give IT services to a preoccupied bunch of customers with the access via the internet or through private networks.

Cloud environments implement remote servers to save and occupy the valid data like, files, business related data, videos or JPG files. Users upload data to the servers through a web connection where it has been retained in a virtual machine or in a physical server. Generally, cloud intends to entail an extended list of instruments and strategies but the major traits of cloud computing remain the same. In present situations, cloud computing expands from infrastructure to software as a service models and everything involving artificial intelligence, containers, server less commuting, different types of databases, IoT, analytics, business applications and dedicated networking [5]. These following subsets have their own advantages and issues but many major features of cloud computing have been underpinned by all of them. Thus, there are several types of traits which can be explained by several users of cloud computing. As the first trait of the cloud environment, the non-demand self-service has been counted in an extensive manner.

On demand self-service is one of the common traits of cloud computing or cloud environments which can be considered as the primary characteristic of a cloud environment in an effective manner. For example, AWS, Google cloud, Microsoft azure and other types of public cloud platforms create resources that are available to the users at the click of a button or API call. With the help of data centres across the globe, these vendors consist of a vast amount of computational and storage assets within a quick and ready order [6]. This particular aspect portrays a radical departure for IT teams which are relatable and closely connected to on-premises procurement procedures that can take months to execute. There is another trait of cloud environment which is the resource pooling and it has been regulated majorly by the public cloud providers. Public cloud providers are dependent on several tenant architectures to regulate more users at the same time. Therefore, this is the concept of cloud

computing and act accordingly.

Theme 2 Importance of using cloud environment

Cloud environments or cloud computing provide a business more flexibility and visibility in the existing marketplace and increase market recognition of that company in a certain manner. An individual can rapidly range the required resources and storage to meet the requirements of a business without having to invest in physical infrastructure. Also, the companies do not require to purchase or construct the infrastructure required to support their highest load levels [7]. Also, the cloud infrastructure intends to support environmental productivity, powering virtual services rather than physical products and hardware and mitigating the paper beats, developing efficiency of energy resources and reducing computer oriented emission can occur in a more successive manner.

Later on, cloud computing has been ranged around for approximately two decades and from data pointing to business effectiveness, cost advantages and competitive advantages it retains a big part of a business group that regulates without it in a continuous process. Most of the businesses are implementing cloud environments technology in one capability and decide to use cloud computing solutions at some crucial points. In the same aspects, the companies that invest in big data, mobility, cloud and security, can be able to get faster experiences than other competitors in the existing marketplace [8]. In addition, cloud computing or environment is a term that has achieved a large range of implementation over the last few years. With an extended increment in the implementation of data that has accompanied with Al transition of social inclusion in the present era of the digital world.

There are some leaders who remained hesitant about committing to cloud environments or cloud computing solutions for their organizations. Thus, there are several types of advantages of using cloud environments or cloud computing in a business and benefits are as follows

Cost effective

In case a business owner is worried about the price tag that would come with creating a switch to cloud computing, that owner is not alone because most of the companies are aware about the primary cost of using a cloud based server. In case those who are trying to measure the benefits and issues of implementing the cloud, it is needed to consider several aspects than just primary prices they actually to considers ROI [9]. Once an individual on the cloud, ways to get entered to the firms' data would save time and money within project start up. For those who are actually thinking about that they will execute the process for paying for those features neither wanted nor needed and most of the cloud environment services are paid as per the demand of the business owner.

Security protocols

Several types of firms have a variety of security awareness while the process has comes to adopting a cloud computing or cloud environment solution. After all these aspects, files, programs and other types of data are not retained in a secured form. For one thing, a cloud intends to conduct full time jobs which are actually observed security and which is particularly more effective than conventional in house systems [10]. By implementing encrypted protocols, insights are less accessible by the threat or anyone who is not authorized to view the data.

Flexibility

A business consists of only a limited amount of attention segmented among all of its responsibilities. In case an existing IT solutions are making force to be able to commit too much of a business attention to computer and data storage problems, then a business is not going to be able to focus on fetching business objectives and satisfy the customers in an effective manner.

Insights

In the era of technology implementation and digitalization, it is becoming clearer that the ancient concept of computational forces is that knowledge is power and it has occupied more modern and adequate forms in an impactful manner [11]. Hidden within several bits of data that have surrounded by the consumer transaction are considered as the nuggets of invaluable, actionable insights of a business process. Also, several storages of cloud based solutions give extended cloud analytics for exponential views of the data.

