MID-I

Unit-I

IOT Defination: IOT is a network of physical objects, that are connected to the internet and exchange data with other devices and systems is called IOT.

Sensor: sensor is nothing but a physical device, which can sense physical parameters and convert them into electrical signal is called sensor.

Actuator: Actuator is a device that causes a machine (or) other device to operate is called actuator.

Grate ~~Arrays~~ ways: A gate way is a network node used in telecommunications that connects two networks with different transmission protocols together.

-> gateways serves as entry and exit point for a network.

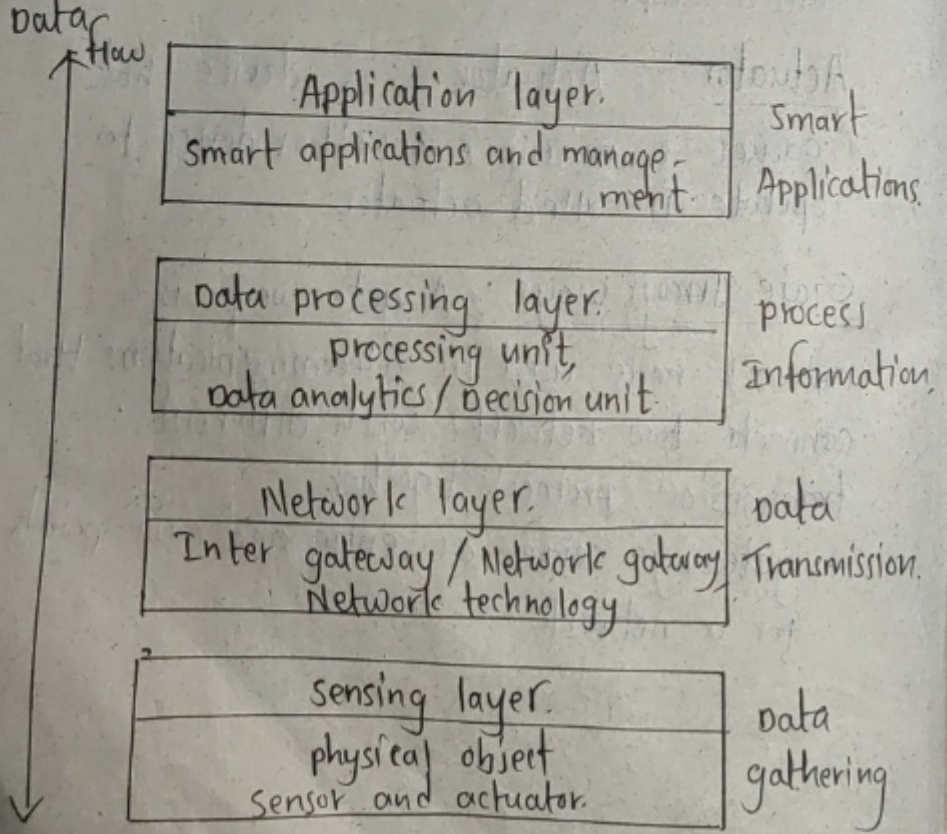
* Architecture of IOT :

-> IOT stands for Internet of Things.

-> The architecture of IOT is divided into 4 different layers i.e.

- o Sensing layer.
- o Network layer.
- o Data processing layer.
- o Application layer.

-> Architecture of IOT.



-> Block diagram shows 4-stage IOT architecture.

Sensing layer :

-> Sensing layer is the first layer of the IOT architecture.

-> This layer includes sensors and actuators.

-> It is responsible for data gathering.

-> Sensing layer connected to network layer by either wired (or) wireless.

Network layer.

-> Network layer is the second layer of the IOT architecture.

-> This layer includes Inter gateway, Network gateway etc.

-> It is responsible for data transmission.

-> It includes protocols and technologies.

-> Network technologies used in IOT are wifi, 5G, gateways, routers.

Data processing layer

-> Data processing layer is the third layer of the IOT architecture.

-> This layer includes processing unit, Decision unit. etc.

-> It is responsible for data (or) Information processing.

-> Data lake technology used in data processing layer.

Application layer:

-> Application layer is the top most layer in IOT architecture.
-> This layer includes smart applications and management
-> This layer directly interact with end-user.
-> This layer include machine learning algorithms.

* Applications of IOT

-> There are various applications for IOT.
-> IOT has made our ~~lives~~ life easier with it's applications.
-> Applications
  - Smart Agriculture
  - Smart vehicles
  - Smart home
  - Smart pollution control
  - Smart healthcare.
  - Smart Retail
  - Smart cities
  - Industrial Automation etc.

* Difference b/w M2M and IOT

M2M	IOT
-> M2M stands for machine to machine.	-> IOT stands for Internet of things.
-> It is based on hardware.	-> It is based on software
-> It uses non IP protocols	-> It uses IP based protocols
-> It is one way communication	-> It is two way communication.
-> It is less scalable.	-> It is more scalable.
-> It supports point-to-point communication.	-> It supports cloud communication.
-> Internet doesn't required.	-> Internet required
-> limited scope.	-> large scope.
-> It does not support open API's.	-> It support open API's

⇒ Design principles and needed capabilities:-

*Design principles :-

1) focus on value.
2) Take a holistic view
3) put safety first
4) consider the context.
5) Build a strong brand
6) prototype early and often
7) use data responsibility.

1) In this you need to plan carefully what features to include and in which order.
2) the whole system needs to work a seamlessly together in order to create a meaningful experience.
3) It is needed to test the end to end system.
4) the context places also one of the kind of Requirements to the design.

~~5) you have Resonates with the end u~~

5) you have built a strang band that truly Resonates ~~band that~~ with the end users.

Capabilities Needed :-

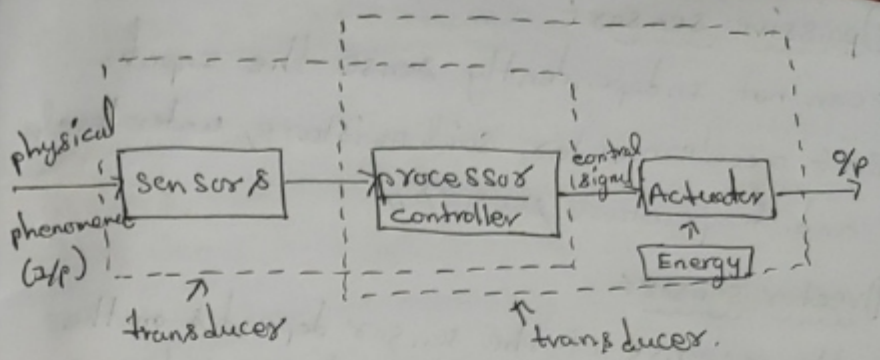
In general, the capabilities of an IoT device management platform include:

* the ability to on board and rigister your IoT devices.
* monitor your device information (such as status and location)
* perform software and firmware updates.
* mange devices at scale.
* troubleshoot problems.
* remotely configure devices, maintain...

=) Sensing :-

→) sensors are devices that detect external information replacing it with a signals that humans and machines can distinguish.

→ IoT sensors used to detect and measures various ~~signals~~ physical phenomena such as a heat and pressure as well as human senses. sight, hearing, touch, taste & smell.



