Chapter 6
Role of Emerging Technologies in Education 4.0:
Challenges and Future Research Directions

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ABSTRACT

Today's Education 4.0 has entered a new era of learning, characterized by the pervasive influence of emerging technologies. Education 4.0 embraces digitalization, personalized learning, and lifelong skill development. Emerging technologies, including artificial intelligence, augmented reality, virtual reality, blockchain, and the internet of things, play pivotal roles in transforming traditional pedagogical approaches. They facilitate personalized learning experiences, enhance data-driven decision-making, and promote global connectivity. However, the integration of these technologies into education faces multifaceted challenges. This chapter discusses the challenges associated with the adoption of emerging technologies in education, including issues related to equity and access, data privacy, teacher professional development, and the need for revised curriculum and assessment frameworks. Furthermore, it underscores the importance of ethical considerations, such as responsible AI use and digital citizenship, in the technology-driven educational landscape.

1. INTRODUCTION

Artificial Intelligence (AI) is the capability of machines to recreate human intellect and intelligence in humans' actions such as reasoning and their knowledge from past experience. AI has been used as an aid to many sections which we will be discussing in the paper such as smart grid, e-healthcare in smart environment. The ai uses multidisciplinary subject's such as linear algebra, statistics, probability, calculus etc., from the fields of mathematics, psychology, computer science etc. it is the mathematics that most often used to model and solve problems using efficient algorithm. Artificial intelligence also works to reduce the work of humans. AI hands-on on with many technologies such as data analytics, Blockchain, big data, IoT etc. AI alone is not enough to build smart environment, since the main work of AI is to take decision according to that particular situation, there need to be many technologies clubbed together with artificial intelligence. Ambient intelligence is part or sub-set of artificial intelligence, since being derived from artificial intelligence, the use of ambient Intelligence can be used in environment meant to build smart environment. Its particular use in building smart environments therefore it was coined the term ambient intelligence. Ambient Intelligence applications can be seen various sectors such as education, hospitality, commerce etc. Blockchain is a type of digital ledger technology which was primarily discovered to cater the needs to serve as the public distributed ledger for bitcoin cryptocurrency transactions, but later blockchain found its way to serve many sectors such as insurance, real estate, voting, logistics, supply chain management, secure internet of things network. Artificial Intelligence after taking decision its task is over the command has to be taken by some technology, for that internet of things was developed for fulfilling the decisions of artificial intelligence using its own in-built sensors. The use of sensing technology and innovative interaction devices interconnected with a network and supplemented with intelligent and context aware software to create useful services for humans in whatever space and time they need support (Molnár & Sik, 2019).

In India, the need for main cities to develop a technology to cater to all the needs of the people in the city which can be viewed digitally is the task. But to achieve it there are many problems for the technology to solve. The rapid development of ICT is constantly challenging the society, the economy and the way of everyday life. This tendency is becoming more and more intensified nowadays. Besides the transformation of basic ways of life, tasks and roles, changes are certain in some elements of the education system (Hajjaji et al., 2021). Combination of IoT, Blockchain, and Artificial Intelligence technologies can be found in Figure 1. Hence, Smart cities are type of framework which is particularly built on the developing the users in the smart city to connect over information and communication technology. It is done because the users must be able to adapt themselves to growing industrialization and urbanization. ICT application are backed up the technologies such as Internet of Things, Artificial Intelligence, Big Data, Cloud Computing and Blockchain. The "smart" paradigm in smart cities is highly motivated by the ability of a city to be environmentally friendly; cities are edging toward conserving the environment by producing less waste that can pollute the environment (Al-Turjman et al., 2019).

1.1 Education 4.0

Education 4.0, also known as the Fourth Industrial Revolution in Education, is a concept that refers to the evolving nature of education in response to the rapid technological advancements and societal changes associated with the Fourth Industrial Revolution (Industry 4.0). Education 4.0 represents a shift

Figure 1. Combination of IoT, blockchain, and artificial intelligence
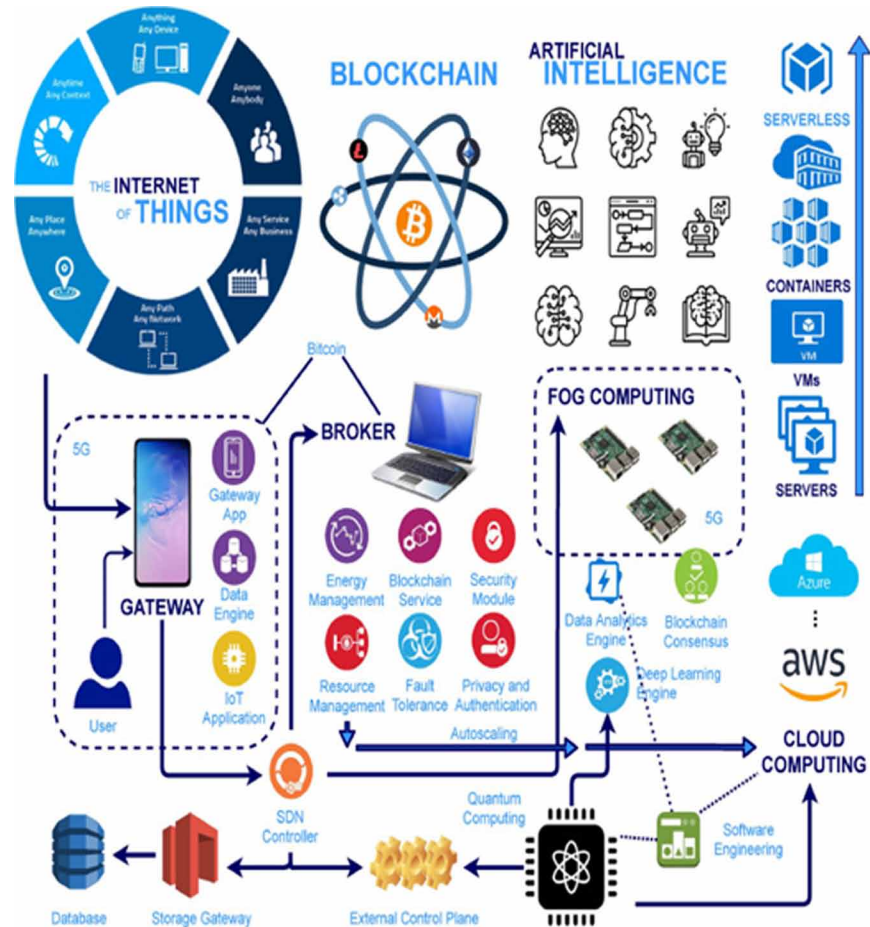
in educational paradigms and practices to better prepare students and learners for the challenges and opportunities of the digital age. Here are some key features and aspects of Education 4.0:

- Digitalization and Technology Integration: Education 4.0 places a strong emphasis on the integration of digital technologies in the teaching and learning processes. This includes the use of computers, mobile devices, educational software, online resources, and digital platforms to enhance the educational experience.
- Personalized Learning: Education 4.0 recognizes that one-size-fits-all approaches to education are no longer effective. Instead, it promotes personalized learning experiences tailored to the individual needs, interests, and abilities of students. Adaptive learning platforms and data analytics are often used to customize learning pathways.
- Lifelong Learning: In the era of Education 4.0, learning doesn't stop after formal education. Lifelong learning is encouraged, and individuals are expected to continuously acquire new skills and knowledge throughout their lives to adapt to rapidly changing job markets and technologies.

