



Learning Outcomes

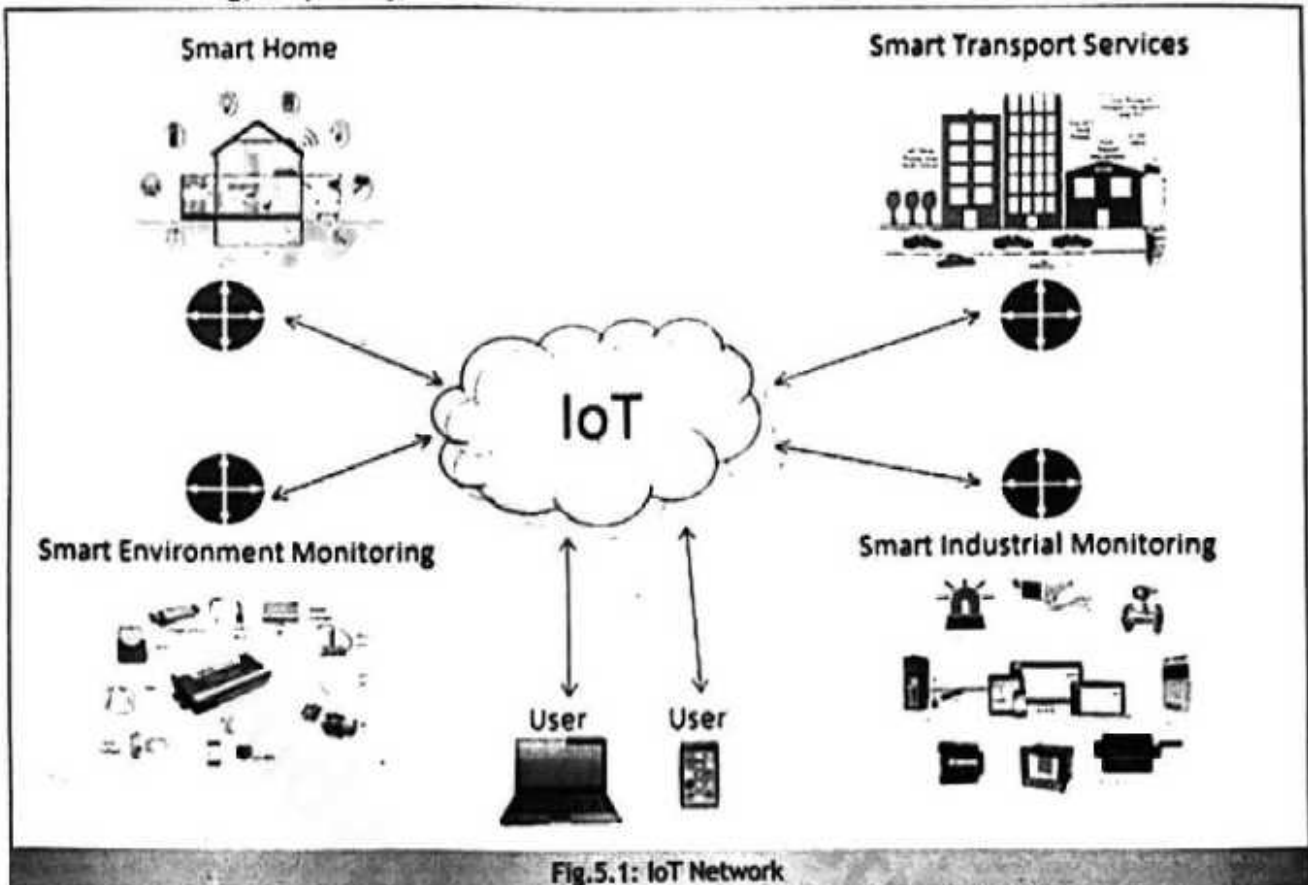
At the end of this unit students will be able to:

- describe uses and applications that are enabled by technologies like IoT and Blockchain.
- explain that AI can be applied to specific applications in areas like NLP, Robotics, Speech Recognition, etc.
- demonstrate the social implications of AI.

INTERNET
OF
THINGS

5.1 Internet of Things (IoT)

IoT is an infrastructure that consists of network of servers that provides connectivity between multiple devices and facilitates man to machine and machine to machine interaction. It collects data from multiple IoT devices, stores it in cloud storage and processes it using technologies such as data analytics and machine learning algorithms. The aim of IoT is to provide automation in various areas such as home automation, automation in manufacturing industry, healthcare, traffic monitoring, hospitality, etc.



5.2 Foundational Components of IoT

There are five foundational components of IoT that make it work.

- Sensors/Devices
- User Interface
- Cloud
- Connectivity
- Data Processing

5.2.1 Sensors/Devices

Sensors or devices are used in IoT system to collect data from our surroundings. This data can come from a large variety of sensors.

Some commonly used sensors are:

- Temperature sensors
- Humidity/Moisture level detection sensors
- Pressure sensors
- Light intensity sensors
- Proximity detection sensors

These sensors are simple ones but it can be complex as well such as surveillance camera paired with IoT devices like alarm to take action when criminal activity takes place. A device can be more than just sensing various types of data. For example, a smart phone is a device that has multiple sensors which include camera, light, proximity, temperature, heart rate, etc. A sensor can be a standalone device or a multiple device like a smart phone.