Mobility

A cloud environment intends to give a permit to mobile access to the corporate data through smartphones and devices which accept over several smartphones which have been implemented across the globe. Employees with hectic schedules or who have lived a prolonged way away from the corporate office can implement the features to retain instantly up to date with clients and co-workers.

Enhanced collaboration

In case a business consists of two employees or more, then a highness owner should be creating collaboration with an effective prioritization. After all these aspects, there is not much point to having a team in case it is unable to perform like a team does [12]. Cloud environments create collaborative features to make a process simpler and team members can observe and share insights easily and protectively over a cloud based platform. Some cloud based services even give collaborative social spaces to get related with the staff over the firm and thus enhancing interest and involvement within the

organization.

Quality regulation

There are some things which work as a determinants to the success of a business as fragmented quality and disrupted positioning within a business. In cloud environment systems, all files are retained in one place and within a single format. With everyone accessing the same insights, a business owner can be able to maintain the consistency within data, to ignore human mistakes and have a clear record of any kinds of observations or updates. Consequently regulating all types of insights in silos can guide the employees accidentally saving various versions of files which lead to difficult, confusing and diluted data.

Disaster recovery One of the major aspects that give to the entry of a business is regulation or control over the business. Successive business control can be controlled with the contribution ofdisaster recovery. One of the factors that can maintain better cloud computing technology is controlled with the complete management of recent trends of the market. Business can maintain at the time of lost productivity, revenue growth, and brand reputation. The downtime of the market can get less effective and this can be anticipated with cloud based technology.

Loss protection

In case a firm is not investing within a cloud environments solution, then all of the business valuable data which is inseparable is tied to the offices desktops in a certain manner. This is more basic issues than an individual business owner who ends up permanently losing all the data in an adverse manner. In case a business owner is on the cloud, that individual is at risk of losing all the insights that have been needed by the owner and can be increased in a certain manner. It can be rather stated that cloud computing or environments can be used as the key player of loss protection.

Sustainability

In the present state of environment, it is not sufficient for a firm to place a recyclable bin within the break room and claim that the firm is doing the possibilities to help the planet in a more superior way. Authentic sustainability needs solutions that denote wastefulness at every stage of a business [13]. By conducting over the cloud is more preferable for the mature and it causes less rate of carbon footprint.

Competitive advantages

When the cloud environment or computing has been increasing with recognition, there are still those who are eager to retain everything within a regional aspect. That is the choice but making place for the

process of cloud computing at a different disadvantageous phase when competing with these firms which has the advantages of the cloud.

Figure 1: Business outcomes of effective cloud initiative

By using cloud environments in an organization, there are 69% benefits which turn out to be the benefits of a company in a successive way. On the other hand, expansions within new industries and improved customer experiences have increased the use of cloud environments by the rate of 76% and 74% [14]. Also, the benefits of investors for the use of cloud computing has been increased by different phases of business organization and the phases are as followsexpanded services and product portfolio, crested new streams of revenue, enhanced present revenue and reduced operational costs. The rate of optimizers for the use of cloud computing has been increased by the rate of 60%, 59% and 58% in various types of phases of optimizers.

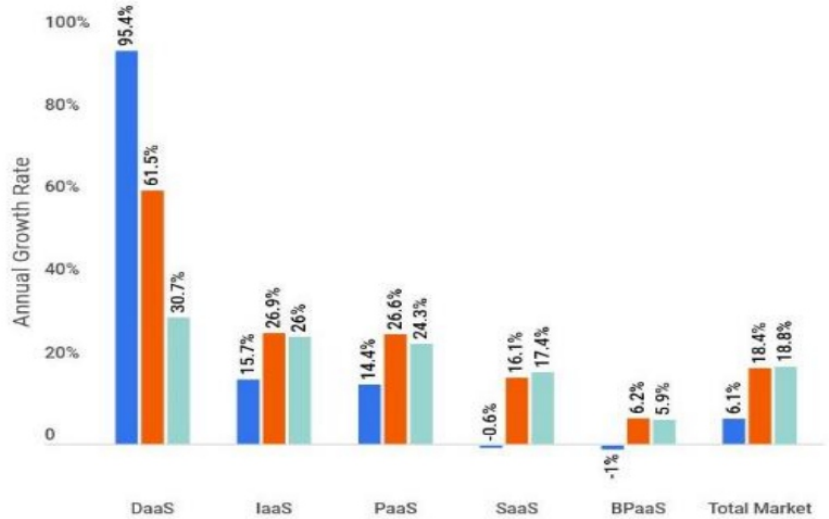

Figure 2: Annual growth rate of public cloud environment services

In the year of 2021, spending over cloud environments has been enhanced by the rate of 35.3% and it has increased over the years till date. In the year of 2020, the net spend over cloud computing was $191.7 billion [15]. The trends of using cloud environments in different types of IoT devices exceed, the amount of spending on cloud computing is $200 billion by the end year of 2022.