- Critical Thinking and Problem-Solving: Education 4.0 places a strong emphasis on developing critical thinking, problem-solving, and creativity skills. These skills are considered essential for navigating complex, information-rich, and rapidly evolving environments.
- Interdisciplinary and STEAM Education: There is a growing recognition of the importance of interdisciplinary education, which combines science, technology, engineering, arts, and mathematics (STEAM). This approach fosters innovation and a holistic understanding of complex issues.
- Global Perspective: Education 4.0 encourages a global perspective, fostering cross-cultural understanding, and preparing students for a globally connected world. Virtual exchanges and international collaborations are often integrated into the curriculum.
- Data-Driven Decision-Making: Data analytics and educational data mining are used to gather insights into student performance, engagement, and learning trends. Educators can use this data to make informed decisions and improve instructional strategies.
- Ethical and Digital Citizenship: Education 4.0 places a strong emphasis on digital ethics and responsible digital citizenship. Students are taught how to use technology responsibly, ethically, and safely.
- Flexible Learning Environments: Traditional classrooms are evolving into flexible learning environments that can adapt to various teaching and learning styles. Blended learning, which combines in-person and online components, is common.
- Teacher Roles: Educators in Education 4.0 often take on the roles of facilitators, mentors, and guides rather than traditional lecturers. They support students in self-directed learning and exploration.

Education 4.0 acknowledges that education needs to evolve to meet the demands of the modern world and equip individuals with the skills and knowledge required for success in a rapidly changing, technology-driven society. It seeks to bridge the gap between traditional education and the emerging needs of the Fourth Industrial Revolution.

1.2 Contribution of Emerging Technologies Towards Education 4.0

In the era of Industry 5.0, each sector has been revolutionized at a higher level and in case the productivity for sustainable environment, also with modern education (refer Figure 2). Emerging technologies play a significant role in shaping and advancing Education 4.0 by offering innovative solutions to enhance the learning experience, improve educational outcomes, and prepare individuals for the challenges and opportunities of the digital age. Here are some key contributions of emerging technologies towards Education 4.0:

- Personalized Learning: Emerging technologies, particularly artificial intelligence (AI) and machine learning, enable the creation of personalized learning pathways for students. These technologies analyze individual learning patterns, strengths, and weaknesses to tailor educational content and resources, allowing students to learn at their own pace and style.
- Interactive and Immersive Learning: Virtual reality (VR) and augmented reality (AR) provide immersive learning experiences. They allow students to explore historical sites, conduct virtual experiments, or interact with 3D models, making learning more engaging and memorable.

Figure 2. Industry 5.0 relationship with sustainable environment
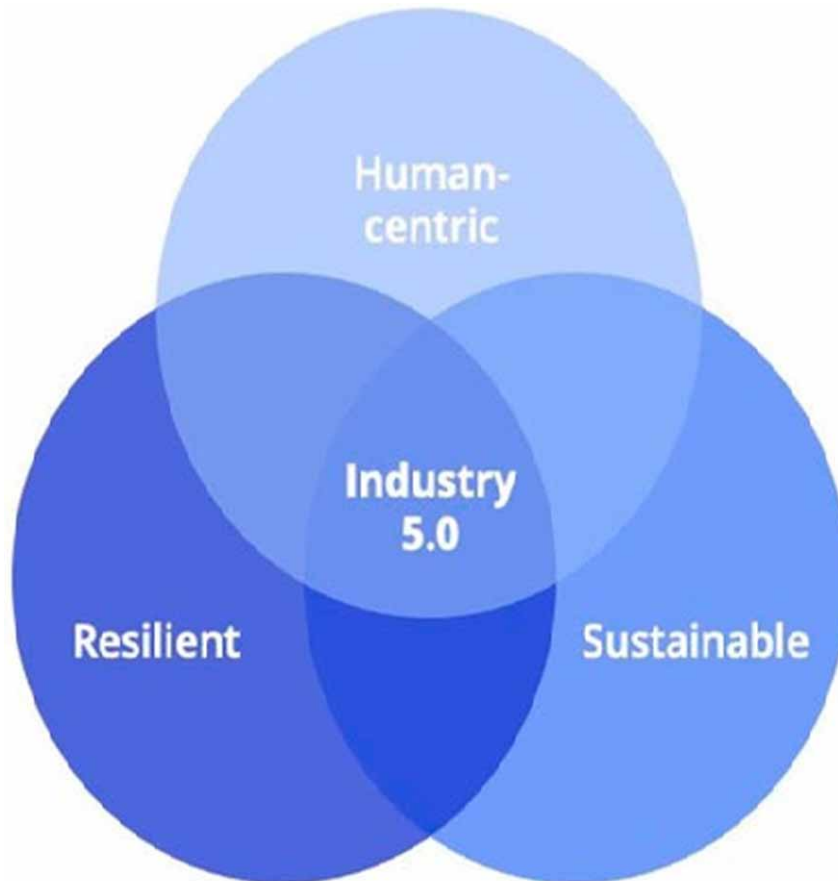
- Access to Quality Education: Online learning platforms and Massive Open Online Courses (MOOCs) powered by emerging technologies offer access to high-quality education to a global audience. This enables learners, regardless of their geographical location, to access educational resources from top institutions.
- Enhanced Collaboration: Emerging technologies facilitate collaboration among students, educators, and experts worldwide. Virtual collaboration tools, video conferencing, and cloud-based platforms enable seamless communication and project-based learning, fostering teamwork and problem-solving skills.
- Adaptive Assessments: AI-driven assessment tools can provide real-time feedback on student performance. These assessments adapt to each student's level of understanding, helping educators identify areas that require additional attention and support.
- Blockchain for Credentialing: Blockchain technology ensures the security and authenticity of educational credentials, such as degrees, certificates, and badges. This makes it easier for employers and institutions to verify the qualifications of individuals.

- Digital Resources and Open Educational Resources (OER): Emerging technologies facilitate the creation, distribution, and access to digital learning resources and OER. These resources are often free or affordable, reducing the financial barriers to education.
- Data-Driven Decision-Making: Advanced data analytics tools help educators and institutions gather insights into student performance, learning trends, and areas for improvement. Data-driven decision-making enhances educational planning and instructional strategies.
- Life Skills Development: Education 4.0 recognizes the importance of teaching life skills, such as critical thinking, creativity, problem-solving, and digital literacy. Emerging technologies provide tools and platforms to develop and assess these skills effectively.
- Continuous Learning: Emerging technologies support lifelong learning by offering flexible, on-demand learning opportunities. Learners can acquire new skills and knowledge throughout their careers, adapting to evolving job markets and technologies.
- Global Connectivity: Emerging technologies enable global connectivity, allowing students and educators to collaborate with peers and experts from diverse backgrounds, fostering cross-cultural understanding and global perspectives.
- Environmental Sustainability: Technology can be harnessed to educate students about environmental issues and promote sustainability. IoT sensors and data analysis can be used for environmental monitoring and conservation education.

