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ROLE OF IoT IN THE SECURITY OF SMART HOMES

Introduction

The technological revolution that occurred due to the fourth industrial revolution is expected to bring an abrupt change in every business sector. One of the most significant revolutions that occurred due to the industrial revolution is the IoT (Internet of Things)is a network of things that are controlled with sensors and other technology with the aim of connecting and exchanging data with other systems or devices ranging from household objects to industrial tools over the internet. This report aims to explain the historical context of the IoT and how various schools of thought on AI(Artificial Intelligence) have helped to approach this IoT and will lay emphasis on the social and ethical issues related to IoT. It will also identify the current state of the art related to IoT and will examine the key challenges in developing current practices in IoT.

Discussion

Understand and contrast how different visions and aspirations for AI, from the scientific literature and/or other published material, relate to the topic.

Artificial Intelligence (AI) plays important role in building the smart home and helps to create a well-established connection between the various home appliances with the local network communication. Samsung Smart Things, Google Smart Home, and Amazon Alexa are some examples of AI for building the smart home format between various electronic components. There are large volumes of data that are categorised using the smart algorithm of Big data analytics tools and data mining. The AI uses the estimated data by big data analytics to generate a specific result for the users as per the needs of the customer. AI produces a smart Graphical Users Interface (GUI) which is better than the Character User Interface (CUI) module. Kumar et al.,(2021) show that AI can be used in order to estimate the level of comfort of the users in terms of their living standards such as smart remote control, optimal utilization of resources, and the level of security in the home appliances. People can use the smart remote control on their smartphones and tablets to control some of the major home appliances like television, air conditioner, washing machine, and CCTV surveillance in the home. People can access their

home view from remote places (offices) to watch the inside of their home with the aid of an AI-generated module in their application.

Rio et al., (2019) show there are mainly six major components by which the AI can monitor the overall operation and they are recognition of the activity, processing of data, voice recognition, image processing, phase of decision making, and predictive analysis of the operation. The AI forms a definite layer of the Neural Network by which it can process all the data given to it. The kernel version of the software is formulated under the Lynux Environment which ensures the best security in archiving the data in it. AI can measure and analyze human behaviour and emotions to produce specific results as per the requirement. AI also plays important role in the decision-making phase (Sepasgozar *et al.*, 2020). For instance, if any stranger enters the house then AI can sense its motion behaviour and can trigger the security alarm instance. The owner of the home can easily recognise the irrational movement of humans in the home and take precautions as per necessity. Moreover, the user can access such situations by their smartphone even if they are located far from their home. It is basically used in the Nest Thermostat and Viaroom home application to monitor such activities.

AI also helps in building the health-assistance smart home. It can recognise the body gesture, temperature, and heart rate to trigger some of the crucial data for the users. For instance, old parents may be in the home and with the help of AI it can be easily detected if they have a certain attack while sitting in the home. Even located remotely, body gesture detection via smartphone can help to take preventive measures (like calling an ambulance) for saving a life. Thus, even not in the home and people can take care of their family members with responsibility. The Internet of Things (IoT) with the integration with AI can also help parents to control the mobile phones of their children. Parents can set the time duration up to which their children can watch content on the internet (Rocha *et al.*, 2021). Moreover, they can even monitor the quality of the content of which their children go through. They can share their location and if any mishap happens then parents can know the location of their children by their smartphones and take preventive measures. The smart program (like Google Family link) can send an SOS message automatically if any unnatural behaviour is detected from their end.

Chart the historical context of the topic and explain significant events in its Development.

The advancement of the semiconductor industry generates the required thrust in developing the modern future by building the smart AI neural algorithm and by the various phases it is implemented in the different phases of people's life-cycle for the betterment of their life. In the year 2008, the European Technology Platform on Smart Systems Integration (ETA EPoSS) formulates the word 'Internet of Things (IoT)' which is based on smart communication among

people. The internet Suits and the integration of TCP/IP in the main frame accelerates the development of AI in the building of smart homes. Berkley University in the same year integrates the computational networking platforms in the neural frame of the AI to form the embedded computing system. In the year of 2009, CASAGRASS suggests a proposal for integration between physical and virtual objects. It offers identification, sensing of the object, and connectivity between different parameters of AI (Chin *et al*., 2019). The autonomous data-capturing ability of the neural network accelerates the overall framing producer in the field of the development of AI. In the year of 2010, The Internet Engineering Taskforce (IETF) formulates the very concept of seamless communication between the different sections of AI. They develop different tags related to RFID which ensures the integration of different sensors, tools, and actuators. The integration phase in the development of IoT catches a new direction when physical and virtual objects are interrelated with each other (Bryson, 2019).

