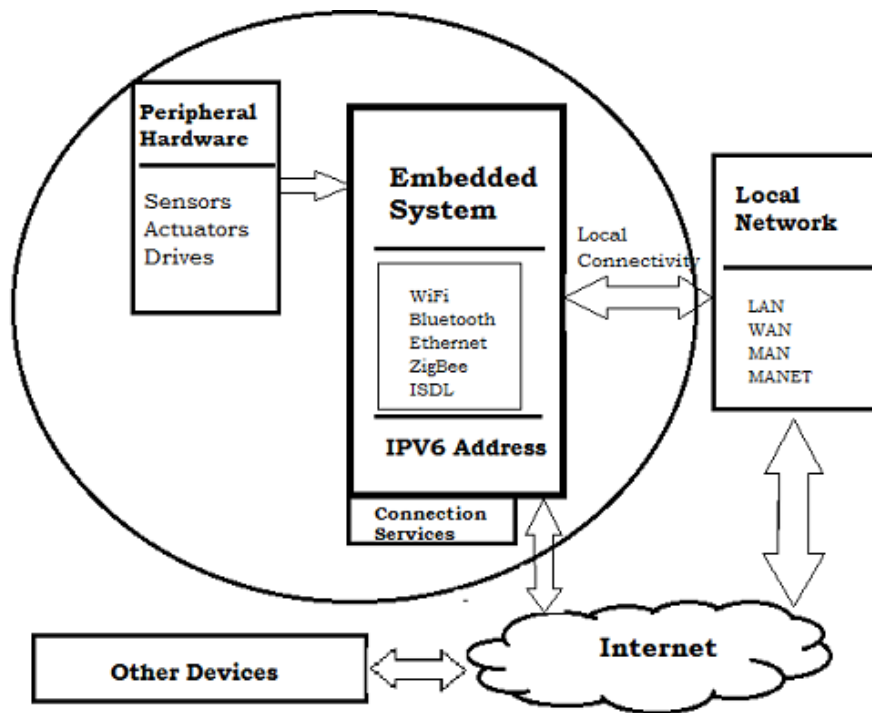## Embedded System in (IoT)

It is essential to know about the embedded devices while learning the IoT or building the projects on IoT. The embedded devices are the objects that build the unique computing system. These systems may or may not connect to the Internet.

An embedded device system generally runs as a single application. However, these devices can connect through the internet connection, and able communicate through other network devices.

Internet of Things (IoT)

Embedded System Hardware

The embedded system can be of type microcontroller or type microprocessor. Both of these types contain an integrated circuit (IC).

The essential component of the embedded system is a RISC family microcontroller like Motorola 68HC11, PIC 16F84, Atmel 8051 and many more. The most important factor that differentiates these microcontrollers with the microprocessor like 8085 is their internal read and writable memory. The essential embedded device components and system architecture are specified below.
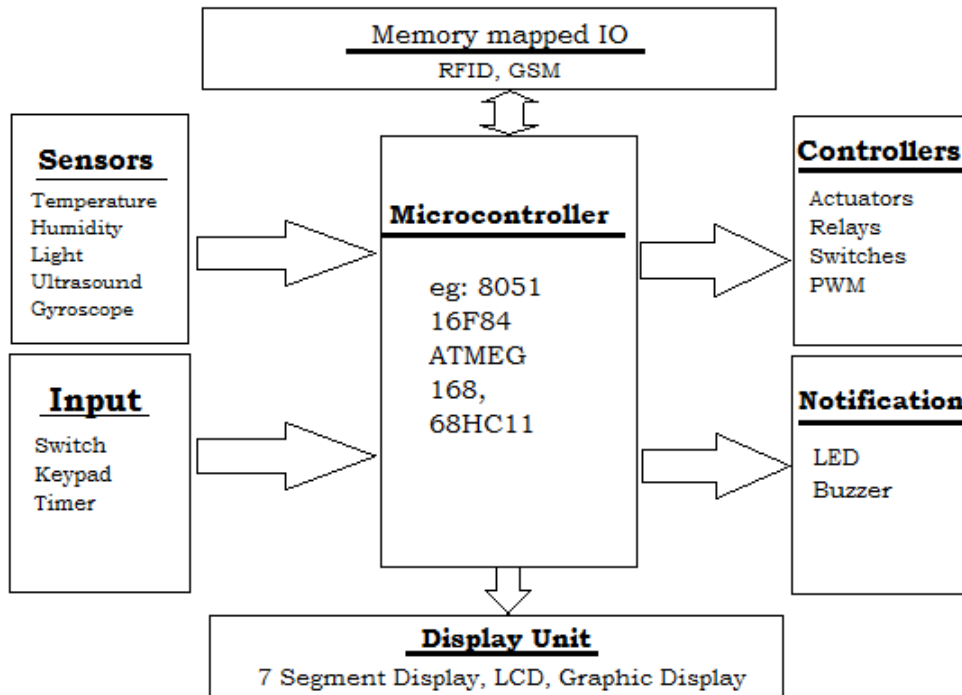
Fig:Basic Embedded System