Fig.5.2: IoT based video surveillance

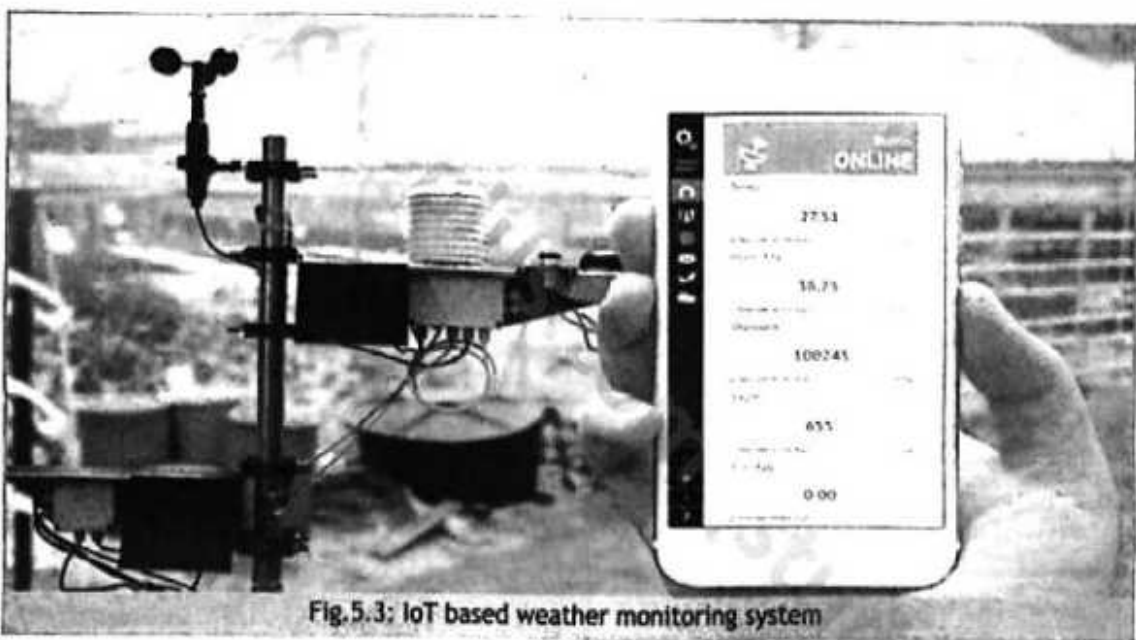


Fig.5.3: IoT based weather monitoring system

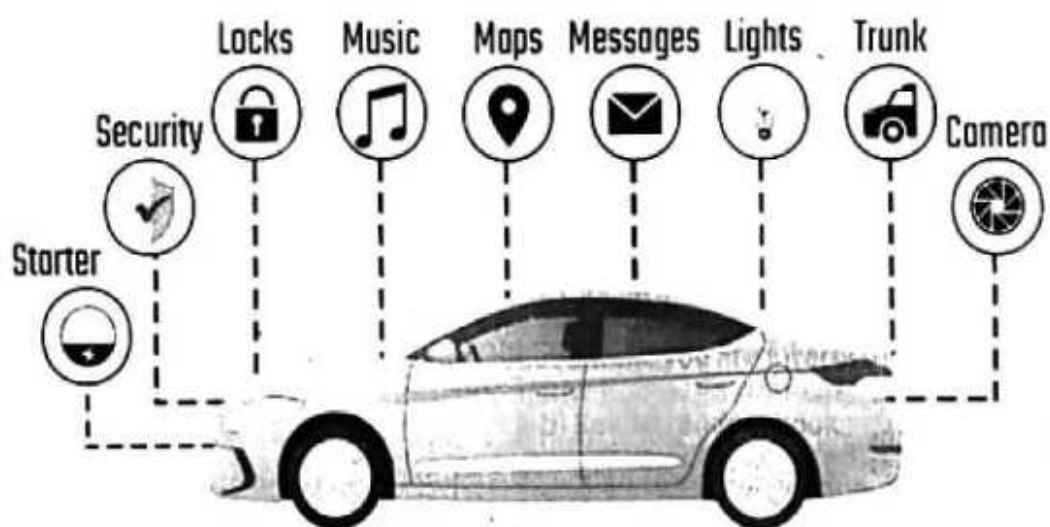


Fig.5.4: IoT application in automobile



Fig.5.5: IoT based smart classrooms

5.2.2 User Interface

User interface provides user-friendly interface and functionalities that allows users to access and control the IoT devices.

For examples, a user has a camera installed in his home, he can check the video recordings through a web server. As another example, in case any intruders are sensed, the IoT system can generate an alert to the owner.

5.2.3 Cloud

The data collected from different devices is stored on the cloud storage. Cloud computing or cloud infrastructure is a set of servers that works continuously (24x7) over the Internet. IoT cloud is responsible for data collection from devices, processing of data and management. The data can be accessed remotely from the cloud storage at any time by the users to take decisions.

IoT cloud is a network of servers that efficiently handles data at high speeds for a large number of devices and analyzes it.

5.2.4 Connectivity

The data collected by IoT has to be sent to the cloud infrastructure through some type of communication media. Devices are connected to the cloud through cellular networks, satellite networks, Wi-Fi, Bluetooth, Wide Area Network (WAN), etc.

5.2.5 Data Processing

Data processing is the process of analyzing and interpreting the data stored in the cloud storage using software. Data processing is responsible for receiving raw data from the IoT devices, processing it and making it available for action. A variety of technologies such as analytics platforms and machine learning algorithms are used for data processing.

Do you know?

An analytics platform is an integration of multiple application software that provides comprehensive capabilities to connect, organize, visualize and analyze data. It helps organizations to build their strategies based on data.

Do you know?

Machine learning algorithms are computational models that allow computers to understand data patterns and make decisions or predict output based on it. These algorithms form the foundation of artificial intelligence.

5.3 Applications of IoT

The following are common applications of IoT.

5.3.1 IoT Wearables



Fig.5.6: IoT Wearables

Many small wearable devices equipped with sensors have been developed by many companies for measurements and readings of users' data. Some examples include wearable bands used for monitoring heart beat rate, calorie expenditure and GPS tracking belts. Samsung, Apple and Google have developed many wearable Internet of Things that are used in our daily life.

5.3.2 Healthcare

Special IoT devices are used in hospitals to enhance the quality of healthcare services for patients. In modern hospitals smart beds are used that are equipped with various types of sensors to observe vital signs of patients in real-time. These sensors continuously monitor patient's vital signs such as blood pressure, oxygen level in blood, temperature, etc. and alert the nurse or doctor to urgently attend the patient if needed. Wearable sensors are also connected to patients outside the hospital that allow doctors to monitor them in real-time.

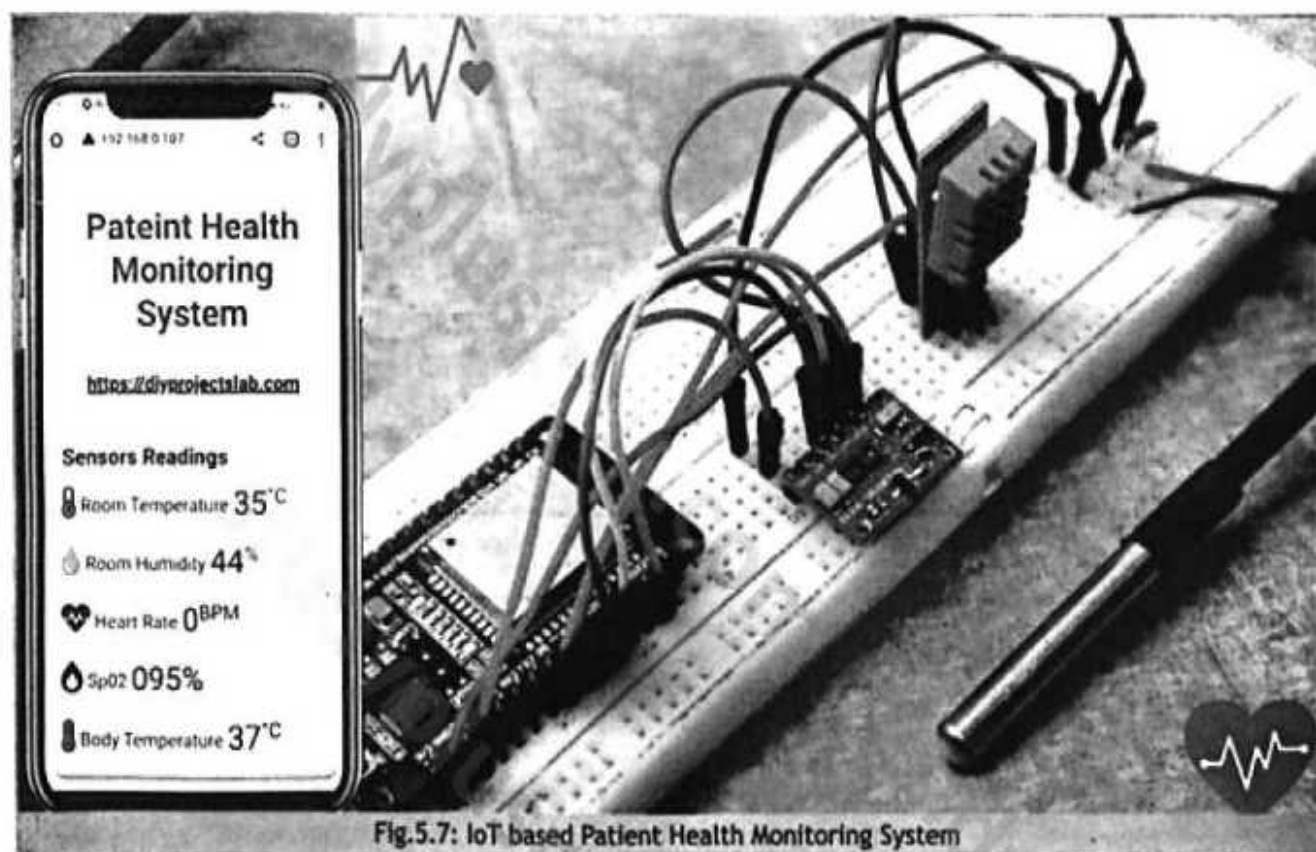


Fig.5.7: IoT based Patient Health Monitoring System

5.3.3 Traffic Monitoring

Traffic jams have become a big issue in big cities. IoT allows authorities to monitor and analyze real-time traffic data. It helps in improving the flow of traffic in areas with congestion and ensures road safety for drivers. Cameras and sensors are used to detect accidents, vehicle breakdowns and road hazards. The traffic data collected by IoT devices is transmitted to the traffic management control center for quick action to resolve issues. Moreover, IoT devices provide real-time updates on weather conditions for safety of drivers.