The physical world becomes a huge source of information for AI and there were different phases of the development which integrate the real world and virtual world data. The Physical world possesses the virtual identity for the IoT in the development phases of AI. The three simple steps for AI are capturing the input, Processing the data, and production of the required outputs. The development of IoT-A (Internet of Things- Architecture) takes a step forward in the development. The development of the Transmission Control Protocol (TCP) and wireless communication like the development of File Transfer Protocol (FTP) and New Technology in File Transfer (NTFS) add an extra layer to the field of the development of the IoT extensively (Eliseeva *et al*., 2020). The development of the embedded system by adding the physical object with the virtual reality (VR) makes huge coordination between the data. In phase 2013, the development of cloud computing is one of the major steps in the development of the IoT. Cloud computing integrates the worldwide database for the user's experience and people can use many facilities with the aid of cloud computing without having bulk-sized software or application in their system. The National Institute of Standards Technology (NIST) develops the layer phase physical system for cybernetics (CPS) which ensures the smart connection between the IoT and smart devices. It is encompassed the health sector, smart home building, , manufacturing sector, and transport facilities (Dong *et al*., 2021). The development in the Augmented Reality (AR) and people can watch the three dimension object in the captured place (connectivity with the smartphone camera) moreover, people can use their camera to measure the length, area of the place, and object volume of the given shape by using the smartphone camera. In the development of AR, the Google Virtual Development team plays a significant role in this case. The INTEL in the year 2017 creates a robust design in the electronic processor that is embedded

with the internal core system to generate the data for the user interface. There is extensive research still going on in the development of IoT, and AI to make people's lives better.

Various ways the IoT has been approached, according to different schools of thought on achieving AI.

IoT devices generally generate a wide range of data that needs to be collected for some activities that are required for the output which can be done with the help of the AI algorithms which help to convert the data into results that can be implemented by the IoT devices. There are various schools of thought on the achievement of AI, in this point, the discussion will be on the influence of AI in the IoT (Newman,2018). Although the various schools of thought differ from each other, one common thing that is certain is that it will help in the development of the economy in the future The various schools of thought are discussed here:

Dystopian thought: This school of thought focuses on what can be the negative effects of AI on the planet. This thought elaborates that AI will be in the dominating charge for the high-skill jobs and the low-skill jobs will be aligned to the robots which will result in high unemployment, low wages, and a downturn in the economic system of the world (Qilin, 2022). According to the school, the productivity of human capability will also go slow the income of the individual will also decrease as well as the demand for goods and services.

The utopian thought: This school of thought is generally based on the positive effects of AI on the world economy, the scholar of the school believe that AI will help the development of the economy as the machine will help the human brain to accelerate the work and will generate more productivity. Human will apply their cognitive skills while AI will enable the ease of physical work. The school also believes that the amalgamation of cognitive and physical skills will help to generate an economy with increased productivity.

Tech optimistic thought: This school of thought focuses on the optimistic result due to the technological advancement that AI has brought. Many companies are still in the learning stage in the application of AI, however, this school of thought believes that the companies will eventually grasp the opportunity of this technological advantage which will help to generate profit for them as it will help in the increase of the productivity and help in the economic development of the nation as well. This school of thought believes that investment is required for training and educating individuals to gain the advantage of AI.

Lack of productivity thought: While most school of thought believes that there will be an increase in productivity due to the use of AI but this thought believes that due to the use of robotics, there will be a lack of productivity.

Realistic thought: This school of thought believes that it is crucial to be realistic in all approaches, it focuses on the realism behind the application of AI and the fundamental changes that occur in the business due to the implementation of AI. The school of thought believes that AI will help in productivity but there will be a decrease in employment level especially in the middle-skill job, however, the job that required high-level skills and the low-level skill will increase.