Embedded System Software

The embedded system that uses the devices for the operating system is based on the language platform, mainly where the real-time operation would be performed. Manufacturers build embedded software in electronics, e.g., cars, telephones, modems, appliances, etc. The embedded system software can be as simple as lighting controls running using an 8-bit microcontroller. It can also be complicated software for missiles, process control systems, airplanes etc.

The Role of Embedded Systems in the IoT:

Embedded systems are at the heart of the Internet of Things. They provide the intelligence that enables devices to communicate with each other and with the cloud. The role of embedded systems in the IoT can be summarized as follows:

Sensor Integration:

Embedded systems are responsible for integrating sensors into devices. Sensors are used to detect and measure physical properties such as temperature, pressure, and humidity. These sensors generate data that is processed by the embedded system and transmitted to other devices or the cloud.

Communication:

Embedded systems are responsible for communication between devices. This communication can be wireless or wired, and can use a variety of protocols such as Wi-Fi, Bluetooth, and Zigbee. Embedded systems also handle the routing of data between devices.

Data Processing:

Embedded systems are responsible for processing the data generated by sensors. This processing can include filtering, normalization, and aggregation. The processed data is then transmitted to other devices or the cloud.

Security:

Embedded systems are responsible for the security of devices in the IoT. This includes securing data transmission, securing access to devices, and protecting against cyber attacks.

Power Management:

Embedded systems are responsible for managing the power consumption of devices in the IoT. This includes managing the power supply, optimizing power usage, and managing battery life.

Applications of Embedded Systems in IoT

Embedded systems in IoT are responsible for collecting, processing, and transmitting data between various devices and systems, and they play a crucial role in the overall functionality of IoT systems. Here are some of the applications of embedded systems in IoT:

➢ Smart Homes: Embedded systems in IoT are used in smart home applications to automate various functions such as lighting, temperature control, security, and entertainment. These systems are designed to be energy-efficient and cost-effective, and they can be controlled remotely using a smartphone or other internet-enabled devices.
➢ Industrial Automation: In industrial settings, embedded systems in IoT are used to monitor and control various machines and equipment. These systems enable real-time monitoring of production processes, ensuring that they run smoothly and efficiently. They can also detect and report any anomalies, reducing downtime and improving productivity.
➢ Healthcare: Embedded systems in IoT are used in healthcare applications to monitor vital signs, track medication schedules, and manage chronic conditions. These systems can transmit data to healthcare providers in real-time, allowing for timely intervention in case of emergencies.
➢ Agriculture: Embedded systems in IoT are used in precision agriculture to monitor soil moisture, temperature, and other environmental factors that affect crop growth. These systems enable farmers to optimize irrigation and fertilization, resulting in higher yields and reduced water usage.
➢ Transportation: Embedded systems in IoT are used in transportation applications to monitor vehicle performance, track routes, and manage logistics. These systems can also be used to monitor traffic conditions and optimize routes, reducing travel time and fuel consumption.

Examples of Embedded Systems in the IoT:

There are many examples of embedded systems in the IoT. Some examples include:

➢ Smart Home Devices:

Embedded systems are used in smart home devices such as thermostats, lighting systems, and security systems. These devices are capable of communicating with each other and with the cloud, and can be controlled by a smartphone or other device.

➢ Medical Devices:

Embedded systems are used in medical devices such as pacemakers, insulin pumps, and blood glucose monitors. These devices are capable of monitoring the patient's condition and transmitting data to healthcare providers.

➢ Industrial Automation:

Embedded systems are used in industrial automation systems such as assembly lines, robotics, and process control systems. These systems are capable of monitoring and controlling industrial processes, improving efficiency and productivity.