Transducer :-

* the transducer converts a signal from one physical structure to another
* it converts one type of energy into anther type
* it might be used as actuator in various systems.

classification sensor :- → it use 3rd unit in (classes).

1) Active sensor :-

Independently sense the Input. Example- Radar, sounder and laser altimeter sensors.

2) Analog sensor :-

the response or output of the sensor is. some continuous function of its Input parameter.

Ex: temperature sensor, LDR, analog pressure ~~effect~~ sensor and analog hall effect.

3) passive sensor :-

* can not independently sense the input.

EX :- accelerometer, soil moisture, water level, and temperature sensors //.

4) vector sensor :-

* the response of the sensor depends on the magnitude of the direction and orientation of I/p parameter.

Ex :- Accelerometer, gyroscope, magnetic field and motion detector sensors //.

5) digital sensor :- response in binary nature.

Ex :- passive Infrared sensor and digital temp sensor.

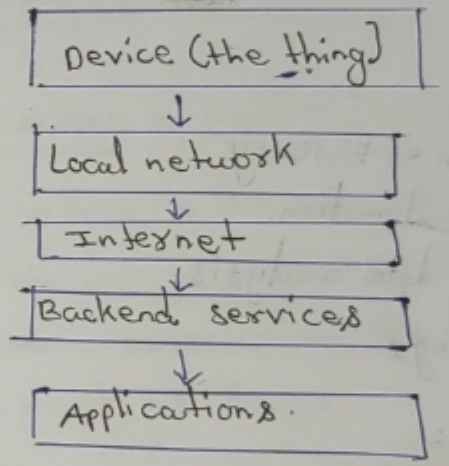
6) scaler sensor :- detect the input parameter only based on its magnitude.

Ex :- temperature, gas, strain, colour & smoke sensor //.

=) Basic of Networking :-

* IOT :- IoT Refers to the network physical devices, vehicles, home appliances, and other items embedded with sensors, software, and connectivity, allowing them to collect and exchange data.

* IOT components :-



1) devices :- sensors, actuators, and smart devices.

2) local network :- wireless communication protocols (wi-fi, bletooth, etc).

3) Applications :- sortwave that Interpets and uses IOT data.

* IoT network Architecture :-

1) Device layer :- Devices collect and transmit data.
2) Network layer :- data transmission via wireless protocols.
3) gateway layer :- data processing and filtering.
4) Application layer :- user interface and decision making.

* Benefits :-

1) Increased efficiency.
2) Improved automation.
3) enhanced data analysis.
4) cost savings.

Applications :-

* Smart Homes.
* smart cities.
* agricultural monitoring.
* wearable devices.
* health care monitoring.

* complexity of network :-

* growth of network
* interference among devices.
* network management.

* scalibity :-

* flexibility within Internet.
* IoT integration
* large deployment.

⇒ M2M (machine to machine) communication :-

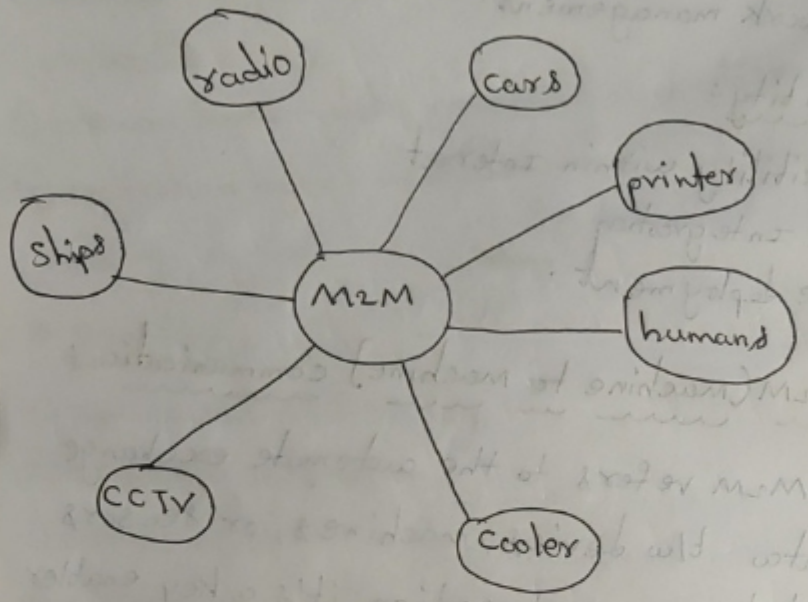
Def :- M2M refers to the automate exchange of data blw devices, machines, or sensors without human intervation, it's a key enabler of the Internet of things.

* M2M is also ~~calle~~ named as machine type communication (MTC) in 3Gpp.
* M2m is communication could carried over mobile networks.

Ex :- GSM, GPRS, networks.

* M2M is only subset of IoT.
* M2m communication, going to be the next generation of Internet revolution connecting

* enabling data to be transmitted from one device to another device through wired and wireless communication networks.



*it may be applied to robots and conveyer belts on the factor floor, tractor and irrigation on the farm//.

⟹ IoT Technology fundamentals - devices and gateways :-

→ IoT technology ~~of devices~~ fundamental devices :-

classification of devices in oIT system is :-

1) Basic device.
2) advanced device.

Basic device :-

Basic devices, microcontroller-class device are those which an perform simple operations and usually cannot communicate with each other without gateways.

Advanced device :-

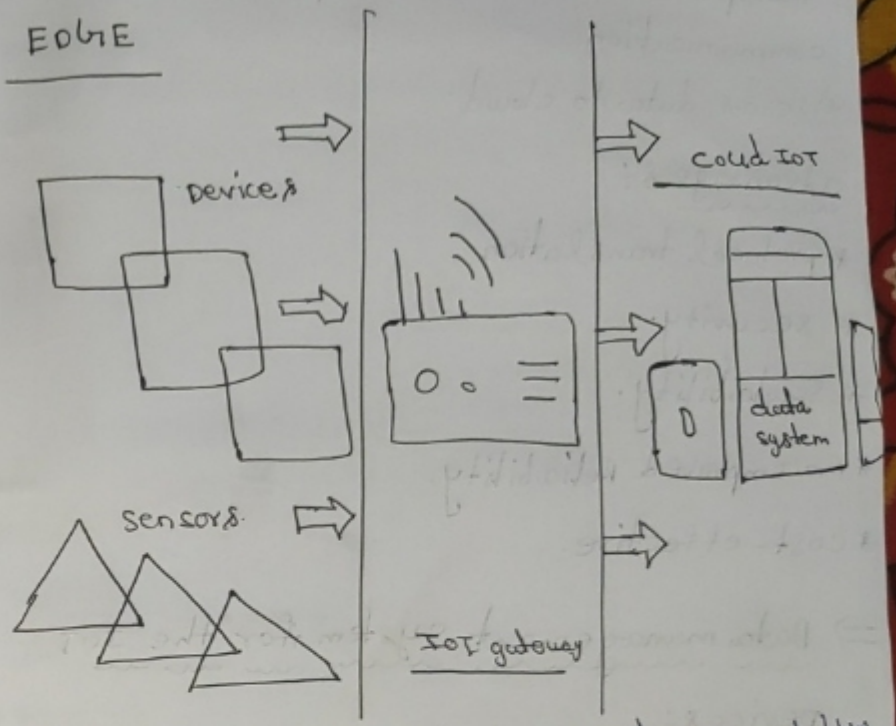
advanced devices or general purpose-class devices are performing application level logic and support communication protocols.