AI needs some capabilities to process the information that receives and to deliver the output. The capabilities that are required by the AI are a natural language processing system that helps to understand and evaluate the language that is essential for the communication and next representation of knowledge so that the AI can store and generate the data that it has received the capability of automated reasoning helps the AI to gather knowledge and to derive information from and finally the capabilities of machine learning of the AI that helps them to adopt the environment and detect the ongoing patterns from the past actions.

The social impact and ethical aspects of the IoT, including comparatively from different ethical perspectives.

The use of IoT devices has become ubiquitous and the number of devices that are connected today is about 31 billion which is estimated to rise to 75 billion by 2025, it has been observed that most of the IoT devices are used by private consumers in Smart home devices like set-top boxes, speakers, lighting, lock, TVs and much more as the number of devices increases there is also an increase in the potential attacks(Schiller, *et al.*,2022). Nowadays consumers depend on technology and are expected that the smart devices connected to the system will listen to the voice commands, due to this access to the IoT there is an infringement of privacy as the consumer cannot control the fact that only the commands they will convey will be processed by the IoT, even the private conversation are also get process and stored and thus there is a high concern about the security in the today's world. It is important to have appropriate social behavior while using the IoT as it is interconnected with the cyber environment that links various devices systems and data, however, inappropriate behavior can put the individual at potential risk related to the IoT.

The interconnected technology of the IoT is vulnerable to cyber attacks from any part of the world and thus it is important to make the security of the IoT more compact. The devices should be built on the basis of social and ethical values which helps them to get protected from cyber attacks. Cyber security played a crucial role while implementing the IoT in smart home devices, to protect the devices, a few things should need to be emphasised such as confidentiality which helps to keep the data private and can only be accessed by authorised users. Secondly,

authentication is required to control such devices so that the information cannot easily tamper so it should be encrypted and protected by a password, thirdly, only authorised users should have access to such devices (Ketu and Mishra, 2022).

There are various social and ethical issues related to the IoT, social issues are the problems that affect an individual or an entire society. IoT is an impediment to the climate change goals as it produces near about 3.5% of Global emissions within 10 years which is expected to rise by 14% by 2040, sensors are generally had a detrimental effect on the environment as it has a huge power consumption capability(SlideShare,2023). For instance, autonomous vehicles controlled by a device controlled by the IoT have anti-Lock brakes if the car met with an accident who will be responsible for such an act becoming a social issue? The most common applications of the IoT in the smart home are the integration of devices for security and safety purposes which includes survivals cameras, smart alarms, and much more all of this can be accessed on the smartphone even if the individual is not present at home as long as they are connected with the internet. Survivelence camera is extremely helpful as it helps to monitor senior citizens and newborns even in the physical absence of the individual but Technology has no ethics and thus it can expose personal things to corrupt persons.

There are certain ethical issues that arise due to the use of the IoT. For instance, Email advertisements and various add notices received over the phone that are interrupting the customers are generally portrayed on the basis of information by assessing the IoT and it has been observed that cybercriminals often hack the Security locks and other systems by easily getting access with the help of the IoT devices that are connected and captured various camera footage without the knowledge of the individual. To prevent such ethical issues it is necessary for the government to put some regulations on the use of the IoT and while building those devices it is necessary to keep the emphasis on ethical codes and it is also necessary to improve the security to a large extent and to increase customer awareness.

- ***Identify and appraise the current state of the art in the topic.***

IoT is a dynamic network that generally manages various objects in an intelligent way that allows the interconnection of the devices which will share information that will improve the lives of humans. People are always looking forward to a new approach to having a luxurious life for that they had implemented the IoT to control the various smart appliances in their homes and to manage various tasks at home. The state of the art in the IoT includes the security and

privacy that needs to be maintained and their applications in various fields. An IoT ecosystem basically involved various smart devices that are connected to the internet and use an incorporated system like sensors, and processors. The sensors enable the device to gather data and enable the devices to perform the task assigned, they are generally embedded in the Smartphone and various other electrical appliances and other signal-based devices that help to create a network that is well connected with the IoT(Infonomics Society,2023). The devices that are connected to the IoT perform the task without human intervention just on the basis of the command but human interaction is necessary with the device to configure to command or to access the data. IoT basically performs tasks on the basis of AI which enables machine learning that helps to generate data in a more convenient way and it also helps together a large amount of data in real-time, with the help of the IoT device it is possible to detect the potential threat in the smart homes. There are various types of sensors generally used in the applications of the IoT, Smartphone sensors- There is various sensor that is installed in the smartphone which is convenient to use the device, with the ubiquitous use of the smartphone among people there is a significant amount of increase in the IoT.