Theme 3 Fundamentals of designing and building cloud environments

The cloud computing or cloud environment architecture has been crafted in such a way that it can be able to solve any sorts of latency problems and develop the need of data processing in a certain manner. Also, it helps to mitigate IT regulated cost and provides effective accessibility to access data and digital; instruments [16]. With the help of designing and building cloud environments, it becomes easier to range up and range down the cloud resources in an effective manner. There are also some basic fundamentals which can be denoted by the use of cloud environments and fundamentals are as follows- storage, compute, database, networking and security.

Instead of observing and provisioning the server and effectiveness of the connection within a local data centre, a business owner can be able to outsource the computing power which has been required by the servers from a particular cluster of virtual machines within the cloud environment. Whereas the major benefits of storing and maintaining the data within the cloud is a convenient way of enhancing the storage capability without regulating and purchasing more regional hard drives [17]. Also, the database is a type of system that retains and regulates structured and unstructured insights with the help of implementing cloud environments within the business organization.

Furthermore, the cloud is an extended ecosystem of computing devices that helps to connect and extend the networks with each other to provide a service to the consumers. Cloud environments services providers assure that they always regulate and retain the network's authentication and connection within the infrastructure to support the needs of the end users. Also, an individual can be able to give global links and bonds to provide the application all over the globe. In the cloud, data has been retained in a protected from within a remote data centre [18]. This describes that attacks and threats such as theft and data breach have been often going to happen. As a cloud environment a user, it is the responsibility to manage the data by maintaining a top most priority. Also, the cloud has fixed up all kinds of tools to help a user with enforcement of effective security protocols within the IoT devices.

These are the basic fundamentals of designing and building up cloud environments within a business and thus, it can be able to depict the importance of using cloud computing within a business organization or any sorts of IoT devices in a more effective manner.

DISCUSSION

The study is based on the fundamentals of designing and building cloud environments and the study has

been evaluated and finished with the help of such data which related and represented the authentic insights for maintaining cloud environments within a business program. Based on several insights and data which are related to the cloud environments and cloud computing, crucial themes have been constructed to flaunt the intensity of the subject matter. three major themes have been constructed which have been developed based on the importance of cloud environment and cloud computing in a successive manner and all of the themes have been developed by consisting crucial topic related insights. The first theme is based on the concept of cloud environment and the theme has been showcased in business organization and IoT devices.

The concept of cloud environments has been discussed elaborately in the study and also, several types of formats of using cloud environments to increase the rate of storage has been illustrated in this section. Furthermore, the second theme has been developed on the importance of using cloud environments and within this theme, different kinds of importance have been showcased in an illustrative manner. The importance of cloud computing has been depicted as a cost effective factor which has been used in several types of IoT devices or business models. Also, the cloud environment can be used as the factor of disaster recovery which is a huge part of a business organization. The last theme is based on the fundamentals of designing and bundling cloud environments which is majorly used as a key player to maintain and increase the rate of storage in IoT devices.

CONCLUSION

In the following study, the subject matter is based on the fundamentals of designing and building cloud environments and this study is filled with authentic sources and real context which are related with cloud environments and its importance. With the help of this study, several types of usages of cloud environments have been served which are immensely important to understand the basic needs of an IoT device and business organization which contains data which is supposed to be encrypted. Also, by using cloud environments, a particular business organization can be able to get competitive advantages and retain the data while maintaining priority within the business in an effective manner. Also, there are several fundamentals which have been depicted for the use of cloud design and building in a certain manner with the help of valid insights. With the help of highlighting the fundamentals, the actual importance of the cloud environment has been showcased within this study. Through collecting secondary data, the importance of the cloud environment has been served within a proper manner.