Fig.5.8: IoT based traffic monitoring

5.3.4 Hospitality

Smart hotels are using IoT technology to improve the quality of services for guests by automating many things.

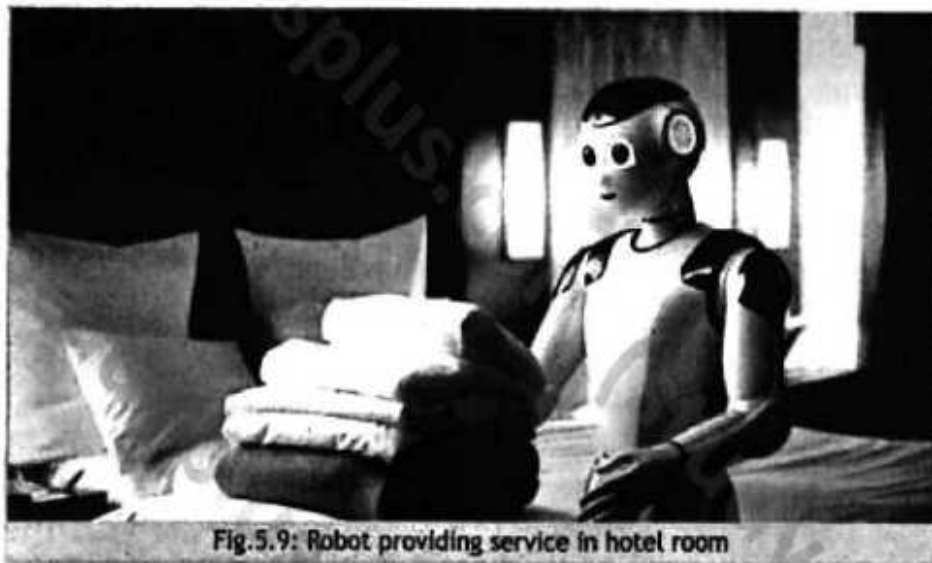


Fig.5.9: Robot providing service in hotel room

The following are some applications of IoT in hotels.

- Some hotels are staffed with robots that help in performing various tasks such as cleaning rooms, transporting guest's luggage, providing location-relevant information, etc.
- Hotels use sensors to detect when the guest enters the room and automatically adjust the room temperature and lighting.
- Sensors can detect whether the guest is in the room or not. When he leaves, appliances used by him are automatically switched off, saving electricity.
- Using IoT technology, hotels can automatically send a digital key to guest's mobile phone that can communicate with the door to open or close. It is also a security feature enabled by IoT.

5.3.5 Industrial Automation

There are various applications of IoT technology in automation of various tasks in industry. These tasks include quality control, product flow monitoring, supply chain optimization, inventory management, packaging of products, safety of products, etc. IoT sensors can collect and analyze data on machine performance, temperature, vibration and other factors. Application of IoT in industrial automation has enhanced efficiency, productivity and safety in manufacturing.



Fig.5.10: IoT in automotive industry

5.3.6 Smart Grid

Smart grids and traditional electrical grids use the same transmission lines, transformers, etc., for supply of electricity. The only difference is that smart grids use IoT devices that can communicate with each other and also with the consumer. It provides valuable information to the consumer about their electricity consumption and how they can reduce their electricity expenditure. Smart grids can monitor and analyze the production of electricity and make predictions when power supply may not be available. This will allow power companies to take quick actions to reduce chances of this happening. Traditional grids generate estimated bills whereas smart grids can generate more accurate as it measures electrical usage in real-time for each household.

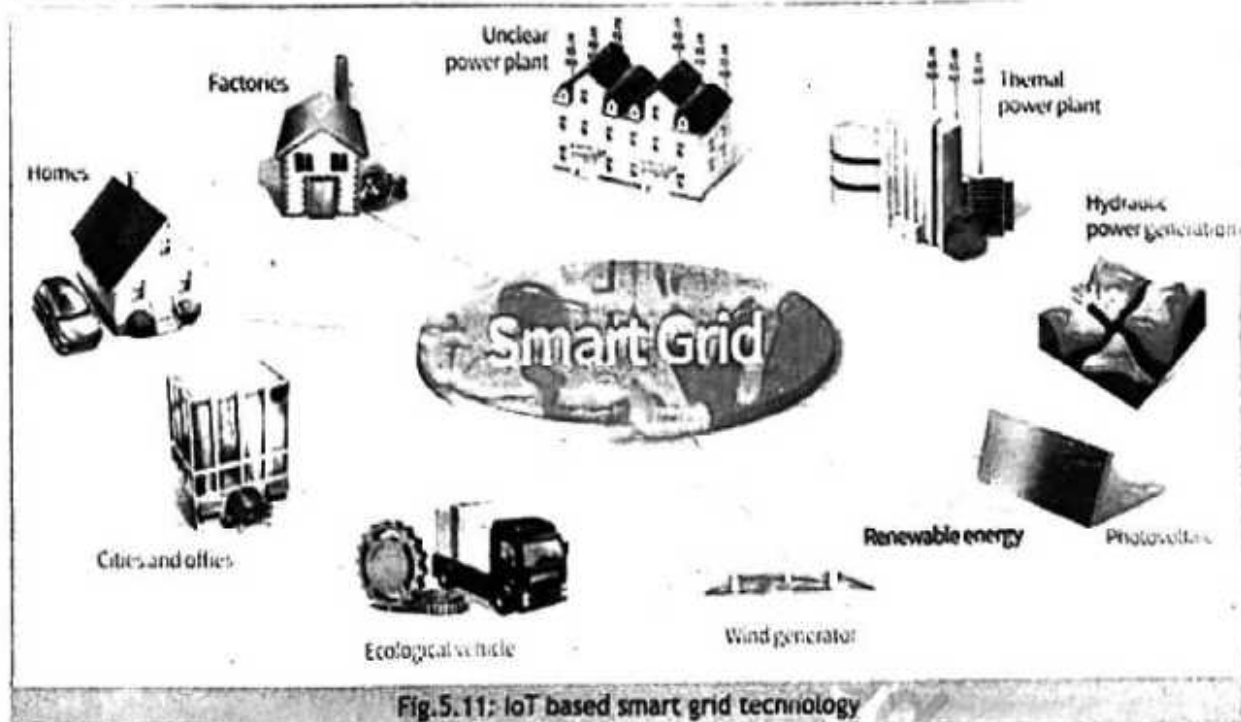


Fig.5.11: IoT based smart grid technology

5.3.7 Smart Farming

IoT-based smart farming uses various sensors that provide detailed information about soil condition to farmers. It uses sensors that monitor light, humidity, temperature, moisture, level of acidity, etc. Smart farming helps farmers control irrigation. It helps in making more efficient use of water, specify best time to start sowing and discover the presence of diseases in plants and soil.