* Basic and advanced IoT devices are different in terms of scenario and processor.
* Basis IoT device good for performing simple process like alarms, metering.
* advanced IoT devices ave designed for more complex process.
* Basic IoT devices usually serve a single operation. it measures temperature, wind force or others. the components used for this type of devices are Inexpensive.
*it consist at least two microprocessors//.

⇒ Gateways :

Def: An IoT gateway is a hardware (or) software solution that connects devices, sensors, and actuators to the Internet, cloud, data exchange, processing and analysis called gateways.

* gateway provides a bride b/w different communication technologies. which means we can say that a gateway act a medium to open up, connection b/w the could and controller.
* it is possible to establish device to device (or) device to-cloud communication.
* a gateway can be a typical hardware device or software program.
* it enables a connection b/w the sensor network and the Internet along with enabling IoT communication.
* it also performs many other tasks this IoT gateway perform, local processing, and it providing additional device security.



* the above fig show how IoT gateway establish communication b/w sensors and the could.
* AS IoT devices work with low power comsumption.
* It consist devices, sensors, IoT gatway, data systems.

working of IoT gateway :

1) Receives data form sensor network.
2) performs pre processing filtering and cleaning on unfiltered data.

3. transports into standard protocols ~~with~~ for communication.

4) sends data to cloud.

advantages:-

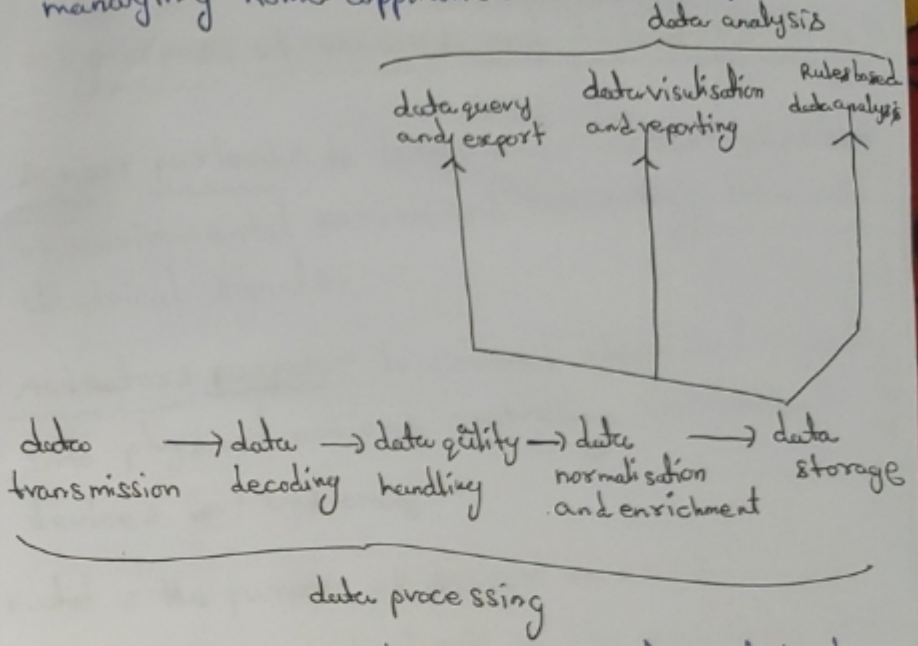
* protocal translation.
* security.
* scalability.
* ~~no~~ improved Reliability.
* cost-effective.

⇒ Data management system for the IoT devices:-

Def: An IoT data mangement system is a software framework designed to manage, process, and analyze data generated by Internet of things devices, sensors, and Actuators.

* billions of sensors Intract with peoples, homes, cities, farms, factories, vechicles, medical devices etc.

* the IoT is changing our lives from managing home appliance to vechicles.



* Devices can now advice us about what to do, when to do and where to go.
* the above fig shows steps In IoT data management.
* write own words of above diagram.

2nd - unit

=) Hardware components of IoT :

=) Arduino :

def : Arduino is a open-source electronics platform that enables users to create interactive electronics projects, combining hardware and software components.

→ Arduino Hardware :

* let us look at the harware components of Arduino :

1) Microcontroller.
2) USB port.
3) USB to serial chip.
4) digital pins.
5) Analog pins.
6) 5 V / 3.3 V
7) GND.
8) VIN

* the microcontroller controls the execution of all the programs and codes uploaded on arduino.
* the microcontral equipped with components that can perform different functions.

2) USB port :-
* this port is used to establish a connection b/w the computer and the Arduino board.

3) USB to serial chip :-
* the USB to serial port is used for adding data from the computer to the m.c.

4) digital pins :-
* these pins are used for turning the LED's on and off by using digital logic ('0' and '1').

5) Analog pins :-
* these pins are used for ~~turning~~ taking analog input.

6) 5V/3.3 pins :-
* these pins are used for supplying power to devices.

7) GND :- this pin is used for setting a Reference level.

advantages :-
* easy to learn and use.
* open-source community
* high customizable.
* Rapid prototyping.

disadvantages :-
* limited processing power.
* Not suitable for complex.
* limited wireless capabilities.

Applications :-
* Robotics.
* home automation.
* medical devices.
* IoT".

=) Raspberry-pi :-

def :- Raspberry-pi is small, low cost, open-source, single-board computer designed for education, DIY projects, and prototyping is called Raspberry-pi".

* the Raspberry-pi is a single computer board with credit card size, that can be used for many tasks that your computer, likes games, word processing, to play HD videos etc".

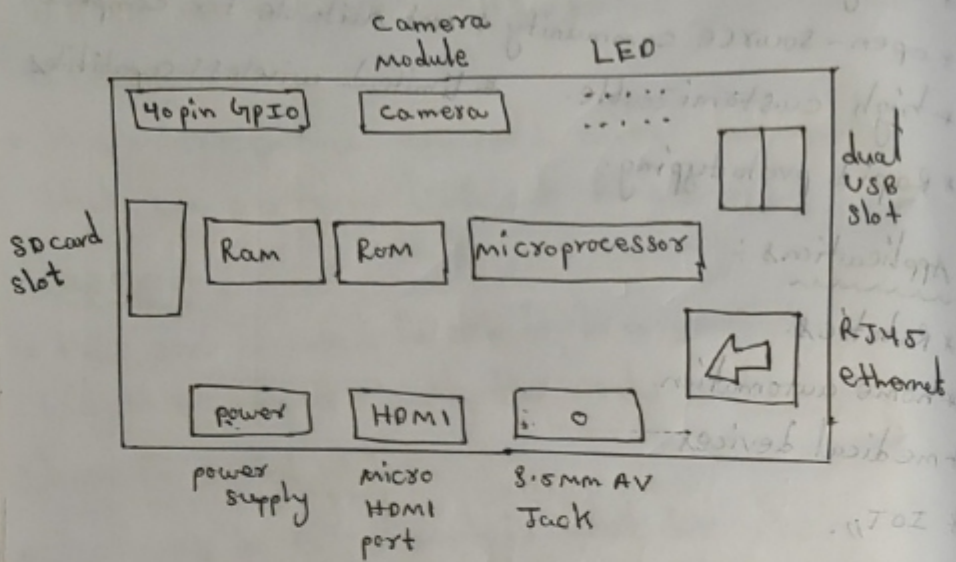


Fig: Raspberry-pi

* the above schematic diagram shows the Raspberry pi diagram.
* it consist of camera module, LED, dual USB slot, SD card slot, power supply, micro HDMI port.
* it has a 1GB of Ram, one HDMI port, four USB port, and a bluetooth connection.
* it has got a series of Input and output pins that are used for making projects - like - home security cameras, encrypted door lock etc.