In summary, emerging technologies contribute significantly to Education 4.0 by transforming traditional education models into dynamic, personalized, and globally connected learning experiences. However, to fully realize the potential of these technologies, it is crucial to address challenges related to access, privacy, equity, and digital literacy while promoting responsible and ethical technology use in education. Now, in next section we will explain about emerging technologies and their importance to the modern era for modern society.

2. MOTIVATION

Indian government on 2016 announces the ideas of building smart cities in existing cities in india such as chennai, vishakpatnam, coimbatore etc. to contribute in my part as citizen of india I have deviced a way in which we can with technology and use technology for our needs more accurately and securely the major goal for the smart city was to connect users in the city to the technology and use the technology such as AI and IoT to cater the needs without the use of manpower. Other names are Digital City, Intelligent City, Ubiquitous city, Hybrid city, and Information city (Vinod Kumar & Vinod Kumar, 2020). Many researchers have aldready addressed the covergence of AI and IoT in building smart environment but very few in the combination of AI, IoT and block chain and this is the only paper to be published about the convergence of AI, IoT, Blockchain, cloud computing and big data. my main motivation to begin the research was since the user's data are in cloud, there is a chance of misuse of data by the hackers. Therefore to adress this problem the blockchain technology can be used, the block chains's major use was in the trading sector for storing peer to peer transfer encrypted data, but I felt if the same thing can implemented in the data sent by the AI after encrypting and sending it to the IoT there is no space in which the hackers get to hack.

The use of big data technology in the smart environment because large amount of data is required to understand the various things such as user sentiment, weather, geographic required by the user in the environment so that the product could process out some efficient algorithm for improving the solution given to the user. Since the data sets are to be very large the need for big data has risen. The use of big data analytics are rising due to the software such as "Hadoop" and shark are open source and can do it at low cost, the next advantage of using the big data analytics is that it makes faster and accurate decisions. The more accurate the decision gets the more satisfied the users become. As discussed earlier blockchain is one of the best way of seccuring data when blockchain used in cloud based data storage when transmitting and saving important data my idea is that if block chain can be used for this cloud to cloud or person to cloud data sofware will be the most secure way to transmit and store data.

3. ARTIFICIAL INTELLIGENCE'S INTRODUCTION AND ITS IMPACT IN THE RECENT ERA

It was first the tin man from the wizard of oz movie and then there were many appearances of humanoid robot. But the official research discussion on AI Began on 1955 in the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI) by the two scientists. Machine Learning (ML) and Deep Learning (DL) methods have contributed to the progression of models in the different aspects of planning, prediction, and uncertainty analysis of urban and smart cities development in the current scenario (Augusto et al., 2018). AI's history date backs to the late 1950s. AI is one of the disruptive technologies of the recent generation. The idea of disruptive technology is when people work and use software and later comes a new software, in this case, it was artificial intelligence, so the new technology came and took over the existing technology and created itself a huge demand in the market. This is said to be disruptive because the technologies which we are using now and the time-consuming work we are doing will soon be replaced by the AI.

3.1 TYPES OF ARTIFICIAL INTELLIGENCE

AI being a very broad and extensive sector has various types and forms to it. The major one's are discussed below:

- **Artificial Narrow Intelligence (ANI):** It is also known as weak artificial intelligence; it is the stage of Artificial Intelligence in which the machines can perform pre-defined set of tasks whose algorithms are already defined in the modules of the AI product. In this stage, the machine does not use its own thinking ability as its tasks are already set perfect by the developer. What AI does is whenever the system needs a decision to be processed at that stage of the program, it reverts back to the system which is pre-set by the user. Types of artificial narrow intelligence include Alexa, Siri, autonomous driving cars etc. The major types of AI used in the recent era consist of development with weak AI, while the other types of AI are under research and slowly being implemented.
- **Artificial General Intelligence (AGI):** It is also known as Strong Artificial intelligence. In this stage of Artificial Intelligence, the machine will have the ability to think and make human like decisions in the place of the pre-defined commands given by human. There are no existing examples

of artificial general intelligence as it is believed that in the future there will be more work on the implementation of Strong AI. Many stated that strong AI is threat to humankind in the future because of its thinking and even Stephen Hawking said that, "The development of full artificial intelligence could spell the end of the human race". It would take off on its own, and re-design itself at an ever-increasing rate. Humans who are limited to slow time evolution cannot compete against the Artificial general intelligence.

- **Artificial Super Intelligence (ASI):** it is the stage of Artificial Intelligence in which the ability of the Artificial Intelligence will surpass or exceed the intelligence level of human and can think much smarter than the living human. However, the artificial super intelligence is a fictional concept but it is in real time implemented in chess engines for analytics examples of such are AlphaZero, stockfish, Komodo etc.

The recent example of AI taking over human's job is the one open-source software released to get the image of photo in their mind, the user has to give the attributes of image what they want. This technology would pretty much eradicate the need of artists, costing them their professions. There is also an advantage of this software which gives slight edge over the artist work, which is that it was able to replicate the exact image which the user had in mind to the creating a sort of telepathic connection between user and AI. Telepathic communication means one user can read other user's mind that was the connection between the AI and human, AI work is to read the user's mind and give the accurate or close one the user wanted. Where in the artist will have his own touch in the image wanted by user and user does not get satisfied.

AI has also given rise to many new technologies using its own idea. One of the technologies which will be discussed deep in this article is "Ambience Intelligence". Ambience intelligence is very essential in building a smart environment, it uses the concepts of AI in public places in the smart environment. It uses IT and AI to get the things needed to done by the user. One such example is the sensor affixed in the tap water which recognizes the motion of user and there was a motion recognized, it immediately pumps out water. There is work of AI in detection of the motion, after the detection, the main work for AI is to take the decision and revert the decision to the IoT device enabled in the tap after the AI has taken the decision to pump water in the IoT sensors the decision and pumps the water out. This an example of an easy Ambient intelligence device which can be enable in the smart environment.

4. INTERNET OF THING'S INTRODUCTION AND ITS IMPACT IN THE RECENT ERA

The Internet of Things (IoT) is being hailed as the next wave revolutionizing our society, and smart homes, enterprises, and cities are increasingly being equipped with a plethora of IoT devices (Sivanathan et al., 2019). The idea of IoT dates back to year 1982 when coco cola introduced its vending machine that was the first IoT machine built. Now IoT is used everywhere from healthcare, grid system, transporting, environment monitoring. What IoT does is it connects the internet enabled things in the environment and operates them by the commands given by AI or the pre-set command by the humans. Now days Internet of Things (IoTs) devices are using much in our (human-being) lives/real-world's applications than mobile phones, but both devices contain our personal data like contacts, messages, social security numbers and banking information, even every activity made by us online (being made on internet or made by devices) or offline (Fortino et al., 2014).