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Green Cloud Computing and Its Role in Reducing Carbon Footprint

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ABSTRACT

Green cloud computing has been used in many sectors like the manufacturing sector, service sector and in the information technology sector. There has been tremendous technological development in the cloud management technology and in the due process some of the companies had made a significant impact and those are like Google, Azure and Amazon. This discussion has given the importance of the green cloud computing in reduction of the carbon footprints. The first section of this discussion has talked about the background about the research topic which is here reduction of the carbon footprints with the green cloud computing. The next part that had been discussed here is about the material and method section where the research design qualitative has been used. The research type that has been used is secondary and the data has been collected on the basis of secondary data collection method. After the material part the results section have been discussed and with respect to the topic where the important graph has been used and it had been interpreted with the topic. Finally, the discussion has been concluded with the brief discussion part which had provided all the necessary findings.

Keywords: Green cloud, carbon footprint, technology

INTRODUCTION

Cloud computing in the modern technological era can be explained as the availability of the computer system resources like the storage of data and other power for computing and it should be on demand supply. In today's computing there are three four types of cloud computing and they are like the private clouds, public clouds, hybrid clouds and multi clouds [1]. According to the data storage capacity they are used by different entities as the data that are stored by the government is enormous and they definitely need a cloud which can store billions of information with proper security. Today, the computer has become the crucial part of the working sector whether it is the commercial or it is the service sector. Computers are used in each and every workplace exclusively also in the manufacturing industry for ensuring the quality [2]. Managing all these business operations the cloud technology can help to manage the useful data storage and can be accessed in future. Moreover, the cloud technology provides the agility and flexibility in the working process as well as it delivers the digital transformation which is vital for the business operation. Some of the popular cloud computing service providing countries is Host winds, Clouds, Hostinger, Amazon web services are the example of popular cloud services providing companies.

Green cloud computing is a term which basically refers to the benefits to the environment that will be provided by the IT services over the internet to the society. It can be implied in the process of the business cooperation and they are like purchasing the environmentally committed companies, should participate in the recycling of the electronics, using the virtual reality and augmented reality technology and limiting the use of the paper and use only recycled papers [3]. This is the whole concept of the green cloud technology and it is going to be key technology that will help many industries in future to become sustainable. Today there are many applications which help with paperless transitions like PayPal, Google Pay and other technology [4]. Today many of the IT companies have become paperless and all the work is done in the online workspace. The technology that has been providing these services is like the Google drive, Google sheet and all the products that are provided by Microsoft. If the working space will push its business process more and more paperless and the increase in online connectivity can help to reduce the use of the paper. In this way the deforestation can be minimized and therefore the carbon footprints can somehow be less. As the minimization has been minimal but at the same time it is important to take collective steps in all the domains so that the carbon footprints can somehow be reduced. The use of green cloud technology like virtual technology can also help a company to reduce the carbon footprints as each and everything changes that are made in the virtual world have no correspondence with the real world.

MATERIALS AND METHODS

The research design of the given research topic is qualitative research design and it has been chosen taking in consideration of the significance of the research topic. The given research topic is based on green computing and its role in reduction of the carbon footprints that have been created through various processes. A qualitative research design can be defined as the type of research design which focuses on obtaining the data from the conversational communication and open end sources. It does include some of the quantitative data and which will be used further which will be interpreted with the research topic not calculated.

Research type is the term that is often used to explain the significance of different methodologies that have been used for preparing a research study. There are various types of research type and according to the research topic the research type is chosen and taking in consideration of this research topic the research topic that has been used here is secondary research type [5]. The given research topic has included to show the significance of the green cloud technology in reducing the carbon footprints. It will need to study the concepts of cloud computing as well as green cloud computing. The best possible way to explain this will be the secondary research type hence it has been taken here in this research topic analysis.

For any of the research the data is the most important ingredient as without this any of the arguments

cannot be made and it cannot be proved. Therefore, in this research the data has been collected on the basis of the secondary data analysis which includes the theoretical data collected from the research of others, journals, and books. After the data collection part the next part is the data analysis and in this research studies the data that has been collected is analyzed with the help of thematic data analysis method. Thematic data analysis is the type of data analysis method which is often used in the qualitative data analysis research type [6]. In this the data are basically analyzed with the help of preparing the themes based on the research topic.

Table 1: Inclusion and exclusion criteria

Inclusion criterion	Exclusion criteria
• Collected data has been analyzed with the help of thematic data analysis. • Authenticated and recent journals article have been taken for the research. • Both the research type and the data collection method being the secondary.	• Quantitative data analysis has been excluded from this research study. • Old and out-dated articles have been excluded from this research. • Primary data and research type has been excluded from this research.