* it also provides a set of general purpose input/output pins allowing you to control electronic components for physical computing and explore the Inter of things.

advantages:
* Affordable ($35 - $55)
* compact size
* energy-efficient
* highly customizable.

disadvantages:
* limited storage capacity.
* limited processing power.
* No-built-In hard drive.

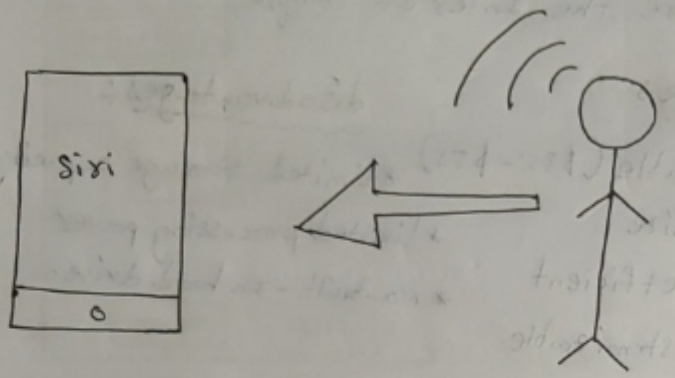
Applications:
* Robotics
* home automation.
* medical devices
* IoT.

⇒) communication in IoT:

def: communication In IoT Refers to the exchange of data, Information (or) b/w devices, sensors, actuators and ~~~~ cloud or other networks, enabling Intelligent decision-making, automation, and control called communication.

Types of communication In IoT :-

1) Human to machine (H2M) :-

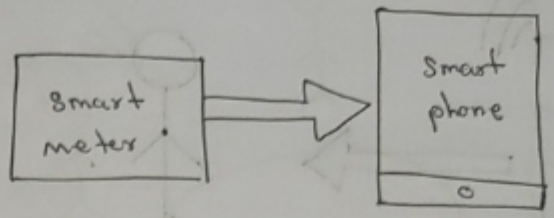


H2M communication :-

* the above figure shows the H2M communication in IoT.
* In this human gives input to IoT device. Such as (speech/text/image) etc.
* IoT devices are sensors and Actuators then understand the Input. analyzes it and responds back to human by means of text (or) visual display.
* this is very useful as these machines assist humans in every everyday tasks.
* it is combination of software and hardware.

Examples :- facial recognition.
+ Bio-metric attendance sys. * speech(or)voice recognition.

(2) machine to machine (M2M) :-



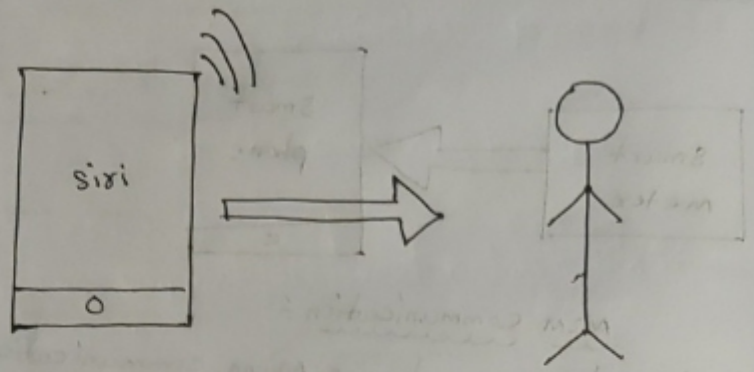
M2M communication :-

* the above diagram shows M2M communication
* the process of exchanging Information (or) message b/w two (or) more machines is known as machine to machine (M2M) communication.
* it is the communication among the M2M, which do not need human intervention.
* it also known as machine type communication In 3GPP.
* the machines may be either connected through wires or by wireless connection.

Examples :-

* smart washing machine sends alerts to owners, smart devices after completion of washing of clothes.

3) Machine to Human (M2H):



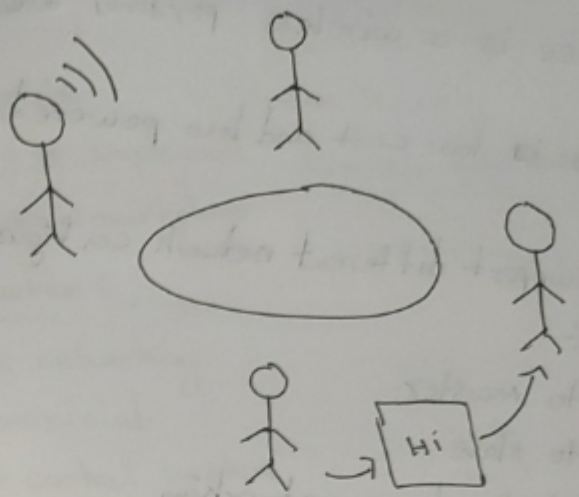
M2H communication:

* the above figure shows the M2H communication
* In this machine interacts with humans.
* machine triggers Information (text, message, Images/voice) of any human presence.
* this type of communication is mostly commonly used in daily life.
* it is way of interaction in which humans co-work, ~~that~~ the systems by using tools to finish work.

Examples:

* fire alarms.
* traffic light.
* fitness bands
* health monitoring devices

4) Human to human (H2H):



H2H communication:

→ above figure shows the H2H communication.

* this is generally how humans communicate with each other to exchange information by speech, writing, drawing, facial expression. etc.
* without H2H, M2M applications cannot produce the expected benefits.
* the humans can immediately fix issues, slove challenges, ~~and manage~~

Examples:

* bluetooth.
* wifi.
* zigbee etc.

⇒ Zigbee :-

Def :- Zigbee is a wireless personal area network.

→ Zigbee is a low cost and low powered network.

→ Zigbee support different network configurations they are :-

* master to master.
* master to slave

→ It is used for home networking.

→ It is created by zigbee alliance.

→ types of zigbee devices.

* Zigbee coordinator device :- this devices is used for connecting the devices.

* Zigbee router :- this is used for passing the data b/w devices.

* zigbee end device :- this used to control.

→ characteristics :-

→ low cost.
→ low power consumption
→ low data rate
→ used for short range.