The example of IoT in the smart environment can be shown with an example of the use of autonomous vehicle, where there is an integration of AI and IoT, which the AI machine detects obstacles in the path of the road and if obstacle detected in the path, it makes the decision to stop the car to the brake system which is connected to the AI device will get the command to stop the car, the breaks will be applied and car will come to rest. As we discussed earlier, the AI taking the decision it is the duty of IoT to make the response on the decision made by the AI.

5. BLOCKCHAIN'S INTRODUCTION AND ITS IMPACT IN THE RECENT ERA

Blockchain was first introduced in 2008 and transformed the well-known third paradigm warranty and provide a way in which the transactions take place in a peer-to-peer network, by means of a distributed database (ledger) in which all the involved nodes belonging to Blockchain Technology in Smart City 349 the Blockchain network not only act as "witnesses" of transaction but also guarantee its integrity (Deshmukh, Patil, & Tyagi, 2022; Deshmukh, Sreenath, Tyagi et al, 2022; Sheth, 2022; Singla et al., 2009; Tyagi & Nair, 2022; Tyagi, 2019; Tyagi et al., 2022). Blockchain technology is being used in coming technologies because of the following reasons:

- Time reduction: in the fintech industry the blockchain has become inevitable because of its quick transaction. It does not have tedious process for the trades involving the verification and settlements.
- Unchangeable transactions: as discussed earlier, once the data is entered in the blockchain in chronological order, we cannot modify/alter and delete the data, same thing applies to the financial transactions too once the transaction is already done, we cannot alter or change or delete the data.
- Reliability: since blockchain is one of the safest platforms for the financial transaction it notes the user identity before the transaction has to be done.
- Security: since blockchain uses the concepts of advanced cryptographic techniques, and it locks the data of the user in the blockchain this makes the blockchain platform more secure.
- Collaboration: since blockchain platform is meant for peer-peer transaction it does not require a third-party member to look over the transaction and the respected user to transfer or receive the money is alone enough.
- Decentralized: since it involves peer to peer transaction, therefore it does not require a manager or head to look over the transaction.

To accommodate and cater to the needs of various types of use cases, blockchain has several different types that vary in terms of characteristics and features (Deshmukh, Patil, & Tyagi, 2022; Deshmukh, Sreenath, Tyagi et al, 2022; Sheth, 2022; Tyagi & Nair, 2022; Tyagi, 2019; Tyagi et al., 2022), are mentioned below:

1) Public blockchain: A public blockchain is one where anyone is free to join and participate in the core activities of the blockchain network. Its main features are as follows:
   ◦ High Security – It is not possible to modify or change the data after it has created in the block chain environment.
   ◦ Open Environment – The public blockchain is open source one and can be accessed by all.

○ Anonymous Nature – In public blockchain everyone is anonymous, everything is hidden on public blockchain including your name and identity.

○ Regulations: there is no regulation on vertical in which vertical you want to use blockchain due to its heterogeneity and interoperability one can use the blockchain software almost anywhere.

○ Full Transparency –the public blockchain allow you to access your ledger that is your financial statement anytime.

○ Full User Empowerment –there are many tedious rule and regulations that must be followed in other software which are not meant to be and there is no authority person in blockchain to watch over you.

○ Immutable – as discussed before when something is written in blockchain it cannot be changed.

○ Distributed – there is no centralized data base in blockchain.

2) Private blockchain: A private blockchain is one in which only specific users have access and abilities and is generally used only by the entity it belongs to. Its main features are as follows:

○ High Efficiency: The problem with public blockchain is that the it lacks the efficiency because for the public blockchain everyone gets access to it and use more features so that the platform cannot backup a lot. While in the private blockchain due to limited people the platform can still back up the resources.

○ Full Privacy: The best level of privacy and security to the data is offered by the private blockchain, since the companies deal with sensitive important data therefore the private blockchain would be better option.

○ Stability: Private blockchain provide stable solutions, the fee for transaction to be done on blockchain is higher than the fees for the transaction in private blockchain.

Uses of blockchain include: Cryptocurrency, smart contracts, financial services and in detection of goods in supply chain management. The major advantage in blockchain is its interoperability nature where when 2 or more systems are connected with blockchain together block chain goes good cooperation with them,

6. CLOUD COMPUTING'S INTRODUCTION AND ITS IMPACT IN THE RECENT ERA

Cloud computing refers to the continual access to computer system resources, particularly data storage and computational power, without the user's direct active supervision. Large clouds frequently have functions spread across numerous locations, each of which is a data center. Some of the major advantages of cloud computing is as follows.

● Cost Factor: it reduces the cost to company by not buying huge software and hardware.
● Speed: the resources added to cloud can be accessed in a minute or few seconds.
● Scalability: we can add products of different technology to the cloud connect them and access them.

- Reliability: backup and recovery of data in cloud is not very expensive and the data backup process is very fast.
- Security: There are many clouds software service or vendors that offer good security to the data in the cloud.

A cloud network (George & Tyagi, 2022; Pal et al., 2022; Rekha et al., 2020) is a computer network that occurs within or is a component of a cloud computing architecture. It is a type of computer network that connects cloud-based or cloud-enabled applications, services, and solutions. A cloud network might be either cloud-based or cloud-enabled. The major types of cloud networks are as follows.

- Public Cloud: the cloud's built in or uploaded resources the user access in the cloud is owned by a third-party member. It delivers the resources for the organization such as software, servers and the amount of data permitted to be accessed in the cloud.
- Private Cloud: the cloud computing resources which can be accessed by the single business company or the organization is called the private cloud. The physical location of the private cloud can be in the headquarters of the organization or business or center of organization or stored in third party area.
- Hybrid Cloud: It is the merge of both public and private clouds, and merged together by a software which helps to transfer or receive data or applications between the two clouds.

Cloud services are infrastructure, platforms, or software that are hosted by third-party providers and made available to users through the internet. The three main types of cloud services are discussed below.

- Infrastructure as a Service (IaaS): in IaaS we can subscribe for the infrastructure in the cloud like the servers, operation systems, cloud vendors etc. using the infrastructure as a service the user gets maximum resources.
- Platform as a Service (PaaS): This service provides a technology for the environment which is on demand like a platform as such for the users to develop, test, deploy, and deliver to manage the software applications. The developer in the cloud environment is responsible for the apps or websites created and the PaaS vendor provides the surface for the developer to do their creation. The management of the PaaS software is done by their vendors which makes it easy for the users.
- Software as a Service (SaaS): It is a centrally controlled and managed software services provided to the users using it. It delivers software over the internet. Azure is one such example of SaaS software.

7. BIG DATA'S INTRODUCTION AND ITS IMPACT IN THE RECENT ERA

Big data refers to data that is so massive, quick, or complicated that typical methods are difficult or impossible to process. Accessing and storing massive volumes of data for analytics has been practiced for a long time. However, the notion of big data gained traction in the early 2000s when industry analyst Doug Laney defined the now-standard definition as the three V's (Volume, Velocity, and Variety) (Deshmukh, Patil, & Tyagi, 2022; Deshmukh, Sreenath, Tyagi et al, 2022; George & Tyagi, 2022; Pal

et al., 2022; Rekha et al., 2020; Sheth, 2022; Tyagi & Nair, 2022; Tyagi, 2019; Tyagi et al., 2022). The main features of big data are discussed below (refer figure 3).