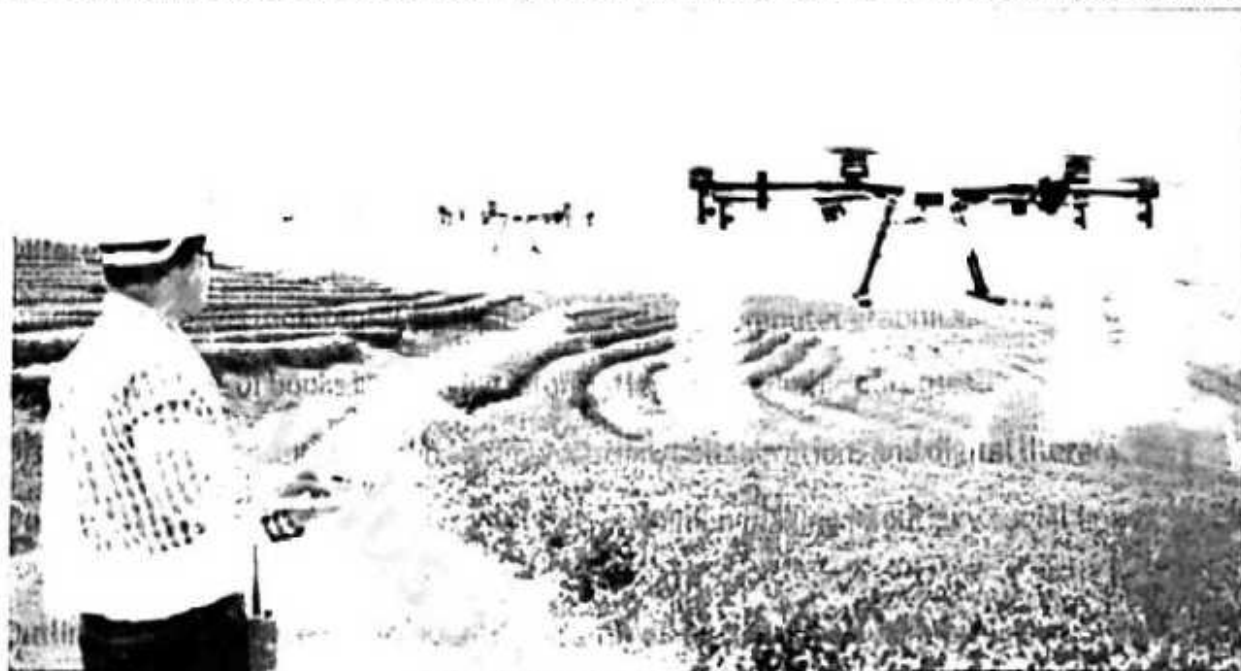


Fig.5.12: IoT based Smart Farming

5.3.8 Smart home

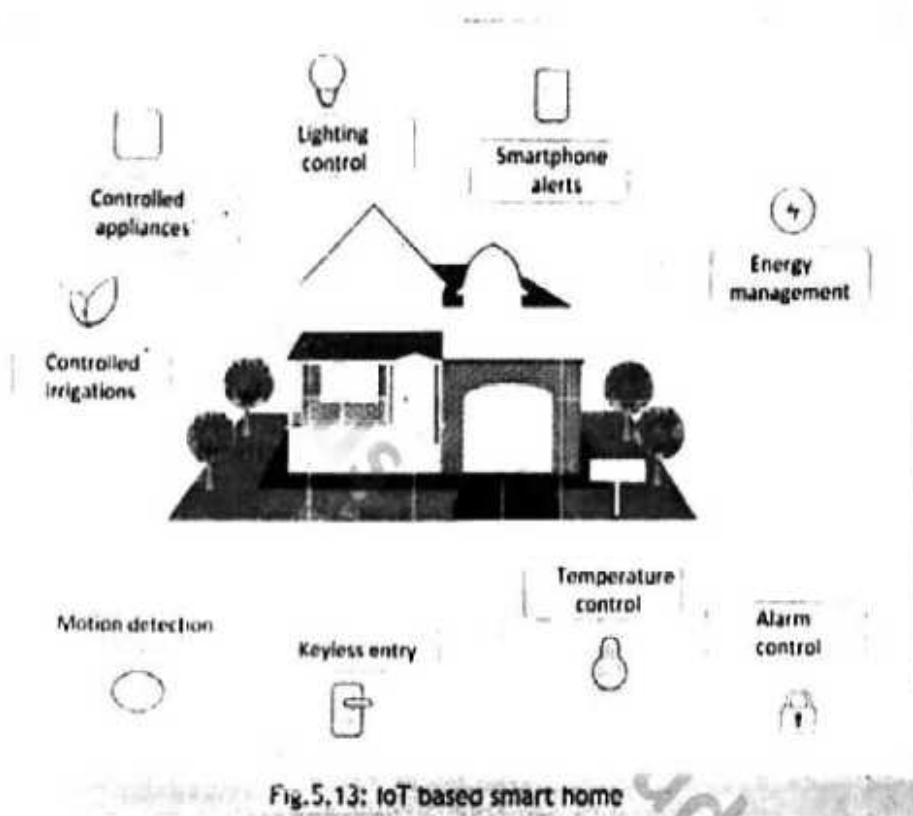


Fig.5.13: IoT based smart home

A smart home is based on IoT technology to provide convenience to home owners in using home appliances. All the appliances equipped with sensors are connected with each other to collect and share information and automatically perform specific tasks. The smart home system consists of devices such as smart light bulbs, smart security system having cameras, smart door locks, television, refrigerator, air-conditioner, etc. All these devices are remotely controlled using Internet connection from anywhere through an app installed on mobile phone, tablet or computer.

5.4 Blockchain Technology

Blockchain technology has become popular during the recent years. A Blockchain is a digital ledger or database of transactions that continuously grows. It is created, maintained and shared by network users. It plays an important role in cryptocurrency networks such as Bitcoin. It is very safe to use Blockchain for recording sensitive transactions as it is difficult to modify or delete the contents of a block (transaction) after it has been added at the end of the Blockchain. It also provides quick and easy transactions for individuals when needed.

5.5 Applications of Blockchain

The following are common applications of Blockchain:

5.5.1 Management of Supply Chain

Blockchain technology is very useful for real-time tracking of products during their journey across the supply chain. Blockchain helps in allocating the current location of products as products change hands between different parties in the supply chain. It also provides increased transparency and security as it is very difficult to change or delete contents of transaction data in the ledger.

5.5.2 Healthcare

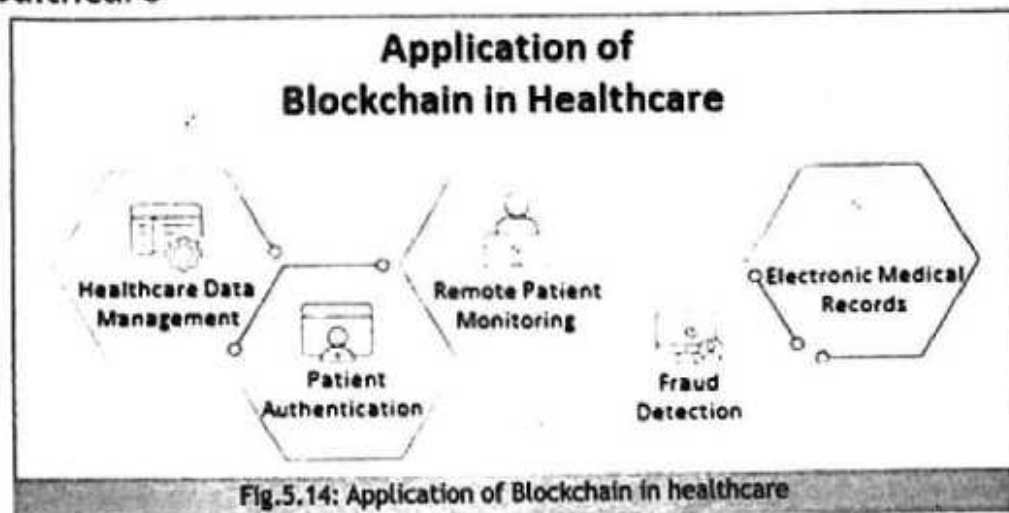


Fig.5.14: Application of Blockchain in healthcare

Blockchain has wide range of applications in healthcare. Some applications of Blockchain in healthcare are managing healthcare data, patient authentication, remote patient monitoring, fraud detection and electronic medical records. It is implemented in healthcare for data

integrity, access control and data logging. Blockchain provides patient data security which aids in improving healthcare services in hospitals and research institutes.

5.5.3 Protection of Copyright and Intellectual Property

Blockchain technology makes it easy to protect copyright and intellectual property rights internationally on music, films, books, blogs and other internet contents as it operates globally. It is very useful in protecting people's creative work by making it easy to apply copyright regulations. It helps in reducing copyright violations due to its secure and transparent nature. Any type of unauthorized download of digital material can be traced easily.