Advantages :-

→ low cost.
→ Reliable.
→ easy to implement.
→ use in smartphone.

disadvantages :-

→ limited range.
→ no security.
→ limited data rate

Application :-

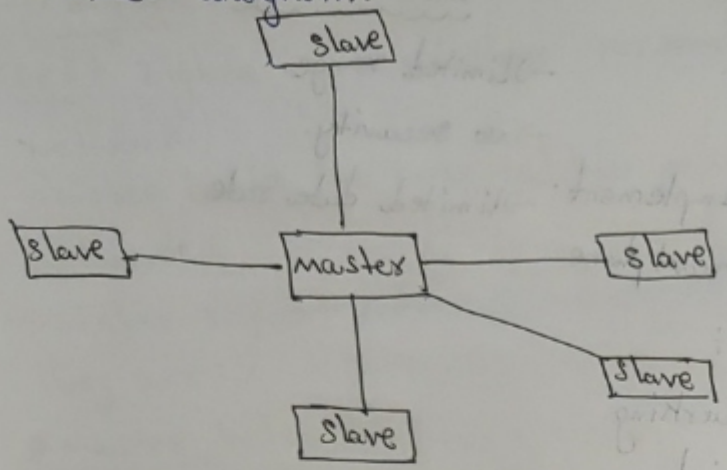
→ home networking.
→ commericial.
→ light control system.

⇒ Bluetooth :-

def :- Bluetooth is a wireles technology used for short distances. for exchanging data over radio waves.

→ bluetooth is a wireless technology.
→ Bluetooth use radio technology called freqency.
→ Bluetooth transmit and Receive data in the form of packets.
→ It uses for short distances only.
→ It is low cost.
→ It requires low power.

→ Block diagram.



→ max no. of master nodes - 1

→ max no of slaves node - 7

→ max no of nodes in a piconet - 8

Advantages :-

→ Low cost.

→ easy to use

→ It can penetrate through walls.

disadvantages :-

→ Unless secure.

→ can be hacked.

→ slow data transfer.

Applications :-

→ wireless headsets.

→ digital camera

→ Bluetooth speakers.

⇒ UDP (User Datagram protocal) :-

→ UDP - stands for user datagram protocal

→ UDP is a transport layer protocal.

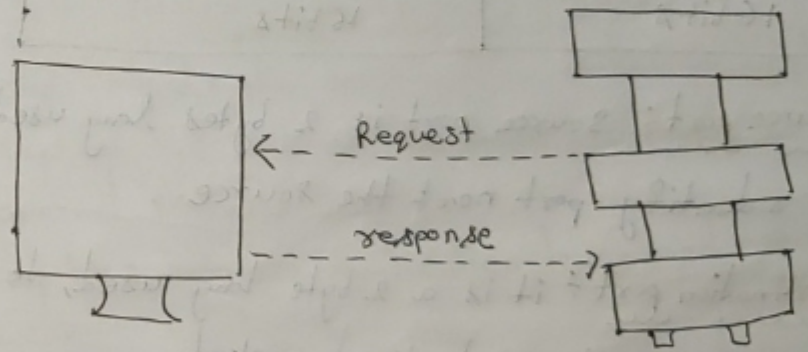
→ UDP Enables process-to-process communication

→ UDP is a part of Internet protocal i.e, UDP/IP.

→ UDP is a standard protocal.

→ UDP is the alternative protocal to the TCP protocal.

→ Block diagram.



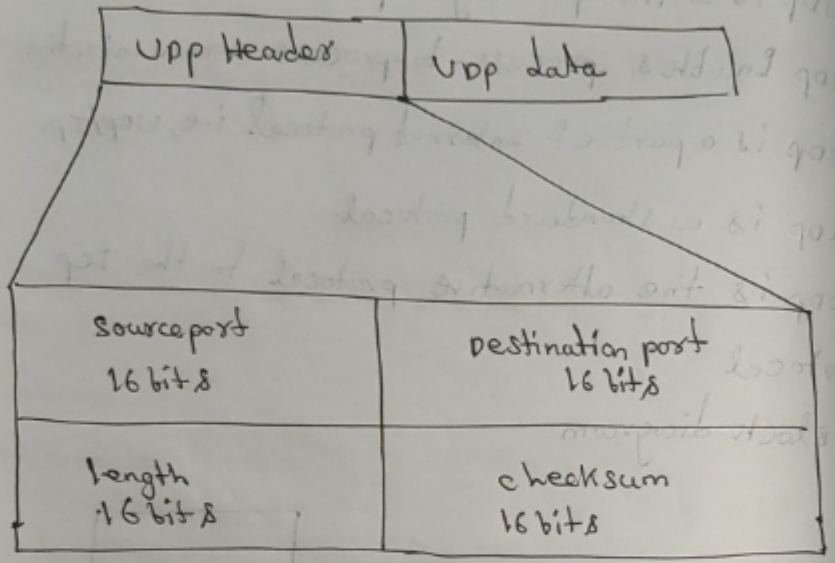
→ there is no error checking in UDP.

→ UDP Header :-

→ UDP header is an 8 byte simple and fixed header.

→ the first 8-bytes contains necessary header info and remaining contains data.

→ UDP is 16 bits long.



Source port: Source port is 2 bytes long used to identify port no of the source.

Destination port: it is a 2-byte long used, to identify port of destined packet.

length: length is the length of UDP, including header and data (16 bits).

checksum: checksum is 2 byte long field (16 bits)

It's calculation is not mandatory.

advantages:

→ spee is fast.
→ simplicity.
→ smaller packet size.

disadvantages:

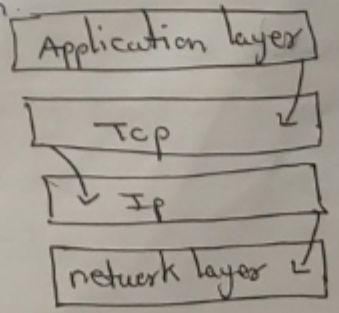
→ No reliability.
→ no flow control
→ No congestion control.

Applications:

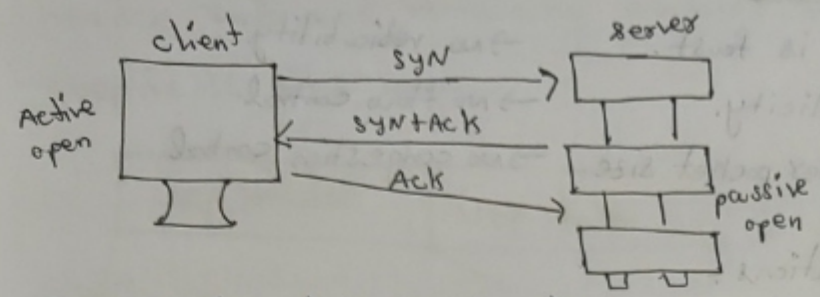
→ streaming media
→ online gaming.
→ VoIP
→ DHCP.
→ DNS.

⟹ TCP (Transmission control protocol):

→ TCP - stands for transmission control protocol.
→ TCP is the one of the main protocol in Internet protocol (TCP/IP)
→ TCP lies between application layer and network layer.
→ TCP is a connected-oriented protocol for communication.



→ Tcp :



→ In Tcp/Ip, data breaks down into small bundles and afterward reassembles the bundles into riginal data on oppend.

→ the main function of Tcp is to take data from application layer.

→ In Tcp data exchange is b/w client and server.

→ client end is called Active open.

→ server end is called passive open.

* features of Tcp :

→ transport layer protocol.

→ Reliable.

→ connection-oreiented.

→ Full-duplex

→ stream oriented.

→ flow control

→ error "

→ congestion "

Advantages :

→ Reliable.

→ flow control

→ open control

disadvantages :

→ Tcp made for WANs.

→ No modification possible

→ speed becomes slow as time increases.