The neural sensor- This sensor enables medical personnel to get insight into the brain and provides them with a better learning opportunity regarding the matter related to the brain. Even sometimes it is used to check the veracity of the statement of the offenders.The Technologies of the IoT are generally based on the hardware system, the software devices, the route of communication, and the platform(Researchgate,2023). The hardware system is generally the bridge between the digital world and reality and is available in the forms like the sensor in a smartphone. Software devices generally collect the data, process it and generate the output according to the user command.The root of communication of the IoT is generally based on the satellite control or the Wi-Fi LAN, the communication is essential otherwise the IoT will not be considered because connectivity is the crucial factor.

- ***Identify and examine key challenges or barriers to further developing current knowledge and practice in the topic.***

The crucial role played by the IoT in smart homes is the management of home security by monitoring the person that will have the access to the home with the help of the smart lock features. It will also help to identify intruders before granting access to the home with the help of the smart doorbells as it has high definition cameras which automatically get active by the

motion of the intruders and with the help of this the authorised person gets notified by in their smartphone which is connected with the IoT. In the case of some infringement of security, the smart devices also have an input alarm that triggers an alarm to contact the police to ensure safety at home. IoT generally combines with AI which helps to evaluate better performance (Hammi, *et al*.,2022). The main advantage of the IoT is that the smart home can share real-time data so that home security can be protected as early as possible. Although there are a plethora of advantages of using the IoT in smart homes, there are some shortcomings related to the IoT which act as an impediment to the further development of the IoT. Some of the greatest challenges that act as a barrier to the development of the IoT are discussed here:

Security related to IoT-it is the vital part related to the IoT that needs to evaluate, the developers of the IoT should lay emphasis on tightening the security otherwise the personal information are vulnerable and can be easily accessed by unauthorised person. IoT connects various elements like software Hardware storage and network connectivity which can be easily exploit exploited by hackers To ensure security it is necessary to properly evaluate the security of the home by a cyber security expertise, security threats like the default setting of the devices often store the data which are at a high risk to get access by unauthorised persons thus it is important to encrypt the data while transferring it to the cloud.

Cost related to IoT- Another challenge related to the further development of IoT is that it is very expensive as the infrastructure of the IoT needs to be properly designed (Ahmetoglu, *et al*.,2022). Due to the ever-changing technological environment the IoT often needs to get updated and be maintained properly which requires the replacement of outdated devices and cyber security also needs to be updated.

Integration-For the proper working of the IoT it is necessary to integrate it with various devices and with various security platforms and data storage platforms like OS, Cloud Service and others in failure to achieve in the proper integration will result in the low usage of the product and it may not survive in the at one Technology environment

Reliability-For the effectiveness of the iot in the smart homes it is necessary to be reliable and it should be working efficiently few sensors that are easily available are in expensive but not reliable so before inputting the IoT in the smart homes it is necessary to check the reliability of the IoT-connected devices

Strong Connectivity- Before implementing the IoT in the smart homes it is necessary that the connectivity is from otherwise it will not transfer data properly if the devices are placed in the areas which have no connectivity it will not give the same output that is required so it is

essential to ensure that there is proper connectivity otherwise there will be a failure in the system

Quality check-It is important to check the quality of the devices connected with the IoT from time to time so that the security does not get open to threat.

Design of the device-IoT becomes an important thing across the world as the interface allows to use of multiple devices at a time so it is necessary that the devices should be well designed and the battery life should be made well.

Establish and justify a position, grounded in the above context and discussions, on how research in this area should proceed.