5.5.4 Voting

Blockchain technology helps in building trust and satisfaction of citizens on Election Day and speeding the time for announcing the final results. It is useful in solving issues related with manual and digital voting systems such as voter privacy and fraud. Through encryption Blockchain makes voting safer, more transparent, protects privacy of voters and it is more cost effective as well. Application of Blockchain technology in voting is still under research.

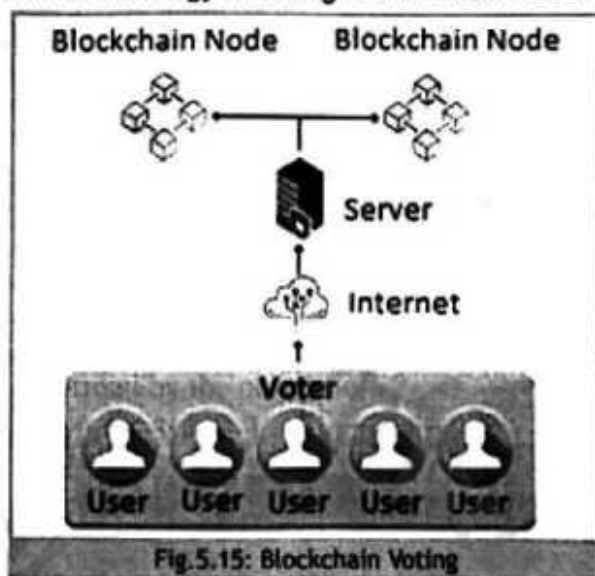


Fig.5.15: Blockchain Voting

5.5.5 Cryptocurrency

Blockchain technology has enabled the existence of cryptocurrency. Bitcoin is the best-known cryptocurrency. Cryptocurrency is a digital (or virtual) currency that facilitates direct payment without the involvement of intermediaries such as bank. It works through peer-to-peer global network without central clearing authority. Global peer-to-peer network is a worldwide network of computers in which all the computers have the same capabilities. In a peer-to-peer network, each computer can access the shared resources of other computers and share its own resources with other computers as well. In this type of network there is no need of a central computer or server. Cryptocurrency uses Blockchain technology to record and process transactions while maintaining transparency and security of financial information. Blockchain has the ability to improve business processes between companies by providing a direct and quick way of making payments.

5.5.6 Asset Administration

The key features of Blockchain technology such as decentralization, transparency and security create efficient and trustworthy system for managing assets. It is a new approach to managing digital assets. Digital assets means anything that is created and stored digitally, has value and ownership. Digital assets include photos, videos, books, cryptocurrency, music, illustrations, logos, etc.

Today, our lives are more digitally based. For example, when we are looking for information about anything, we turn to the Internet that stores digitally hosted information on any topic because it is easier and quicker than going to a library.

5.6 Cloud Computing

Cloud computing is the delivery of computing services such as servers, storage, database, networking and application software over the cloud (Internet). It is an alternative to on-premises computing in business. It enhances business productivity in various ways.

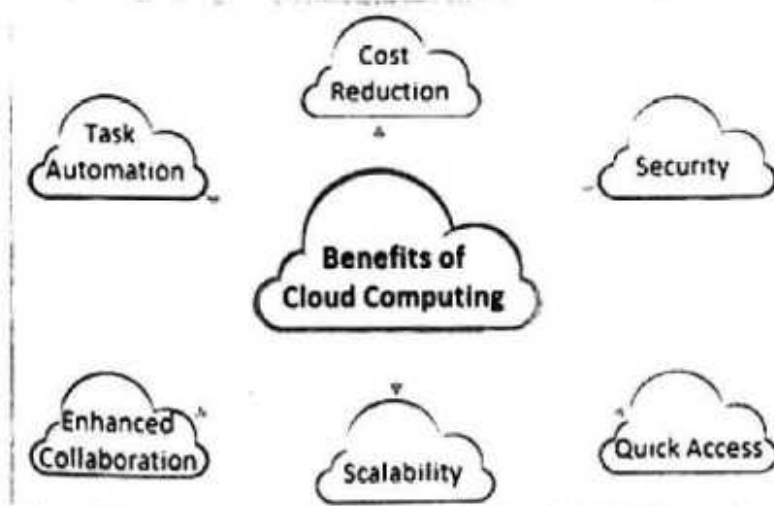


Fig.5.16: Benefits of Cloud Computing

5.6.1 Benefits of Cloud Computing

Cost Reduction

With on-premises computing, we have to purchase and install hardware, install the operating system and required applications and set up the whole infrastructure. Cloud computing reduces huge cost of buying hardware, software and setting up the networking infrastructure. Besides, the cloud provider is responsible for the maintenance of hardware and software.

Security

Cloud providers provide better security than on-premises systems. Cloud service providers follow best security practices and take active steps to defend against modern-day cyber-attacks. It is the responsibility of cloud providers to update cloud systems, fix bugs and resolve security issues. Data stored in cloud storage is at low risk. Cloud providers can restore the data from backups maintained in cloud storage.

Quick Access

Cloud computing provides quick access to resources, within few clicks. Employees can easily connect to cloud services from anywhere using devices like smartphones, tablets and laptops. Clients and customers can also log in and access their information.

Scalability

Cloud computing allows businesses to scale up or scale down in response to the changing circumstances and requirements. If business grows and demands increase, the cloud capacity can be easily increased without having to invest in physical infrastructure. Scalability minimizes the risks associated with on-premises operational issues and maintenance.

Enhanced Collaboration

In cloud computing, employees have easy access to essential business information whether they are working in the same office or remotely, increasing productivity. It enhances collaboration among teams anywhere in the world at any time. This leads to more efficient and effective performance.

Automation of Tasks

Cloud computing helps in streamlining business operations. It allows automation of time-consuming tasks. Cloud-based tools and services can automate companies tasks like data backups and software updates, freeing employees to focus on more important business activities.

5.6.2 Uses of Cloud Computing

The following are the uses of cloud computing

File Storage

Files storage is the most common use of cloud computing. Cloud-based storage system enables users to store and access files from any location. All you need is an Internet connection. Cloud-based storage is secure and affordable.

Data Backup

It is essential for individuals, organizations and businesses to backup data for protection and recovery in case of disaster. Cloud computing provides solution to this. It allows users to backup important files to cloud-based storage systems. Data on cloud-based storage systems can be encrypted to make it impossible for hackers to access. Some examples of cloud-based storage systems are Dropbox, Google Drive, OneDrive, iCloud, and Amazon.

Education

Cloud computing has revolutionized education. It is very effective in teaching and learning process. Cloud computing platforms store course material such as assignments, videos and quizzes in the cloud. It enables students and teachers all over the world to access educational material from leading institutions from anywhere. Some examples of cloud-based education solutions are Khan Academy, Coursera, edX, and Google Classroom.

eCommerce

Cloud computing provides cloud-based solutions for buying and selling products and services over the Internet which is known as eCommerce. It provides fast and secure shopping to customers. Shopify, WooCommerce and BigCommerce are some examples of cloud-based eCommerce solutions.

Social Networks

Social networks are one of the most popular uses of Internet. Cloud-based social networking platforms allow users to connect and share information with friends, family and customers and form relationships. There are many social networking platforms. These include Facebook, WhatsApp, Instagram, Tiktok, YouTube, LinkedIn and X which is the new name of Twitter.

Communication

Cloud computing provides reliable, secure and cost-effective communication services over the Internet. It uses various methods for communication such as email, chat, voice, video conferencing and social media. Cloud-based communication services are provided by Microsoft Teams, Zoom and Google Workspace.

Gaming

Gaming refers to playing video games for entertainment and education. Cloud computing provides cloud-based gaming solutions. It provides access to a variety of high-quality games on any device and from anywhere. Some examples of cloud-based gaming services are Microsoft Xbox Cloud Gaming, Amazon Luna, PlayStation Plus Premium and Nvidia GeForce Now.