RESULTS

Different Green cloud computing technologies and its significance in reducing the carbon footprints

Before actually explaining the green technology the first and foremost important which needed to be explored is the reason behind using the green cloud computing for the reduction of the carbon footprints. The most significant point that is often considered here is that it provides the most efficient resource for provisioning and offers de-materialized the overworking setup. Meanwhile, the green cloud computing technology has three main goals which it has aimed to achieve and those are to increase the efficiency of energy of whatever the device is used, promote the recycling of the materials and reduce the harmful components that are used in IT operations [7]. It can be of two different types: they are like the green hardware and the green software. Most of IT operation includes both the hardware and software and in hardware components, especially the hardware components include the servers, network appliances, storage devices. Along with all these cooling units, power supply units and other such components are included in the green hardware technology. he reason behind security norms of IoT devices is that there are various IoT devices, extending within the security systems which are not possible to maintain [6]. Lack of security integration can be an immersive challenge in the implementation of IoT devices. ***Deficiency of visibility***Users of IoT devices often deploy it without having any sort of knowledge regarding the IT department and this can make a huge impact on the

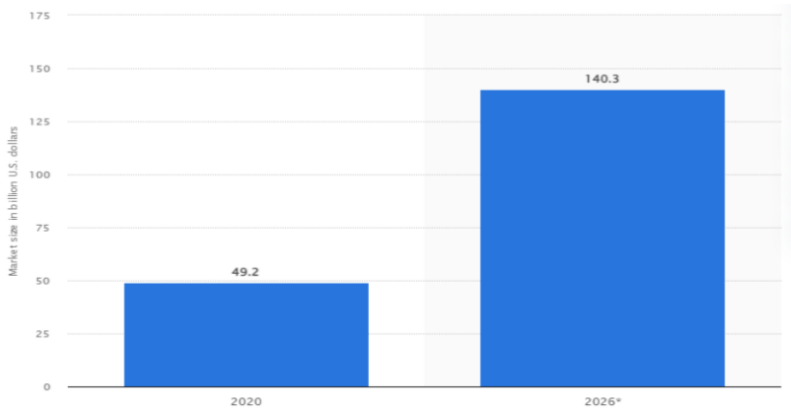

Figure 1: Global green data centre market estimation as compared to 2020 to the year 2026

A graph has been provided in the above section and it is about the global green data centre and the estimation has been in the year 2026. Globally, the green data centre market is estimated to rise in future and hence to compete with the green cloud computing technology is useful. In the year the size of the overall market of the green data centre was 49.2 billion US dollars [8]. In the year 2026 according to statista the overall market size will be around 140.3 billion US dollars [8]. This can only be possible if the green cloud technology is used in the process of the business operation. Global carbon emission has been increasing day by day and the carbon footprints have also been increasing day by day. The global carbon emission has been explained in the figure based on various domains of the human livings.

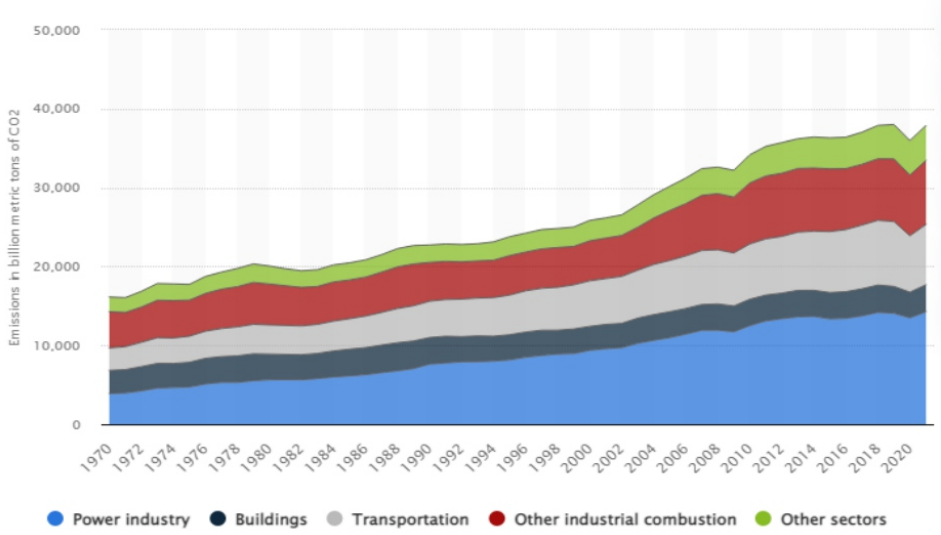

Figure 2: Carbon dioxide emission from the year 1970 to the year 2021 industrywise