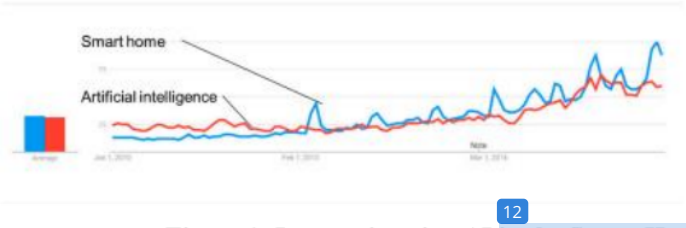

Figure 1: Interest in using AI in the Smart Home

Source:(Guo *et al.*, 2019)

It is seen from the above figure that the usage of AI and the interest of people in the implementation of AI in smart home development increases over time. It is in the design phase in the year 2010 and people have less level of interest in using AI in smart home development. The IoT and integration of AI in different aspects are there in the year 2010 and people are less aware of this in 2010. It is also seen that by the end of 2016, the using of AI and IoT in the smart home is in the phase of extensive use and it is increased over time.

In this report, there are core functionalities of IoT and AI and they are management of the device, management of the energy, Intelligent interaction of the healthcare, and security & surveillance (Guo *et al.*, 2019).

Figure 2: Percentage of different phases of AI in smart home management

Source:(Guo *et al.*, 2019)

The above figure, it is shown the functionalities of AI in smart home interaction. In all aspects, there are six steps of AI and they are active recognition, processing of data, Making decisions, recognition of images, prediction analysis, and voice recognition.

It is seen that energy management 34% needs data processing and 33% decision making and the other percentage 11% and which means device management cannot be done very effectively by voice recognition and more work needs to be done in this area (Guo *et al.*, 2019.)

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In the case of energy management, 43% of AI is used in data processing and 33% in active data recognition and only 5% is in decision-making. It means AI in smart home management cannot take effective decisions in energy management. It also shows that energy management by voice recognition cannot be done and users need to control some of the energy devices (AC and television) manually from their device and the voice-over function does not function very well in this case.

In the case of health management by AI 60% of data is produced by active recognition and it implies that AI can detect health data like heart rate, Oxygen saturation, and step-counting (walking) very well and the percentage of image recognition and voice-over control are few in this case. Samsung Smart Health, Google Health, and Apple Health are some of the useful mediums to monitor the smart health status moreover, there is still may work to do in the case of voice-over control over a certain operation. Health management is essential to monitor the health status of the family member even if located far from the home and people can take necessary action in an emergency situation on time (Guo *et al*., 2019).

The intelligent interaction has 53% weightage in this case and people may use Google Assistance, Apple Siri, and Amazon Alexa in phone calls to their contacts, take notes, and listen to music on their devices. The smart interaction between the user and deceive in this case work well with AI and Smart home device (like Google Nest).

In the case of security and surveillance, there are 60% of the data processing and 40% of the image recognition are done by the AI in order to produce the outcomes. Any trespassing in the home premises by unauthorised people and AI can monitor the body gesture and movement with a body temperature of the unknown and can trigger the alarm to generate consciousness.

In the overall data, it is seen that there is extensive work in the field of decision-making, voice-over control, and image recognition by AI is needed. The overall neural architecture of building an AI framework is a huge task and time-consuming, however, with the aid of modern technology and innovation, AI is getting better with the passage of time.

Recommendation

It is evident that the integration of AI with the IoT makes people's lives better with the passage of time. Moreover, the most concerning fact, in this case, is the data privacy and data security of the people (Park *et al*., 2019). The data may be affected by malware attacks and leakage of the data is always associated with people's privacy and other important information. It is seen from Figure 2 that AI needs more work in image recognition and voice-over control. There are

visually impaired people and voice-over control can be a good medium for them (Abdi *et al*., 2019). The smart transcriber and translator integrated with AI can be useful in this case.

Conclusion

The Internet of Things (IoT) and AI are integral parts of each other and it saves a considerable amount of time for people and smart interaction with modern devices and well-established connectivity with a family member in the case of an emergency. Although it is true, that the hierarchy in the AI algorithm still needs a considerably good amount of work to integrate with people's lives and their daily work. The avoidance of data breaches and malware attacks must be reduced in order to convey user information in the wrong hand.

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