- Volume: refers to the size of the data occupying in the users' environment created from different sources.
- Velocity: this refers to the pace at which the data is generated, distributed and collected.
- Variety: it refers to the different types of data which are generated or processed like whether the data is grouped or ungrouped and raw or clean etc.
- Value: the value of the data means the impact of the particular data will have on the organization in business analytical part.
- Veracity: veracity of the data refers to the accuracy, truthfulness and meaningfulness of the data generate for the particular program to be run by the organization. It also refers to the meaningfulness of the analyzed data from the generated data, is it being helpful for the study or not. One of the major purposes of combining big data and IoT is the growing availability of different communication technologies that helps dealing with a large amount of data existing in smart environment applications. The connectivity between interlinked data nodes and the data management systems (DMS) serves as the backbone that ensures operational success (Hajjaji et al., 2021).

Figure 3. Big data and its features
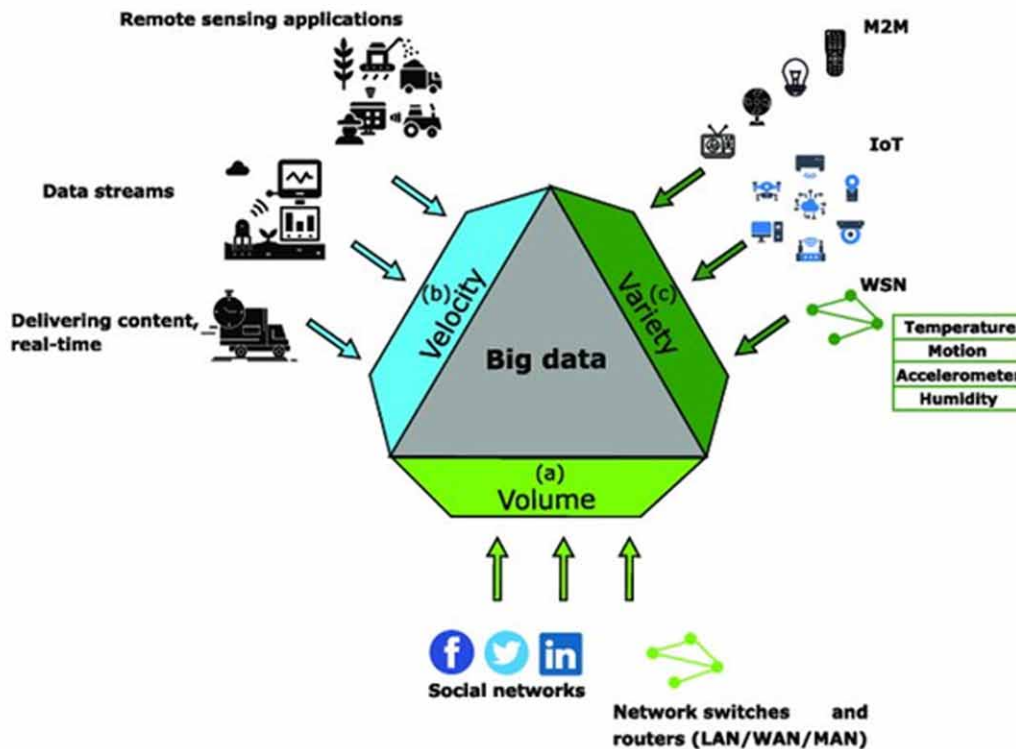
8. MAJOR CHALLENGES TOWARDS SMART ERA

The significant and main challenges faced when it comes to using such technologies for enhancement are quite a few. The major ones are discussed below as (Liu and Zhang, 2021; Orecchini et al., 2019; Tyagi, Rekha, and Sreenath, 2020; Tyagi and Rekha, 2019):

a) Prerequisite for the smart environment: Not all part of the city in the smart environment are Technologically developed or developing, so before Aiming for a full-fledge smart environment in that particular area in the smart city, we have to make sure that the city is getting basic amenities. This will be the pre stage in building the smart environment, to check the and solve the problem regarding their basic amenities. A city like Denmark before becoming a smart it was ensured that all part of city had perfect electrical and network supply. After that they started building on the city only concerning about its technology growth. Then it went on to becoming the best smart city model established in the World. Only physical infrastructure supporting the technical objects is not enough, without proper guidance of the information technology sector in the area, then there would be no continuous development of the city, to update and upgrade the smart environment product in the smart city there must be an information technology company or government informatics institute properly update, upgrade and resolve threats in the backend.

b) Well-developed Infrastructure: Before dreaming of building a smart environment, the infrastructural development of the city must be very important before calling it a smart environment before implementing the above-said technologies it is important to check how the infrastructure and the people are intact, there is no use in building a smart environment with poor road transport connection to the respected city. The IT infrastructure of the city is also very important, the IT infrastructure of the city must support the demands and needs of multiple solutions from various technology sectors to build the environment

c) The technology should be easily scalable: Since in this picture we are going to deal with many types of devices from different technology, to ensure the heterogeneity of the product made, the scalability of software must be up to the mark. A solution to this could be automatic bootstrapping, boot loading, monitor and automatically upgrade itself. once we have established the main software, the software on its own should do the above said operations such as bootstrapping, boot loading, monitor and automatically upgrade itself immediately. After this process is finished the product is now able to add multiple servers, technologies and also will be able to connect to the primary server. In addition to this there must be well data processing pipeline system Established in the product so that it is able to establish nonstop in the continuous flow of data and must also be able to handle situations of the unexpected errors and the performance issues. If the data is processed well under the pipeline, then then the sudden new upgrade in the system will not be in trouble and our motive to add many heterogenous system is established. To the needs of the residents living in the city, which vary from city to city, the technology should be able to easily upgrade itself. Without the upgradation and close monitoring of the technology the smart city which was made for a useful purpose, will be left ignorant by the residents of society (Augusto et al., 2018).

d) Efficient data analytics and data mining: To get the efficient answers and outputs from the product as I have discussed earlier we must need a large amount of data, to get a large amount of data in Chennai (India) highly populated and technologically intellectual city in India is easier task but getting it in a remote village in India is not as easy it seems, because if want to implement it in that village, the user must have a good knowledge of the cyber physical systems, but many users in remote village will not have access to basic network therefore the point mentioned before about the development of infrastructure

took place and they are very well developed technically. We must perform repeated surveys to fetch the related data from the user in order to feed the system the data about the environment it is in so that we can get efficient output in the data. To evaluate the accuracy of our recognition algorithms we assess them using real data collected from participants (Liu & Zhang, 2021). Also, the previous surveys which had already fetched the data, we have to convert it into a readable form and analyze the data on the information we want to update in the existing product. So, there is a large work of big data needed here. In the product for the product to fetch the accurate data there must be a good data analytics and big data analytics software installed in the product so that we get the accurate solution. Further, the data's coming from the different sectors of the smart city must be well managed and be kept in under good privacy as discussed, this where we introduce the concept of blockchain the private blockchain is the best way to store the data in the most secure way so that there is no chance of theft of data. Big data Analytics can collect, analyze as well as mine data about smart cities projects already established in parts of the world and also the existing city in an intelligent way to get information to develop various smart city facilities. In a big country like India where each of the its city are having massive population, there should be an effective data analytics and data mining. It is one of the important analytics tools which will be able to upgrade the environment by aiding the data to AI and IoT. In which we can build effective products as per the datasets present already. The accurate prediction depends on the techniques of big data analytics and machine learning used to build the product. Big data Analytics can collect, analyze as well as mine data about smart cities projects in such an intelligent way to generate information to improve various smart city facilities, this information can be used by the IT infrastructure team to build and upgrade efficient products for the environment to be used according to the changing needs of the residents living in the city (Vinod Kumar & Vinod Kumar, 2020).