As the graph that had been provided it can be said that the highest emitter of carbon being the power and energy sector after that the transportation and other industrial operation. In the year the annual carbon emission for the power industry was around 3879.6 billion metric tonnes but the figure has changed drastically in the last five decades and it had reached up to 14,258.8 billion metric tonnes in the year 2021 [9]. Power industry needs to work more and it can only be achieved through lowering dependence

on fossil fuels as the primary source of energy and power generation. In other carbon forms the industries which are not based on fossil fuels like the IT sectors and the other technological sectors can become sustainable through policies which include the green cloud computing technology.

The green cloud computing technological tools that can be used to achieve sustainable goals are; virtualization, cloud optimization tools and carbon awareness among a larger population. Virtualization can be used in the data centre to reduce the electricity consumption in an enormous amount [10]. Up next is the cloud optimization tools which is often seen as the best to reduce the carbon emission from the process of the business. The best other sources being carbon aware and it includes taking the help from those service vendors who are well aware of the carbon and its reduction that is overall carbon awareness. These are the significance and importance of why the green cloud computing technology has been used in the current business atmosphere especially in the technological sector.

Recent developments of the green cloud computing and its future perspective regarding the reduction of the carbon footprints

Recent developments in the green cloud computing are making more and more developed technology of virtualization, reducing the usage of paper as much as possible, power management and green manufacturing. The importance of the paper reduction can be understood with the help of the globally paper consumption including the education sector, public as well as the private sector through various methods.

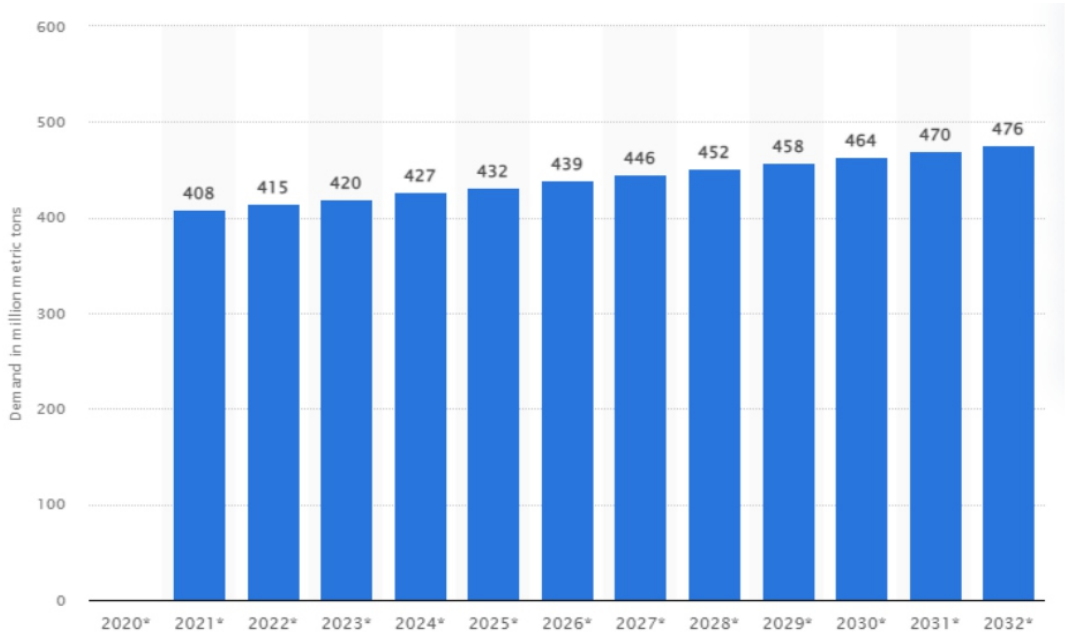

Figure 3: Global paper consumption from the year 2021 to the year 2032

In figure 3 the annual global consumption of paper and paperboard consumption by the companies as well as the other sectors which use. According to the year 2020 the total global consumption of the

paper was 408 million metric tonnes at the same time the deforestation has also increased in the due years. In the year 2022 paper consumption was 415 million metric tonnes and this has been seen to rise further in future [11]. According to statista's projection in the year 2032 total paper consumption will be 476 million tonnes [11]. Hence, it has been clearly stated from the graph that in future the paper consumption would be increased. Therefore, here the cloud technology can be used to reduce those future possibilities with the technology of digitization and soft file rather than going with the hard copy of the document. Virtualization is yet another technology with the help of which the carbon footprints can be minimized as it reduces the use of excess hardware in the operation. In any computing cloud the role of hardware is important but at the same time these technologies have played an active role in cloud computing and made it green cloud computing. Virtual processes at the same time are cost as well as time efficient therefore the possession of virtualization is important.