5.7 Speech Recognition and Voice Recognition

Speech recognition and voice recognition are two different technologies though they are closely related.

Speech Recognition

Speech recognition is a form of artificial intelligence. It is a software that converts human speech into text form or commands that devices can understand and respond to. It provides hands-free control of various devices and equipment. It provides an easy way to operate devices and some hands-free equipment is very helpful for disabled persons.

The software used for speech recognition is quite complex as it involves signal processing, machine learning and natural language processing. The output accuracy of speech recognition software may depend on the quality of original recording and the complexity of the language. After the conversion of spoken words into text, the user can further process the text to correct the mistakes by running it through spelling and grammar check.

Voice Recognition

Voice recognition software converts voice into digital data based on the user's unique voice characteristics. Voice recognition is a biometric system. It is used to verify a person's identity based on unique features of his voice such as tone, pitch, etc.

Both speech and voice recognition technologies are used for interaction between humans and machines. These technologies are used in various fields to automate various tasks, create convenience, save people's time and improve productivity.

The following are the applications of speech recognition.

5.7.1 Speech to Text Typing Applications (Dictation Software)

There are a variety of speech to text typing software which is also known as dictation software. Dictation software was used in the early days but they had little accuracy. Now, dictation apps are AI-based and give better results but still cannot provide 100% results. Dictation software is very helpful for people with disabilities as they can use it to type more easily.



Fig.5.17: Using dictation software

The following are some popular dictation software.

- Apple Dictation: It is a dictation software on Apple devices.
- Windows 11 Speech Recognition: It is a dictation software for Windows.
- Google Docs: It is a voice typing software for dictating Google Docs.
- Gboard: It is a dictation app for mobile phones.

5.7.2 Calls Centers

Speech recognition systems are used in calls centers to automate customer interactions. They are used to respond to customers' requests and improve productivity.

5.7.3 Healthcare

Automatic speech recognition systems are used in healthcare for efficiency and accuracy. Doctors use it to convert speech in to text for medical reports and updating patients' electronic health records.

5.7.4 AI Assistants

AI Assistants such as Siri, Cortana and Alexa are commonly used to help us in carrying out various tasks at home and at work. For example, AI Assistants can help us to turn lights on in our home, search for something on the Internet, give directions while driving and adjust thermostat. Thermostat is a device connected to central heating/cooling systems in homes and offices to control the temperature.

5.7.5 Quran Memorization Applications

Memorization of Quran is an important religious and spiritual practice in Islam. It is the Holy Book of Allah Subhanahu Wa Ta'ala and is reserved in the hearts of Muslims. Memorization of Quran is an act of worship and those who memorize it will get the reward in the hereafter. Memorization of Quran opens the doors of goodness, virtue, righteousness and morality.

There are many Quran memorization apps available on App Store, Google Play and websites. These apps use creative methods and techniques for easy memorization of Quran.

They provide features like audio recitation, interactive learning tools, progress tracking, selection of reciter and selection and repetition of verses. It can

also detect mistakes and provide feedback for correction. Some popular Quran memorization apps are Tarteel, Al Murqi, Quran Companion, Al Muhaffiz, Ayat-Al Quran and Quran Pro.

5.7.6 Language Translation

Speech Recognition systems are also used with machine translation software to convert human speech from one language to another. It helps to have conversation with someone who does not understand our language. It is very helpful for international business and organizations.

The following are applications of voice recognition.

5.7.7 Voice Recognition for Security

Voice recognition systems are used in various fields such as banking to recognize a specific voice for authentication and work as unique password to unlock protected account. The account cannot be unlocked by other people as their voice sound is different. Sometimes voice recognition is used along with facial recognition for identification of people.



Fig.5.18: Ayat-Al Quran Memorization App



Fig.5.19: Voice Recognition

5.7.8 Criminal Investigation and National Security

Voice recognition is used all over the world to solve crimes. If voice recording of a crime suspect is available, voice recognition technology can be used to provide evidence and identify criminals. Voice recognition can be helpful in investigating telephone-based fraud. It can also be used for surveillance of organized crimes on telephone and the Internet.

National security agencies use voice recognition technology to identify terrorist and government spies.



Fig.5.20: Voice recognition for criminal investigation

5.8 Natural Language Processing

Natural Language Processing (NLP) is a branch of Artificial Intelligence. It gives computers the ability to understand text and spoken words the same way humans do. Writing AI-based NLP software is extremely difficult task. The NLP software has to accurately understand the intended meaning of text or voice data for interaction between computers and humans. It is about making computers learn, process and manipulated natural language just like human brain.

NLP plays a growing role in increasing efficiency and productivity in business. It is very helpful in streamlining business operations and simplifying business processes.

The following are some common applications of NLP.

5.8.1 Email Filtering

We receive pile of emails every day which are related with our work, studies or many other things. Some emails are important to use and some promotional or spam. Spam is unwanted junk email sent in bulk. Spam can be advertisement, marketing message or even malware (malicious software) that can be harmful. The NLP email filtering software uses artificial intelligence to identify the incoming emails as important or spam and places them into their respective folders. This is done by detecting certain words or phrases in the emails that signal a spam message. Email filtering is not 100% accurate. Sometimes an important email is wrongly identified as spam.

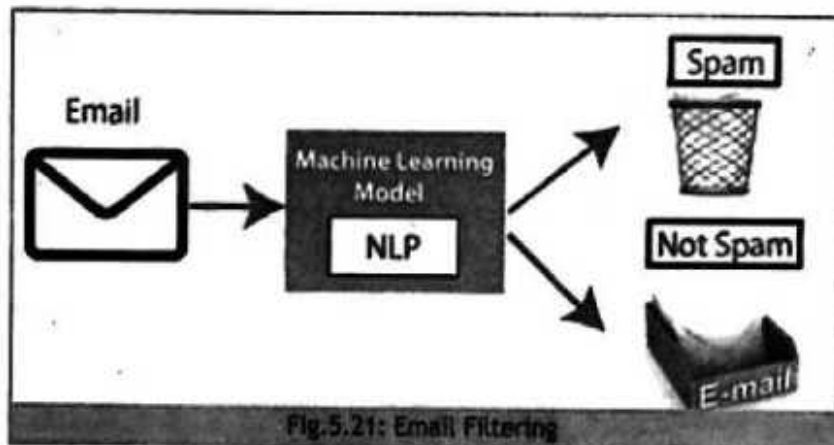


Fig.5.21: Email Filtering

5:8.2 Language Translation

NLP language translation software can translate written or spoken words from one language to another. It uses AI technologies known as Machine Learning (ML) and Deep Learning (DL). It is very helpful in removing language barriers. For example, it enables world leaders to participate in meetings where everyone speaks a different language. Here computer software and human interpreters work together to translate the speech into other languages. NLP programs can translate many other things such as books, business letters, websites, etc. and reduce cost of translation as well. The level of accuracy has increased as the technology is growing and advancing.

5.8.3 Document Analysis

Document analysis is an important application of NLP. Organizations, businesses, institutions and many such places have pile of documents stored in computers. The data stored in documents is properly organized, searched for and maintained using NLP. The NLP software extracts specific information from documents and categorizes it according to the user's requirements. It is very helpful in analyzing the data and making decisions and important predictions. It also helps in finding a person's information from pile of files.



Fig.5.22: Document Analysis

5.8.4 Predictive Text

Making online searches is a very common task we perform on our smartphones and laptops. The NLP algorithms generate a list of predictive text, that is, probable next words or phrases as soon as we type anything in the search bar. We can click on any predictive text that matches the information we are looking for to display the relevant websites. Predictive text improves the search speed, enhances our experience and ensures that the suggestions align with our intention.