⇒ IoT I/O Interface :

def : the process of connecting devices together so that thy can exchange the information is called as Interfacing.

Interfaces :

* parallel : A parallel interface refers a multi-live channel with each line capable of transmitting data simultaneously.

* serial : serial interface stream their data, one single bit at data. thise Interface can operate as one wire.

* USB : universal serial Bus is a technology that allow a person to connect an electronic ~~dive~~ device to a microcontroller

* it is fast serial bus.

*I2C :

* It stands (Inter Integrated circuit) Bus ~~is called~~ is used to interconnect peripheral device within small-scale, embedded systems called I2C.
* I2C is pronounce as "I-quare-c"

*SPI :

* SPI stands for serial peripheral Interface is an Interface commanly used in embedded systems for short distance communication b/w a microcontroller and are (or) more IC's is called SPI.

*RS232 :

* RS-232 (Recommended standard number)
* RS-232 is a full duplex, wired.
* RS-232 is an extension of UART.
* RS-232 is transmit and Receive signals.

=)

CoAP	MQTT
* it stands for constrained application protocol.	* it stands for message query telemetry transport.
* It uses "Request-Response" model of communication.	* it uses "publish-subscriber" model of communication.
* coAp is suitable for "state transfer."	* MQTT is "event-oriented" protocol.
* Runs on "UDP"	* Runs on "TCP"
* It has 2 sublayer → message layer. → Request-Response layer.	* It has esentially a "single layer".
* It uses asynchronous and synchronous messaging.	* It uses only asynchronous mode for messagaging.

MQTT

Def: MQTT is a lightweight, opensource messaging protocol that is used in IOT to enable communication b/w devices is called MQTT.

-> MQTT stands for message queuing Telemetry Transport.

-> MQTT is a communication protocol deigned for IOT.

-> MQTT designed with high latency, and low bandwidth.

-> MQTT is a perfect protocol for Machine to machine (M2M) communication.

-> It is Tcp based protocol

-> MQTT uses publish - subscribe model where, publishers send messages to a brokcer. and subscribers receive them.

- MQTT client and Broker.

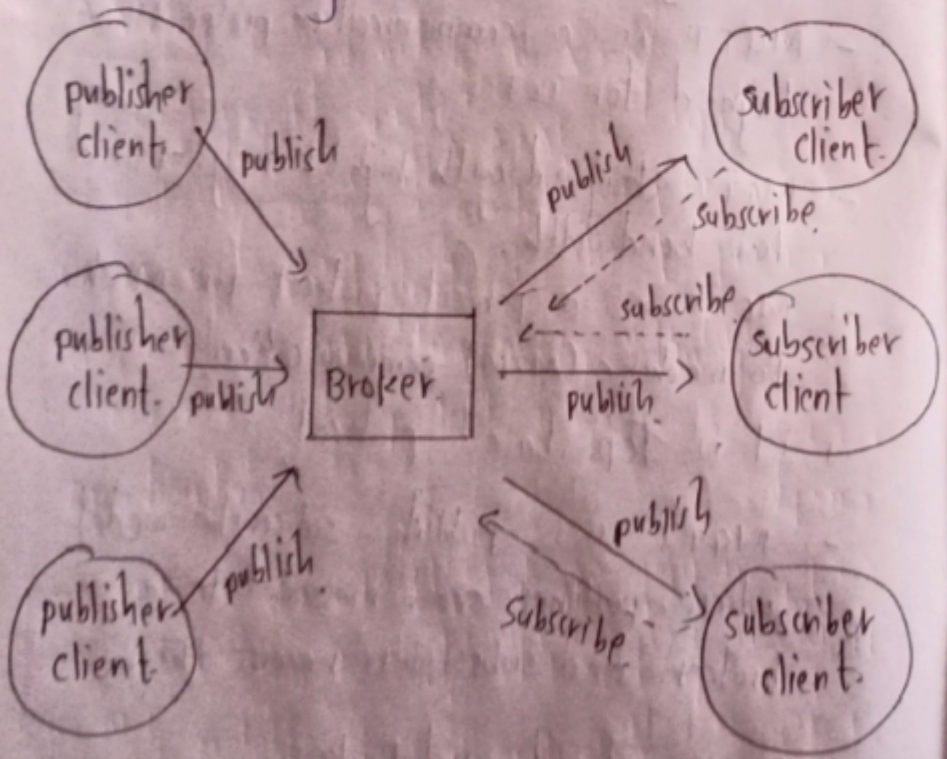
-> clients publish messages on different topics to brokers.

-> The broker is the central server.

-> The broker is the heart for publish/subscribe protocol.

-> A Broker can handle up thousands of MQTT customers.

-> Block diagram shows publish-subscribe model.



Working of MQTT

-> MQTT uses publish - subscribe model.

-> Components of MQTT

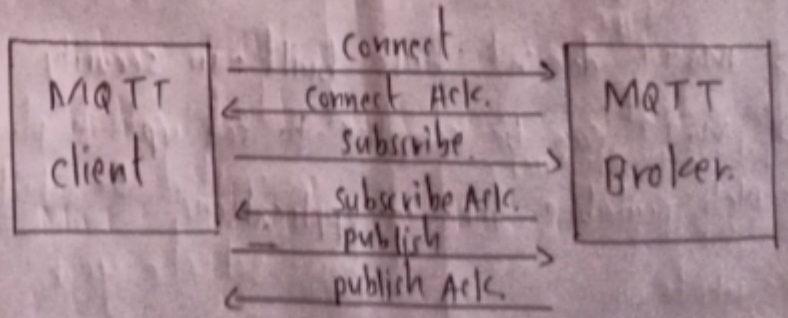
- Message
- client
- Broker (or) server.
- Topic.

-> The the client who transmits the message (the publisher) and clients who receive it (the subscribers)

-> The Broker manages the relationship blw publishers and subscribers.

-> publishers and subscribers they don't communicate with each other.

- Message format.



Characteristics of MQTT:

- Lightweight.
- publish subscribe model.
- quality of service (QoS).
- Retained messages.
- Security.

Advantages

-> Lightweight protocol.
-> Data transmission is quick.
-> low power consumption.
-> prompt and effective message delivery.
-> Minimal data packet usage.

Disadvantages

-> MQTT doesn't have built-in security.
-> MQTT can be complex to set-up.
-> Not suitable for all applications.

3rd unit

⇒ purpose of sensors and Actuators in oIT:

sensor purpose: to detect and measure physical or enviromental parameters, converting them into electrical signals.

Actuators purpose: to convert electrical signals into physical actions, controlling (or) manipulating devices (or) systems.

*what is the purpose of sensor in oIT?

* sensor play a critical role in the IoT ecosystem.
* they enable the collection and transmission of real-time data. and used to monitor and contral the systems, optimze operations and improve decision making.

→ what is the purpose of Actuator in oIT?

* it is part of any machine the makes movement possible.
* In IoT, an actuator is responsible of the physical movement of an object.
* it is devices that can move things and different sources such as battery, electric (or) manually-generated energy.

⇒ Resolution :

Def: Resolution is the smallest of change in the Input that can be detected and accurately indicated by the sensor.