e) The product must respect the privacy of the user's data and must be encrypted: The privacy the user expect in the product are the following:

- Transparency: the user after submitting the data to the product they do not want the data be secretly kept somewhere for non-product purposes.
- Individual participation: the transparency user wants is that he or she may be given the access to their data so as to edit and view the record timely.
- Collection limits: Record collection should be appropriate for the application.
- Data quality: the data collected from the user must be accurate and the data received should be non-raw so that it could be used later for the analytics purpose.
- Use Limits: as discussed before the data acquired from the user must be used for the correct purpose and the accessibility to the data to the only required people.
- Appropriate security: the data acquired form the user must be stored in a secure manner and must be highly privatized so that the product develops the trustworthiness among it's users.
- Accountability: in case of the theft of the data the team behind the data must be accountable for the theft of the data and the data must be retrieved as soon as possible from the third-party hackers.

The government which develop the product does have order over the data supplied by the user, if the data recorder in the smart environment, if the user feels it is private and he does not want to share it willingly, but the data was the one after he had used a product in the smart environment, for building the trust the product must be able to encrypt and store the data so that no one has the direct command over the data, in this way we can develop a trust that the users data will not be accessed directly. The

problem arises when someone (third party hackers) try to steal user's data in an indirect way, if this happens too there is a trustworthiness from the user on the product. The future goal for the product is to make better privacy of user's data. This research is still going on in the cybersecurity side, but what may new research there are new hacking ideas to steal the data. There are high chances when the user's data is accessed by third-party hackers who might misuse the data. In a smart environment, there is a need for good cybersecurity to cover the attacks. There will be a problem when the resident in the smart city feels to prove the data collection is legal if it is in the interest of the public. The data of the residents stored in the cloud must be regularly encrypted, in the later section of the paper there is an extensive explanation of the encryption of user's data using Blockchain technology.

f) Continuous Reliable Connection: There should be a new term coined as uninterrupted network supply from the term uninterrupted power supply, the name itself tells the importance of it 'Internet of Things'. For ensuring smooth run of the whole grid in the smart environment, there must be ensured that the network connection is 24/7, if one of the systems fails there must be a revival mechanism in important parts of the product so that the other system connected to the fault system can run without interruption (Al-Turjman et al., 2019).

The technologies such as:

- Halow: the best technology supported by WiFi is HaLow because of it less power consumption and log range network supply upto 1 km and its ability to penetration over walls and object will serve as the best network supply for sectors of smart environment such as smart environment etc.
- Zigbee: the technology is same to as Wi-Fi working for small areas can be used in smart industry or grid and also used in carious smart environment now including smart home. Due to its less power consumption, we can only able to deliver the network to 100 meters in area. It is designed to carry small amount of data covering short distance with less power consumption. Zigbee has the best battery life where in Wi-Fi there is a need of uninterrupted electrical supply.
- z-power: this too is the same as zigbee but it has much less power consumption and it can carry very less data compared to zigbee but it can do it for long distance compared to zigbee. The qualitiy of the network used for smart environment are as such discussed below:
  ◦ Bandwidth: the bandwidth issue in the network is one of the important problems in the networking part of the product, since there are many devices connected to single Wi-Fi or cellular network. The network does not have the capability bandwidth to allow internet to all the devices in single server therefore there must efficient bandwidth management.
  ◦ Power: in micro level of IoT setup it is still possible to source the energy for only the required sources and the power wastage in the micro IoT setup can be minimized. When working with large scale IoT setup it is difficult to minimize the usage of energy, but there can be steps taken as discussed already we can setup renewable energy sources such as wind energy, solar energy and piezo electricity. There was a smart IoT product developed for the soldiers fighting in the border to charge their phone only by the moment of their legs, smart technologies like this have to be introduced so that it is possible to minimize the wastage of energy in the macro scale by making some modification in the micro aspect of macro scale. The problem arises when there is no power fallout during climate changes can also be a major one because an entire city adopted as smart city will be very difficult to get power connection during hard times so that there must be alternative source of energy during that time to give uninterrupted power supply.

◦ Security: It is the most important in Internet of Things Connectivity. The ensure of secure connectivity when IoT devices are used for official purposes the need for secure network connectivity is very important.

◦ Standards: the standard of the network from the network server must be power efficient, can be used to send data for long distances, must be of cheap of cost and also can allow multiple servers to get internet from the server without technical glitch. There are different types of network service providers as discussed above such as zigbee, z-power and halow.

◦ Presence Detection: there must be a reverse mechanism in the IoT device fixed if there is a network bandwidth drop or network connection goes off. There must a software that detects the problem in the IoT software and must take the necessary precautions so that system revert back with good internet connection. The sensors, IoT devices, and the ai frameworks must be situation active and must produce robust solutions for the residents. They must be well intact together so that no discrepancy happens in between. They should be connected to the internet continuously.

g) Interoperability: Interoperability provides means to share and transfer of data to the end user without complexities. It is the intermediate of connecting different platforms having different technology in the product and creating a single database of the two products unified for user to access two devices at same time without haze. It is the process of receiving data from one product and interpreting or modifying other product connected to the cloud. Interoperability is a way of collaborating with the different products in the cloud, Interoperability is an important criterion when it comes to design of a smart city which plays a critical role in reducing costs at the level of system, data, and applications. IoT is a combination of various types of devices and each of its device can connect with each other the problem arises when there is a confusion between the communication of devices to other devices happening in the cloud this can cause a problem in full process. The next problem arises when in a systemic smart environment is applicable only when some of the apps are installed or it works for only some type of devices or it works for devices but there must be some modification done. In this type of situation, the user may feel that adapting to some technologies or buying the devices or upgrading the apps in order to use the environment might seem like a time-consuming and money-consuming task. So, there should be a product made so that it is universally used by everyone (Hajjaji et al., 2021; Molnár & Sik, 2019).

h) Accuracy or the matching relevance to the present environment: The accuracy of solution given by artificial intelligence and machine learning algorithm is directly dependent on the nature and characteristics of the data given by the user. As discussed already the data given from the user must have characteristics of 5V that is volume, variety, velocity, veracity and value of the data. If the algorithm works well and the necessary data is given, we get accurate solution otherwise the accuracy will go down. For example, in MATLAB if we want to compute the graph for sinx + cos x the graph will be more accurate if we use man data sets, if less data sets are used the graph will not be like real sinx + cos x graph. Therefore, the more data we get the more accurate solution we give to user.