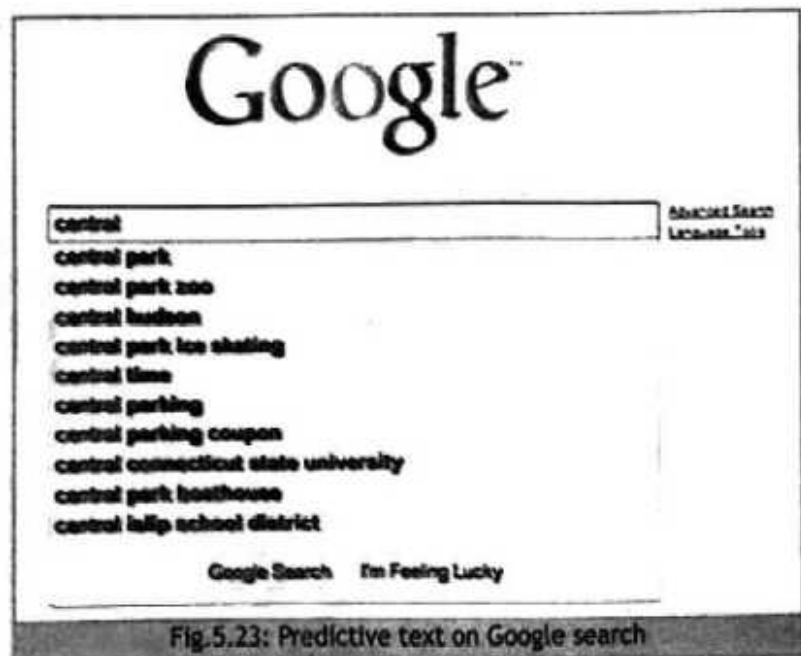


Fig.5.23: Predictive text on Google search

5.8.5 Sentiment Analysis

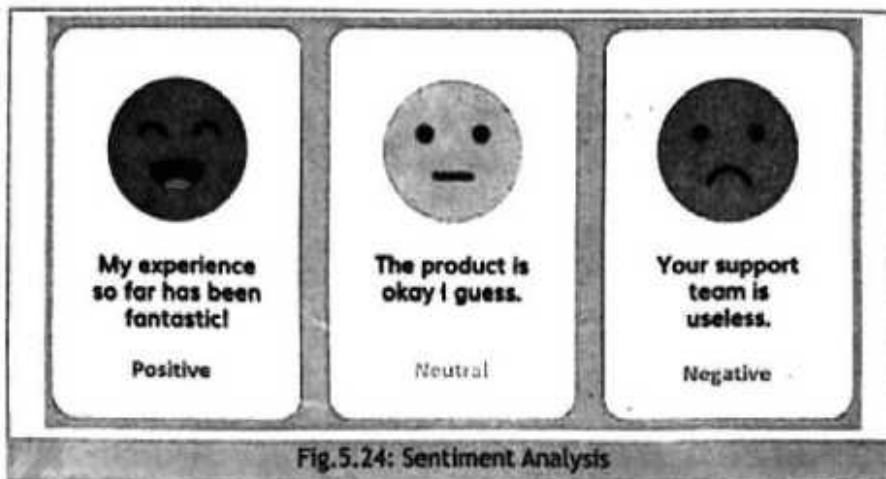


Fig.5.24: Sentiment Analysis

Sentiment analysis is an application of NLP technology to analyze text like humans and determine if the emotional tone of the message is positive, negative or neutral. Companies and business have huge amount of data like emails, reviews, social media comments and articles. Sentiment analysis on this data can be performed to identify the emotional tone of people and determine their opinions about a product, service or idea. For example, sentiment analysis can be performed on customer service to understand customer satisfaction levels and identify the areas for improvement. It can also be performed on a car model, smartphone or any other product to know whether people have positive or negative views about it.

5.9 Robotics

Robotics is a combination of artificial intelligence and engineering. It involves designing, creation and operation of automated machine programmed to perform tasks like humans. Over the years, robotics has developed sophisticated machines to assist humans in a wide range of industries all over the world.

The following are some applications of robotics.

5.9.1 Robots in Rescue Operations

Rescue robots are used for a variety of rescue operations. Firefighting robots are used to combat fire and rescue humans. Rescue robots are also used in natural disasters such as earthquakes, floods, landslides, hurricanes, cyclones and tornadoes to rescue people by searching, removing rubble, delivering supplies and medical treatment.



Fig.5.25: Rescue robot

5.9.2 Robots in Manufacturing Industries



Fig.5.26: Robot in manufacturing.

Robots are used in manufacturing industry for automation of a variety of tasks. These tasks include assembly, welding, painting, product packaging, shipping, loading and unloading parts, etc. They are used to perform repeated tasks and to streamline assembly workflow. Robots replace human workers in some manufacturing industries performing dangerous tasks that may cause injury. Robots generally work in collaboration with human workers. Use of robots has increased productivity and reduced operation cost.

5.9.3 Roomba Robots

Roomba robot is a popular autonomous vacuum cleaner. It is a disk-shaped machine capable of picking dirt, dust, hair, etc. It is usually smaller than a traditional vacuum cleaner. It moves around the cleaning area and under furniture cleaning floors and returns to its dock when finished. While cleaning, it automatically turns away when approaching obstacles. Cleaning area boundaries can be set to restrict its movement. The direction of Roomba robot can be controlled by remote controller.



Fig.5.27: Roomba Robot

5.9.4 Robots in Farming

Robots are used in farming for planting, harvesting, soil analysis, surveillance and monitoring. The purpose of using robots in farming is to reduce cost, optimize harvest and improve working conditions for farmers and workers.

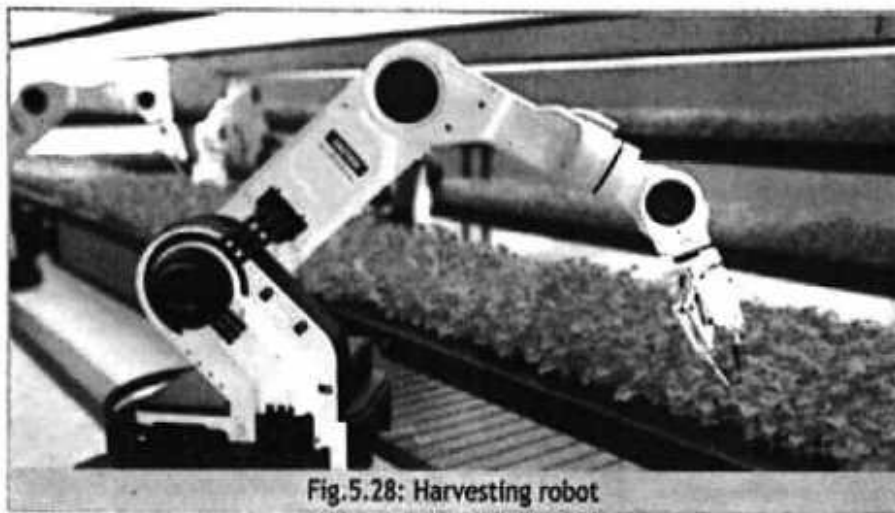


Fig.5.28: Harvesting robot

Various types of robots are designed and programmed to perform specific tasks on farms and agricultural environment.

- Robots developed for harvesting are used for picking fruits and vegetables.
- Spraying robots are used for spraying water and pesticides to plants that need it.
- Grafting robots automate the process of grafting, improve crop quality and reduce labor requirements.
- Palletizing robots are used for stacking and arranging harvest onto pallets for storage or transport.
- Drone robots are used to provide surveillance and monitoring.

5.9.5 Robots in Space Exploration

Robots play an important role in space exploration. Robots help astronauts in performing tasks such as collecting of soil samples, taking pictures of rock formation and sending them back on earth for scientists to study.

Robots help in repair and maintenance of spaceships and space vehicles millions of miles away from earth. Using unmanned space missions using robots are common today to learn about our universe. Robots can work in dangerous space environment as they don't need food, water or oxygen. They can work in extreme temperatures and radiation levels which is not possible for humans.



Fig.5.29: Robot in space exploration

5.9.6 Robots in Healthcare

Use of robots in modern hospitals is transforming the way surgeries and many other tasks are performed by healthcare professionals.