The overall market size of cloud computing globally as of the year 2021 has seen a significant increase especially after the pandemic as during this period most of the workspace had understood the need of the IT services and clouds. According to statista in the year 2021, the overall revenue that has been generated by the cloud computing services was around 400 billion US dollars [12]. Moreover, worldwide IT services spend around 1.3 trillion US dollars and America is the largest country [12]. Most of the successful tech and IT giants are in the USA but slowly many other nations are also making tremendous investment in cloud computing technology are China and India. As the research and development regarding the technology of cloud computing has been going on in other nations as well and the demand for the green cloud in the future will also increase due to global carbon emission. In future for sustainability the most of the companies will be using the technology of the green cloud technology like the virtualization, reducing the paper and paperless translation and other process for promoting the green technology. In the future the green cloud commuting has focused on reducing reusing and recycling of the goods that are used in the business operation. In the future the society seems to be more curious about carbon footprints and therefore the technology will be explored and more development will be seen.

Global green cloud computing developments in various countries

Globally, there are more than 190 countries and there are further categories according to their technological developments. As it had been figured out that as for the majority of the global carbon emission the countries which are the most responsible are the western nations and still they are technologically advanced than the many of the emerging countries of Africa and Asia [13]. America is the world's largest country when it comes to the size of the economy and technological progress. Most of the green cloud computing technological companies is based in the USA itself like Microsoft, Google and IBM. Today Google has been providing its cloud and it has the capacity to store enormous

amounts of data and its main competitors are Microsoft and Google.

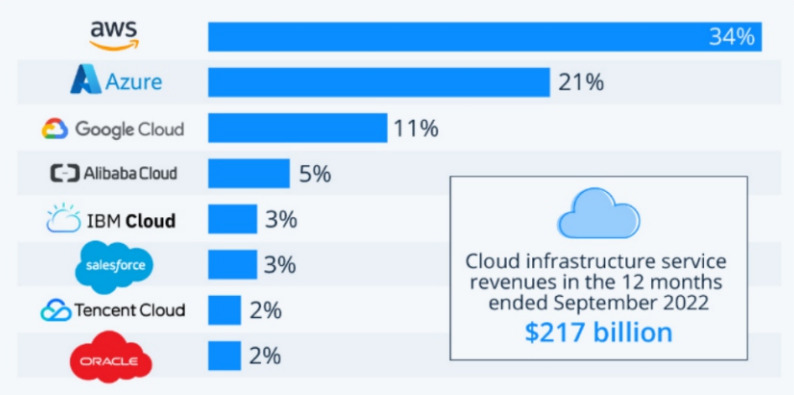

Figure 4: Cloud market Share Company wise

The figure four has been explaining the cloud market share of various companies across the globe which had been estimated to 217 billion US dollars as of the year 2022. The overall market share of the Amazon's around 34% and the company which is ranking in the second spot is Azure with 21% share [14]. After that comes the Google cloud with the market share of 11% [14]. Top four spots have been occupied by the US based companies and the fifth spot has been occupied by the Alibaba group. Amazon, Microsoft and Google are the three companies that have dominated the global cloud computing market despite the challenges that have appeared in the year 2022. The top eight companies that have been provided in the list have been controlling 80% of the market size [14]. During the time of pandemic and the recent geopolitical tension in Eastern Europe the growth has been projected to depreciate further but the company had somehow managed their growth and in the meantime it had grown by 24% [14]. This has been possible only because the process of cloud has aimed to provide more and more sustainable business processes. In terms of growth the Chinese company had performed more or less similar as it had performed in the previous year.