i) Quality assurance: In an IoT based system, any small error in the loop can have undesirable and even disastrous end results such as security threat or breach, physical and cyber accidents and wastage of resources. It is very important to test the quality of the product under various conditions before delivering. the architecture for the setup IoT product will have the following aspects such as Data mining and monitoring the quality of the data processed. A Quality Assurance (QA) team will be required to pass the system requirements. Since there are heterogenous software in the IoT device each device is

connected to other device of other technology, it is difficult to frame on singe testing environment for all the heterogenous devices, there is need of information about the singular IoT devices connected with many different IoT devices so that the testing can be done. Developers can react with the existing IoT system through API based communications using XML and JSON, but in order to ensure the testing standards the testing platform devices must be compatible with IoT devices to ensure smooth testing. Quality Assurance is an essential issue after the IoT development of IoT systems before the final connection of these IoT sensors, devices, applications, and servers into the smart environment. For example, we have already discussed about the application of blockchain in IoT in order for the user to ensure that the goods or packages delivered to them are coming from the said sources or not therefore the new application of blockchain in IoT was in the supply chain management sector. There must be an additional software to the product which checks the accuracy of the algorithm in deriving the output. It is expected that in another 30 years that 66% of the landmass will be urban regions. We should cater to all the needs of the environment such as clean water, clean food, and smart energy. while simultaneously assuring complete economic, social, and environmental sustainability. The lack of standards is another problem when designing a product for the smart environment. The standard setting has to be started from the point of collection of data, so that no key things get missed. The quality of the algorithm designed for the product must work at all costs (Fortino et al., 2014).

j) Cyber threats to the cyber-physical systems involved in the smart environment: The aspects by which the IoT software is subjected are given below: Unprotected abundant data: IoT sensors and big data devices collect highly grouped data from the smart environment from its users. As discussed earlier the data from the user is very important for designing of Artificial intelligence and machine learning algorithms. However, this data not encrypted or secured will be theft. Connection of virtual and physical environments to the cloud: The IoT devices are connected in cloud so that they can transfer or send data to different heterogenous application the problem is when there are recent studies about cloud that they can be easily hacked and the data can be stolen or modified leading to accidents. Creation of complex heterogenous environments: Complex IoT environments can now be created. As the name suggests the complex environment mean the smart environment are made up of many heterogenous devices working in same environment IoT environment and interacting between themselves. This complex IoT environment creates vulnerability of data transferred between the devices.

k) Immediate resolve of threats, updates, and upgrades: There are still many AI devices in research to resolve the cyber-attacks as soon as possible, but things that could be done to reduce the cyber-attacks are:

- Encrypt Your Data and Create Backups: Make sure the data saved in the cloud is encrypted and the backup of the data is created securely. The benefit of the data encryption is that person with the encryption key in the smart environment are only allowed to access and modify the data.
- Keep Your Systems and Software Updated: Software and system in the smart environment connected to the cloud and the technologies in the product must be updated regularly as it will not only give new version of the product but also better secure version removing bugs.
- Assess and Monitor Your Vendors: We will also be discussing this point in the later section of the paper about malicious insider who tries to steal data from the cloud being part of the organization. Monitor the third-party vendors throughout the relationship.
- Reduce Your Attack Surface: Reducing the cyber-attack comes narrow down to this single thing reducing the attack surfaces such as physical attack surface, digital attack surface and social engineering surface.

When we have implemented the product in our smart environment there must be a well-set-up IT infrastructure to cater to and resolve the needs of the residents in the smart environment as soon as possible. The product should have the capability to update itself. Every day there are new security flaws detected, therefore the work for the IT support cyber security teams has to work daily, tedious to resolve the threats (Singla et al., 2009).

l) Malicious Insider: Insider threat is famous word in the stock market in which the current or ex. Company employee gives signal to the investor that whether stock prices will rise or not based in the company situation asses by that employee. When we want to implement our product in a large-scale environment, we must be aware that the data of the residents can be misused by the one working and developing the product. Since the product demands the use of many technologies, the manpower needed for the development of the technology is also huge. Blind spots in insider threats can also be identified due to a lack of awareness between the higher authorities. So, the product must be developed in such a way that the data of the residents can only be used by the higher government authorities. There must be authentication software developed in the product so that the user should give permission for even the higher government authority to view the data.

m) Imperfect Authentication: The failure of smart authentication can be seen on the internet, about failing verification software and too much security-requiring software. The authentication software must be set such that the user does not have to undergo any tedious sign-in process keeping in mind that the verification system must be up to the standards (Sivanathan et al., 2019).

n) Different types of security issues in the smart environment:

- Physical security: In a growing country like India where the income imbalance and intellectual imbalance among its citizen exists, there must be enough information given about the product to the citizens so that the residents in the smart environment don't misuse it. There must be good guarding of the physical cyber system in the environment so that that system is protected.
- Network security: It is not only enough if we protect the software side threats in the smart environment, sometimes hackers try to access the product through the user's system. So, in a smart environment, it is not enough to protect the product alone in the smart environment it is also the responsibility of the developers to ensure the security of the residents.
- Data security: As discussed earlier the securitization of data is more important be it the users or the products, is what we call technically that processed data and data under process. The processed data will be secure if the database management system in the product is secure. But the problem is with the data under process. The best way to secure the data under process is to restrict access to limited users for using the data, much better would be to make the data access to itself. This can prevent the breach of the high secure data from being lost to hackers.
- Another method is to encrypt the data under process. It should always be encrypted when it traveling to different networks

o) Management of Smart environment: Among the large list of government responsibilities, implementation of passed policies in the parliament, passing files to various corporate and public sector fronts, providing services, enabling businesses be it corporate or private sector to sustain, maintaining law & order in place, reducing the percentage of poor people in society, etc., would be top priorities of any government in action. The communication and interaction gap between its people, private sector business to itself is the major before enforcing a bill or policy for the people. E-governance refers to

the strategic integration of intelligent systems using the technologies such as artificial intelligence to create a simple, moral, accountable, reasonable, responsive, and transparent environment that is not to account for any flaw in the system making it less corruptive and cheaper (Augusto et al., 2018). Benefits of Smart E – Governance:

- It simplifies the process of gathering and storing government information regarding any industry in the government sector or be it accumulating information about the citizens and business.
- It helps citizens of the country and private sector industry to actively participate in the processes of making decision for developing/modification of any new law or bill announced in the parliament, because of it being transparent.
- Because of it being a transparent service, it is the best way to reduce and eliminate corruption in the smart environment ensuring the transparency of the entire system it can be accessible to the public.
- Ease of availability: die to the service being open to the citizens in the smart environment 24/7 the user can access the data any time.