- Partially automated robots are used by surgeons to assist in performing high-precision operations in less time.
- Robots are used to replace healthcare professionals and perform their tasks in unsafe environment such as treatment of COVID-19 infected patient.
- Automated Mobile Robots (AMRs) are used to sanitize hospital rooms and make them ready for patients.
- AMRs are also used to deliver medication and medical supplies and move heavy items such as beds.
- Hospital pharmacies utilize robots to store, pick and refill pharmaceuticals.



Fig. 5.30: Robots used in operation room

5.10 Bias and Unethical use of Artificial Intelligence

Artificial Intelligence has become integral part of modern society. It has brought positive impact in many areas of our daily lives but has some negative impact as well. Biased and unethical use of AI based systems has become a big concern all over the world as it can result in injustice to specific people. AI algorithms are developed by humans who can intentionally or unintentionally introduce bias in them. Bias means unfairness or discrimination against someone based on race, ethnicity, gender, age, etc. Unethical means something that is not morally correct such as unfair usage of AI related with violation of personal data or gaining unauthorized access to other's systems. AI based systems are not thoroughly checked for racial or gender biases. If the data used in training an AI system is incorrect, impartial, incomplete or biased in any way then the resulting AI system can cause injustice, hurt people and cause harm.

In, 2015, Amazon realized that their AI algorithm used for hiring employees favored men over women. The reason for this injustice was that the algorithm was based on the number of resumes submitted over the past ten years mostly belonged to male applicants.

As another example, it was observed that the facial recognition technology has sometimes produced wrong results for people with darker skin tones. This can cause injustice to people who are misidentified by the system in a criminal investigation.

The following are some examples of bias and unethical use of AI systems.

➤ **Privacy Breaches**

Privacy breaches are concerned with the violation of protection of personal data. AI systems have the ability to store and process huge amount of data which is vulnerable to privacy violation.

➤ **Social Manipulation and Misinformation**

AI systems can spread propaganda and manipulate social media trends such as peoples' likes and dislikes or changing their opinions related with all the aspects of society.

➤ **Cyber Security Threats**

AI system can employ techniques that can be used in cyber-attacks to gain unauthorized access to other's computer systems. This can lead to financial loss, privacy invasion or identity theft.

➤ **Financial Market Manipulation**

AI systems can be used to manipulate stock market that can lead to economic instability.

➤ **Deepfake Videos**

Deepfake videos are computer created AI based realistic fake videos. These videos misrepresent someone or saying something that was not actually done or said. Such videos can spread misinformation, defamation or change public opinion.

5.11 Responsibilities of AI System Designers

AI technology is shaping the future of humanity. It improves efficiency and provides innovative solutions in various sectors of our society. The designers of AI systems must keep in mind the ethical and social responsibilities while developing AI systems.

The following are the responsibilities of AI system designers:

- They must ensure that the use of AI technology does not result in injustice to specific groups of people.
- They are responsible for safeguarding user data privacy. The use of AI systems should not endanger people's privacy.
- AI system designers must ensure fairness, transparency and impartiality while developing AI algorithms.
- They should take into considerations the ethical values to prevent harm to anyone.
- They should ensure that the use of AI systems benefits humanity and improves people's quality of life.
- They should ensure that AI systems are designed to gain the trust of people and shape our future in positive direction.

Unit Summary

- **IoT** is an infrastructure that consists of network of servers that provides connectivity between multiple devices and facilitates man to machine and machine to machine interaction.
- **IoT cloud** is a network of servers that efficiently handles data at high speeds for a large number of devices and analyzes it.
- **Smart grids** and traditional electrical grids use the same transmission lines, transformers, etc., for supply of electricity. The only difference is that smart grids use IoT devices that can communicate with each other and also with the consumer.
- **Smart home** is based on IoT technology to provide convenience to home owners in using home appliances.
- **Blockchain** is a digital ledger or database of transactions that continuously grows. It is created, maintained and shared by network users.
- **Cryptocurrency** is a digital (or virtual) currency that facilitates direct payment without the involvement of intermediaries such as bank. It works through peer-to-peer global network without central clearing authority.
- **Cloud computing** is the delivery of computing services such as servers, storage, database, networking and application software over the cloud (Internet).
- **Speech recognition** is a form of artificial intelligence. It is a software that converts human speech into text form or commands that devices can understand and respond to.
- **Voice recognition software** converts voice into digital data based on the user's unique voice characteristics. Voice recognition is a biometric system.
- **Natural Language Processing (NLP)** is a branch of Artificial Intelligence. It gives computers the ability to understand text and spoken words the same way humans do.
- The NLP algorithms generate a list of **predictive text**, that is, probable next words or phrases as soon as we type anything in the search bar.
- **Sentiment analysis** is an application of NLP technology to analyze text like humans and determine if the emotional tone of the message is positive, negative or neutral.
- **Robotics** is a combination of artificial intelligence and engineering. It involves designing, creation and operation of automated machine programmed to perform tasks like humans.
- **Roomba robot** is a popular autonomous vacuum cleaner. It is a disk-shaped machine capable of picking dirt, dust, hair, etc.

Exercise

Q1. Select the best answer for the following MCQs.

1. The technology used for management of supply chain is known as:
a. IoT b. Blockchain c. Cloud Computing d. AI Assistant
2. The technology that provides automation in manufacturing industry, healthcare, home, traffic monitoring, etc. is known as:
a. IoT b. Blockchain c. Cloud Computing d. Robotics
3. The technology that is an alternative to on-premises computing in business is:
a. AI Computing b. Server Computing
c. Cloud Computing d. Network Computing
4. Branch of AI that gives computer the ability to understand text and spoken words like humans is known as:
a. Language Translation b. Digital Language Processing
c. Robotics d. Natural Language Processing
5. The technology that enabled the existence of Cryptocurrency is:
a. Cloud Computing b. Blockchain c. Robotics d. IoT
6. The virtual assistant developed by Microsoft is:
a. Cortana b. Siri c. Alexa d. Bixby
7. The probable next words or phrases that are displayed as we type anything in the search bar is called:
a. Document Analysis b. Sentiment Analysis
c. Predictive Text d. Internet Suggestion
8. AI based realistic videos that are not genuine are known as:
a. Privacy Breach Videos b. Social Manipulation Videos
c. Misinformation Videos d. Deepfake Videos

Q2. Write answers of the following short response questions.

1. Describe how IOT can help traffic monitoring.
2. Describe the benefits of using Blockchain technology in maintaining a digital ledger (database) of transactions.
3. Differentiate between speech recognition and voice recognition.
4. Describe the features available in Quran memorization apps that help in the memorization of Quran.
5. Briefly describe how AI-based systems can cause injustice to some people.
6. Describe how predictive text based on NLP algorithms helps in making online searches.

Q3. Write answers of the following extended response questions.

1. Briefly describe the application of IoT in the following areas.
 - a) Healthcare
 - b) Hospitality
 - c) Smart farming
2. Briefly describe how Blockchain technology is useful in the following areas.
 - a) Management of supply chain
 - b) Voting
 - c) Protection of copyrighted and intellectual property
3. Describe any three benefits of cloud computing.
4. Describe the use of voice recognition for security and criminal investigation.
5. Briefly describe how NLP helps in email filtering and language translation.
6. Describe two applications of robots that are not mentioned in this unit.



Activity-1

Students should use online tools like Google Docs and Google sheets to show the benefits of cloud computing.



Activity-2

Present to students an IoT application like smart parking. Each parking spot has a sensor that can detect if the spot is occupied and users have applications that can check open parking spots in a parking lot or garage. The students are then presented with a scenario of a smart home with temperature sensors, fans and ACs that can be remote controlled from a smartphone, and other household items like umbrellas, lunch boxes, fridges that are connected. Ask students to imagine applications that are enabled in such an environment.



Activity-3

Students can watch different videos on how technology in different fields is automating tasks that were once done by humans.



Activity-4

Read or explain case studies of how AI has discrimination. For example, the COMPAS algorithm used in US court system. Amazon's hiring system was biased against women is another case study.