→ there are four types :

* spatial Resolution
* spectral Resolution
* temporal " "
* Radiometric " "

→ spatial Resolution :

* A measure of the smallest angular or linear sparation btw two objects that can be resolved by the sensor.
* size
* distance
* shape.
* color.

→ spectral Resolution :

* Spectral Resolution refers to the ability of an instrument (or) sensor to distinguish btw different wavelengths or frequencies in a spectrum.
* allows characterization based on geophysical parameters (chemistry etc).

→ Temporal Resolution :

* the frequency of data acquisition over an area
* depend on:
→ the orbital parameters of the satelite.
→ latitud of the targets.
→ pointing ability of the sensor.

→ Radiometric Resolution :

* Number of digital levels that a sensor can use to express variability of brightness within the data.
→ determine the Information content of Image.
⇒ the more levels, more details can be expressed.

→ 2^2 = 4 levels.

2^8 = 256 levels.

2^{12} = 4096 levels.

Unit-1

Introduction to sensors and Actuators:

* **sensor:** A sensor is a device that detects and responds to some input from the physical environment is called a sensor.

→) the I/p can be light, heat, motion, moisture, pressure etc.

=) types of sensors:

1. **Active sensors:** the sensors which Requires an external power source (or) signal to work is active sensors.

2. **passive sensors:** the sensors which do not Require external power source (or) signal to work is called passive sensors.

3. **temperature sensors:** the sensors which are designed for measuring the degree of coolness and hotness in a object is called temperature sensors.

4. **pressure sensors:** the sensors which is designed to measure the pressure in gases (or) liquids is called pressure sensors.

5) strain sensor :- the sensors which are desigred to measure strain on the object by measuring change in Resistance that occurs when object is stretched (or) compressed is called strain sensor //.

⇒ General characteristics of sensors :-

→ sensors characteristics are mainly classified into two types :-

1) static characteristics :-

* sensitivity.
* Resolution.
* linearity.
* Range.
* selectivity.

2) dynamic characteristics :-

* hysteresis.
* temperature.
* frequency.
* Noise.
* saturation
* mechanical variables //.

→ the mechanical sys attached to the actuator that uses the motion of the actuator is called load.

→ load o/p connected to controller is called feedback.

Types of Actuators :-

Actuator :- An actuator is a device used to move (or) control a body in a linear (or) rotational by applying a control signal is called Actuator //.

Classification :-

⇒ Acc to type of motion

1) linear Actuator :- A linear actuator moves a body in a linear direction.

→ they provide push-pull motion.

2) Rotary actuator :- A Rotary actuator moves a body in a circular motion is called Rotary Actuator.

⇒ Acc to type of power used :-

1) hydraulic Actuator :- they utilize hydratic power generated by a pump to create mechanical action.

→ hydraulic actuator consist of cylinder and piston.

→ they use fluid.

2) pneumatic Actuators :-

→ pneumatic actuator utilizes vaccum (or) compressed air to create mechanical action.

→ from this Actuators we get considerable amount of force with small pressure change //

→ they use air (or) vaccum.

3) Electrical Actuator :-

→ Electrical Actuators have applications in automation systems.

4) magnetic Actuator :-

→ they utilize magnetic effect to generate mechanical action.

→ they use magnetic effect.

5) mechanical Actuator :-

→ A mechanical Actuator works by converting one type of motion into another by utilizing gears, pulley etc //

⇒ simple Applications of Actuators :-

→ different types of Actuators have a lot of different applications.

1) In Automation.
* packing.
* label scanning & printing
* control solar panel direction.

2) In Automobiles
* car bonnet control
* throttle control
* door Locking
* window control.

3) In medical Industry
* ventilators
* patient handling

4) other machines.
* CNC machines.
* Robotic welding machine
* material handling machines.

Unit - IV

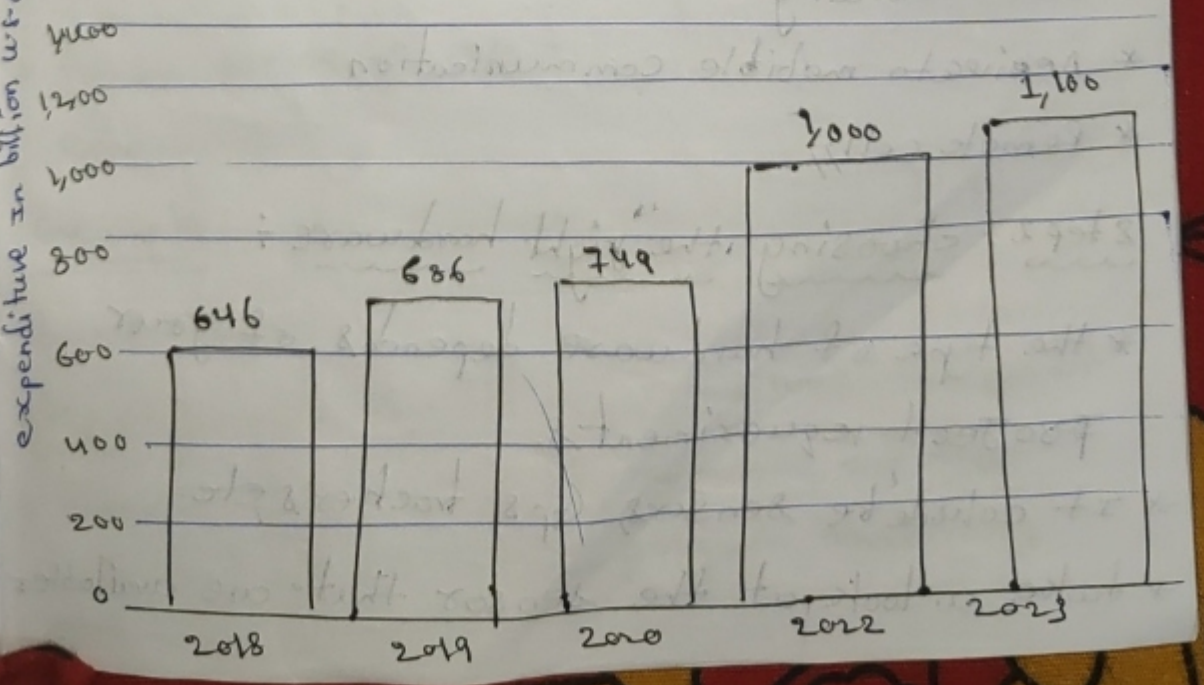
⇒ IoT app development :

Def: IoT application development refers to the process of designing, building, testing, and deploying software applications that connect, manage, and interact with IoT devices, sensors, and data.

* these apps can connect with devices through sensors and internet connectivity features such as remote monitoring, battery status update.

→ why develop an IoT ~~dev~~ applications :

* during the worst pandemic in a centure, IoT spending grew manifolds.



* the bove graph shows the project spending on IoT in the coming years.

I) to develop an IoT application in 5 steps:

Step 1: Define the ~~app~~ Requirements for the Application:

* An important step in developing an IoT application to defined the goal and scope of your app.
* Decide what you want to acheive once the app is live.
→ the scope of your application will include the features that you require. this colud include:
* Device mangement.
* Dashboarding.
* Deaiveto mobible communication.
* Remote cell.