There are a lot of good things there when building and maintaining a smart environment. Thing like it provides a lot of job opportunity to the people working in the above-mentioned technologies, the IT support team, mechanical engineers, and civil engineers for building the physical structure for the IoT devices. But the problem arises when requiring huge manpower, we need to get ample funds from the public and private sectors. After being able to get the funds and finishing the project. There is again a need for the flow of funds for managing the smart environment which needs the same amount of manpower. Thinking in an innovative aspect we can use Artificial intelligence in this topic as previous researchers used ideas of AI in e-governance. So that we can cut costs and reduce human errors in the process.

p) Product time delays (Spontaneity): When working with IoT software in the smart environment, especially in the technologies such as e-healthcare, e-transportation, etc. The spontaneity of the product is very important, the cloud-to-cloud information transfer must happen at the right pace to avoid delays, one delay could set a wrong impression among users. The proactiveness according to the system must be established to avoid last-minute delays (Fortino et al., 2014).

q) Context awareness according to the situation: The software is contact aware if it uses data given by the user and provides relevant information returned back to the user. In a smart environment, the problem can arise when the system cannot understand the form of data the user sends like wrong speech detection, and image detection, therefore, I feel that to ease out the process AI must have an ethnicity package of the city updated so it can make the decisions accordingly. The problem can easily be tackled by setting up a validation software before the showing the output to the user. In this way we can reduce the percentage of error of output shown to the user. Sometimes computer sends data that layman human cannot understand, therefore there must efficient way the communication of data in colloquial terms. There are three things that can be achieved when we have good context awareness.

- Adaptation: Adaptation refers to processing correct and factual data according to the raw or not-perfect data given to the system. This part is very important, many time users never send the perfect data for the system to process and return back the information they need, therefore there must be an auto-suggestion created inside the product which can almost guess the need of the user and show it to him in which he can select the data user meant.

- Personalization: Personalization and contact awareness must go hand in hand, the user may be in his 40's, 20's, and also 80's. there must be the personalization of settings according to age and various factors. If there are good personalization settings the user may not feel hazy and tedious during the process.
- Proactiveness: Over years the AI used in the smart environment was decided reactive, therefore it had no effective risk management, to build effective risk management the system must develop the quality of being proactive. Proactiveness is the future of AI, the pre-monitoring, predicting, and solving faults before they occur and in case the failure like the machine-wise failure is reduced.

r) Efficient energy usage: When building the product for the smart environment, there is a need of lot energy be it the electrical energy or the network needed. There must be efficient optimization in the coding algorithm written so that energy is usefully used. Since we are calling it a smart environment, we want to implement various types of smart energy such as biogas, wind, solar, piezo, etc. to build for efficient energy usage (Sivanathan et al., 2019).

s) Educating & Engaging the Community: It is not completely set after building the smart environment in order to run the system smoothly it is not only the developers and products work to do it, the society must also get well educated about the products in the smart environment. This can be done through a number of ward meeting where the higher official can meet with people in the smart environment and collect valuable input in the rural side as well as for people living in urban regions to access technology can be sent an online form to give their inputs. This will take at least a year or two for the people to get adapted to a new way of living. It will be very challenging in a country like India to get this in action, because as discussed earlier if there is a physical threat to the cyber physical system installed like theft, damage, etc. then building the same infrastructure again, connecting it to the cloud would need a lot of manpower and money power.

t) Appropriate AI-ML algorithm for the design of IoT: The issue here is to get accurate solution, there must be use of efficient AI-ML algorithm. Some of the algorithms include since the heterogeneity of different components in IoT, to handle different software and to work according to different ones there must be an efficient algorithm designed to be used for the product. To choose an algorithm there must be an understanding of different aspects such as where it is applied, the data it is handling and architecture it is being worked on (Hajjaji et al., 2021).

u) Middleware: Middleware, widely used in conventional distributed systems, are fundamental tools for the design and implementation of smart objects as well as of smart environment applications. They provide general and specific abstractions (for example, object computation model, inter-object communication, sensory/actuation interfaces, discovery service, knowledge management) through which smart objects and their related applications can be easily built up (Fortino et al., 2014). Since there is a need for a product helping the working product there comes the concept of the middleware. Before there was three layers in the IoT architecture which consisted of Application layer: it is the one which is connected to the physical IoT, this one is called the layer before processing of the data. This layer has algorithms for all the action involving the input fetching and process the data from the network layer to produce the desired output to necessary user. Network and transport layer: this layer consist of the communication for the IoT software or the other product to the cloud and the cloud then transport the information to the IoT and then it comes to the application layer and processes the desired output.

v) Developing a good User Interface to the product: So far in the previous challenges we have seen the problems regarding the data, network, cyber and physical security. User interface are interfaces cre-

ated by the web developers, focusing on its perception to be viewed by the users. The user's want the user interface to be simple and be easily accessible in IoT devices. In a given IoT system there must be a way in which the product and user in the smart environment communicate with each other. "We live in a time full of opportunity for imaginative individuals. In our lifetime, we will witness the emergence of more and varied forms of human-computer interaction than ever before."

w) Legal challenges: The following are some of the main legal challenges (Molnár & Sik, 2019). Few other challenges are:

- Data privacy and data protection: Protection of sensitive personal information is secured under the Information Technology Act 2000 and The Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules 2011. As per Section 43A of the Information Technology Act 2000 tells us that the product to be designed for the smart environment, if the body fails to keep up sensible data or personal data of the users in the environment, if there is threat to the users' data in the smart environment, the body governing is subject to the damages to the individual. The information technology also additional imposes a fine of 1 lakh Rupees to be paid to the user.
- Data ownership: This will be a big debate in the implementation of our product who owns the data if we send the existing data of the user to a private organization for access of the user to the private technology is private organization taking the ownership of the data and maintain privacy is the big question. Even if we design a very efficient algorithm in order to ensure smooth run of the product without failures it is still not yet possible to develop an ideal one, so there will be a fault in our product. The handling of legal challenges is important one because if this was private public funded the equal amount of the punishment goes to the private companies after this they might fear and stop the funds for the product, therefore we feel that there must be some exercise of punishment, why is that let's take an hypothetical situation if user who is intoxicated and driving the car there is a good percentage of chance that he might deliver into a crash, but instead if he drives using (AVN) the chances of a crash is very less than the first one, therefore users can use the product when they have to use it, it is not a compulsion to use it all time (Shamila et al., 2019).

x) Unemployment challenges: If there is replace of robotic IoT device for the non-skilled works in the replacement of the users who were doing it already there is a chance of economy disruption in that smart environment, therefore in order to satisfy the employment needs of the residents in the smart environment we have to create a situation in which the product has to be maintained by user therefore for the work like this we can employ the non-skilled laborer who have lost their work due to device can still get employed (Tyagi, 2019).

9. CONCLUSION

Smart environment after being developed has to be well maintained by both the users in the smart environment and the people behind the smart environment who develop the products. This chapter discussed several challenges associated with the adoption of emerging technologies in education (in a smart environment), including issues related to equity and access, data privacy, teacher professional development, and the need for revised curriculum and assessment frameworks. Furthermore, it underscores the importance

of ethical considerations, such as responsible AI use and digital citizenship, in the technology-driven educational landscape. Also, this work discussed several future research directions to advance the effective integration of emerging technologies in Education 4.0. These directions encompass the exploration of innovative pedagogical models, the development of adaptable and interoperable technology solutions, and the examination of best practices for technology-enhanced learning environments. In summary, we conclude that emerging technologies hold great promise for Education 4.0, their successful implementation requires a comprehensive and multidisciplinary approach together/ in a smart environment.

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