These companies have been operating globally and with their operation they have helped a lot in making the green cloud computing. These companies have however helped to boost the visualization process in those countries which have poor technological infrastructure and are still using the traditional methods in workspace. In the year 2021 the company had generated overall revenue of 19 billion US dollars which is 7% of the total revenue generated by Google [15]. At the same time the overall revenue that has been generated by the cloud of Microsoft Azure has generated overall revenue of 198 billion US dollars and its expenditure on its research and development is around 25 billion US dollars [16]. All these companies have played a key role in boosting green cloud computing and due to these reasons they are generating higher profits. Both Google as well as Microsoft have a clean and clear market image. Both the companies Microsoft and Google have made their process sustainable and due to these reasons green cloud computing products of these companies has become so much popular and it has been used in most of the workplaces. Hence with all these processes it can be said that green

cloud computing can be very much useful in making the process more sustainable and reducing carbon emission.

DISCUSSION

These days the situation of climate change and carbon emission has been increasing day by day and each country wants to reduce their carbon footprints. There are many processes in which the carbon footprints can be reduced and like reducing dependence on the non-renewable source of power generation method and many more. Here, in this discussion the carbon footprints will be reduced by the green cloud computing. It is generally termed as the type of cloud computing which basically focuses on reducing the carbon emission by including the process like reducing the paper in the process, recycling of goods and visualization of the process. All of these are the important part of reducing the carbon footprints instead of the fact that much of the carbon emissions are generated through the process of power generation.

In the results section themes have been prepared on the research topic which is based on cloud computing, especially the green cloud computing and its significance in reduction of carbon footprints. Carbon emissions was never an issue during the time of 1970 as at that time the overall global carbon emission was 3879.6 billion metric tonnes in the power and energy sector but in the year 2021, it had become 14,259 billion metric tonnes of carbon only for the energy and power generation sector [9]. Contribution of other sources has been less as compared to the energy and power and therefore now it has become to minimize the carbonfootprints. Green cloud computing has certain goals and these are to reduce the use of paper in the workplaces and recycle those things that cannot be reduced like using plastic. Single use plastic has use in many of the workplaces and it should be reduced. In the sales industry they have to prepare the bills and have to make the transaction through the offline mode. Using the green cloud computing the payment can be carried out easily through digitally. Digital payments have been carried all over the world and it has also played a key role in reducing the use of paper globally. Coming to the billing part the company had been encouraged to use certain types of software for preparing the billing or preparing the financial statements and those are like the Microsoft excel and Google sheet.

In the corporate sector today especially the corporations which are based on information technology have been performing each and every task in online mode. In these three companies namely Google, Microsoft and Amazon have outperformed in the market and they have been dominating the market. As per the figure that has been mentioned, the top eight companies have been controlling more than 80% of the market share [14]. In the second theme it had been discussed in terms of countries which are the companies which are huge emitters of carbon and how they are technological in the cloud computing technology. It had been found that USA is the country that had performed best infrastructure in terms of

technology of green cloud computing and ironically it is the country which ranks top in terms emitting the carbon dioxide. It can be understood with the help of the forth figure that has been given as major cloud companies are from the USA and Alibaba clouds the lone major cloud company of China.

CONCLUSION

Cloud computing has become popular in the workplace as it possesses certain benefits and those benefits are; it is fast and it is secure. It can hold a large amount of data at a time and it can increase the connectivity among the people who are either working in a workplace or working from a distant location. Green cloud computing is totally new and it has been introduced due to increasing carbon footprints globally. This discussion has focused basically on the significance of the green cloud technology in minimizing the carbon threats. In the introductory section the importance of the green clouding modern day has been given. Today most of the workplace has been using the computer and it has become the backbone of the modern workplace. Programming, preparing the financial statements and planning a project for the future or present are some of the uses of clouds. For each of the processes the importance of computers has been increased and as its use has been increased the data has been increasing. Storing those data the technology of clouds was introduced and for sustainable practice along with reducing the carbonfootprints it had been green clouds were introduced. Some of the popular cloud computing companies are Google cloud, Azure cloudland Amazon's AWS has been used exclusively in the market. All the data has been collected from the website and only authentic data from recent data has been used.

One of the main goals of the green cloud computing is to reduce the paper consumption form the workplaces as according to figure 3 the overall consumption of the paper in the year 2023 is expected to 420 million metric tonnes which is higher as compared to the year 2020. The growth has been phenomenal in the coming year and it has been expected that if the figure goes in this way in the year 2032 the paper consumption will be 476 million metric tonnes. Therefore, by reducing the consumption using the green cloud computing technology can be helpful in reduction of the carbonfootprints. Although the cloud companies of developed has been helping the emerging countries of Asia and Africa to reduce the carbon footprints. Finally, talking about the future perspective of green cloud computing, it will rise further in the future and the main reason is increasing carbonawareness among the people.

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