Chapter 3

IoT Enabling Technologies

IoT is enabled by several technologies including wireless sensor networks, cloud computing , big data analytics, Communication Protocols, Embedded Systems etc.

3.1 Wireless Sensor Networks:

- Wireless sensor networks are distributed devices with sensors which are used to monitor environmental and physical conditions.
- WSN consists of number of nodes, routers and a coordinator.
- Endnotes have several sensors attached to them and notes can also act as routers.
- Routers are responsible for routing the data packets from endnotes to the coordinator.
- The coordinator collects data from all the notes it also acts as a Gateway which connects WSN to the internet.
- Some examples of WSN used in IoT system:
    - Weather monitoring systems use WSNs in which the nodes collect temperature humidity which is aggregated and analysed.
    - Indoor air quality monitoring system use WSNs to collect data on the indoor air quality and concentration of various gases.
    - Soil moisture monitoring systems used WSNs to monitor soil moisture at various locations.
    - Surveillance systems used WSNs for collecting surveillance data
    - Structural health monitoring systems used WSNs to monitor the health of buildings bridges.
- WSNs are enabled by wireless communication protocol such as IEEE 802. 15. 4. Zigbee is one of the most popular wireless Technology.
- The power of WSN lies in the ability to deploy large number of low cost and low power sensing notes for continuous monitoring of environmental and physical conditions.
- WSNs are self-organizing networks. Since WSNs have large number of nodes manual configuration for each node is not possible. The self-organizing capability of WSN make the network robust. In case of failure of some notes or addition of new notes to the network, network can configure itself.

3.2 Cloud Computing:

- Cloud Computing is transformative computing paradigm that involves delivering applications and services over the internet. Cloud Computing involves provisioning of computing networking and storage resources on demand and providing this resources as metered services to the users.
- Cloud Computing resources can be supplied on demand by the users without requiring interactions with the Cloud Service Provider.

- Cloud Computing resources can be accessed over the network using standard access mechanisms that provide platform independent access through use of heterogeneous client platforms such as workstations laptops tablets and Smartphones.

3.3 Big Data Analytics:

- Big data is defined as Collection of data sets whose volume, velocity or variety is very large so that it becomes difficult to store manage, process and analyse the data using traditional databases and data processing tools.
- Big Data Analytics involves several steps starting from data cleansing, data wrangling, data processing and visualisation.
- Some examples of big data generated by iot systems:
    - Sensor data generated by iot systems from weather monitoring system
    - Machine sensor data collected from sensors embedded in Industrial and energy systems for monitoring their health and detecting failures
    - Health and fitness data generated by iot devices such as wearable fitness bands

3.4 Communication Protocols:

- Communication protocols are the backbone of IoT systems enable network connectivity and integrate with applications.
- Communication protocols allowed devices to exchange data over the network.
- This protocol defines the data exchange format, data encoding addressing schemes for devices and routing of packets from source to destination.
- Protocols also support for sequence control(ordering packets), flow control(controlling the rate at which sender is transmitting data) and retransmission of Lost packets.

3.5 Embedded Systems:

An embedded system is a computer system that has computer hardware and software embedded to perform specific task.
Key components of an embedded system include microprocessor or microcontroller, memory (RAM, ROM, cache), networking units, input output units, storage.
Some embedded systems have specialised processors such as digital signal processors, graphic processor and application specific processors.
Embedded systems run embedded operating system such as real-time operating systems.
The embedded systems range from low cost miniatured devices such as digital watches to devices such as digital cameras, point of sale terminal, vending machines, appliances like washing machines etc.