Step 2: choosing the right hardware:

* the type of hardware depends of your project requeriments.
* It colude be sensors, Gps tracker s etc.
* take a look at the sensor that are availabler
* If your developing smartwaches, ex: you will need oxymeters, and pedometers pulse monitors.
* if you developing smart vehicles. you will need different sensors like Gps.
* it has a microcontroller and microprocessor on the device to process the data.
* depending on whecther your device is consumer based, Industrial.

step 3: find the right connectivity protocal:
* thes are several network protocals that you can use like wifi, 2G, 3G, Bluetooth.
* it takes the depending on your device.
* the availability of resources, you need to pick the right channels for connectivity.
* these device is used in home (or) office environment.

Example: you can use wifi for data transmission.

step 4: Ensure the firmware is well-equipped:
* firmware or device-side software, are the technical terms for the program that runs your hardware.

* it is to ensure that your firmware is well equipped or else you could data loss.
* pushing data on network disconnection so that data loss.
* data encryption using TLS //.

Step 5 : pick the Right could platform.

* the right IoT platform will hand you the necessary tools.
* the create an application that serves your purpose.
* In order to choose IoT Application that works for you.

→ you need to look for the following :

* uptime
* Data security
* Security.
* Scalability.
* Debugging.
* feature stability //

=) Solution frame work for IoT Application-Implementation of Device Integration :

Def : Device Integration refers to the process of connecting, communicating, and coordinating between different devices, systems, and platforms to enable seamless interaction, data exchange, and unified control is called as Device Integration //

Let's look at five of the most important advantages of that device integration :

1) Improved data accuracy :

* Increases the Accuracy of data collected by an organization.
* it removing the danger of data being transferred (or) lost in transist to a centralised system.
* Improved data accuracy refers to the enhancement of data quality, ensuring that information is Reliable, and free from errors //

2) Great Efficiency :

Def: Great efficiency refers to the utilization of Resources, time, and effort to achieve maximum productivity, minimize waste, and improve overall performance.

* A process with connected devices is more efficient when properly executed.
* allowing a team to focus on higher-value activities rather than transmitting data. because data is collected.

3) more effictive decentralized team :

* A decentralized team can have regular Acess to the data with effective device Integration.
* it allowing a support tem to monitor and analyze data from any location.

4) more Reliable response strategies :

* Automated monitering and extensive logging are possible because to thraugh ful device Integration.
* which means that system trigger in alart conditions In particular Instance.

* these is depending upon the soley on human inspection.

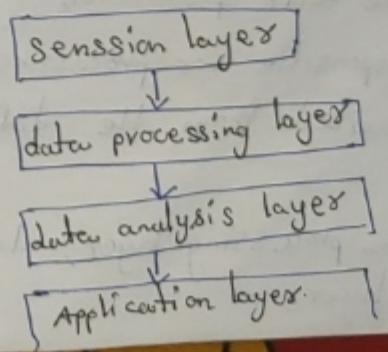
5) An Increasingly Rich Archive of data :

* collecting a body of logged data allows firms the capacity to examine it afterwards, possibly even based on the data they collect, much like any database system.
* Device Integration creating a growing and interconnected repository of usable data.
* which can be quite valuable over time.

=) data acquistion and Integration :

Def: data acquistion and Integration In OIT refers to the process of collecting, processing, and combining data from various IOT devices. ;sensors, is called a data Acquistion and Integration.

Architeture :



1) session layer :-

* It is a top layer.
* the session layer is a collecting data from various IoT devices.
* this is the lowest layer that can be found.
* It gathers different heterogenous types of data, heterogenous gathers such as IoT devices, sensors and Actuators.
* the large volume of big data is sent to the next level layer, data processing layer, for data analysis layer.

2) data processing layer :-

* the data processing layer is ~~second~~ thired layer of the data Acquistion and Integration.
* collected data is processed and analysed to help business make decisions as well as streamline their operations.
* It is responsible for processing and managing data received from the data analysis layer.
* the data processing layer, also known as middle layer.

3) data analysis layer :-

* it is a semcond layer of the internet of things (IoT) Architecture.
* this is a most important layer of the IoT architecture.
* it is two sub modules of the dataprocessing layer.
* It manges the real-time data, data using camera vision algorithms such as spp-net and cnns.

4) Application layer :-

* this layer is frist layer of the internet of things (IoT) architecture.
* this layer is used analyze the data collected from IoT sensor.
* it is real-time settings.
* this layers generates traffic alerts.
* it is used in IoT smart city Applicattions such as traffic, smart homes etc.

* Authentication and Authorization of Devices

Def Authentication and Authorization are critical components of IoT security, ensuring that only Authorized devices and users can access and control IoT Devices.

Authentication The process of recognizing the device is known as Authentication.

Authorization : Authorization in the IoT is the process of determining what actions a device can perform within system is called Authorization.

-> Authenication and Authorization can divided into two ~~cat~~ categories.

1. Device-based Authentication and Authorization

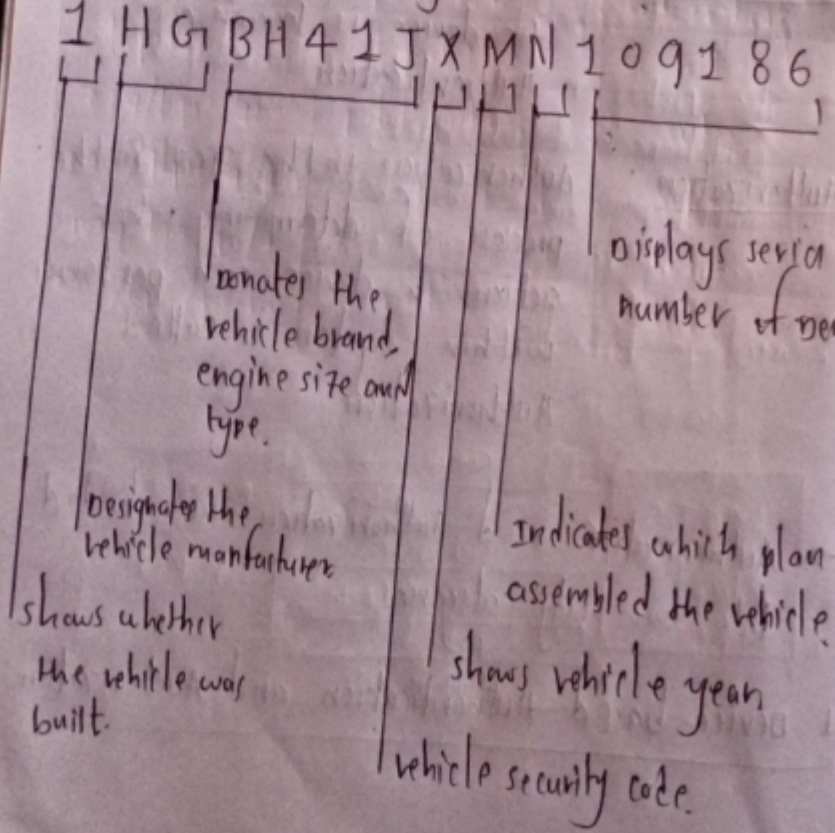
-> Device based Authentication and Authorization is likely be utilized for devices that do not have operating (users).

-> connection is not dependent on user.

-> An automobile is best example for this.

-> client-side certificates in automobile used for device based Authentication and Authorization.

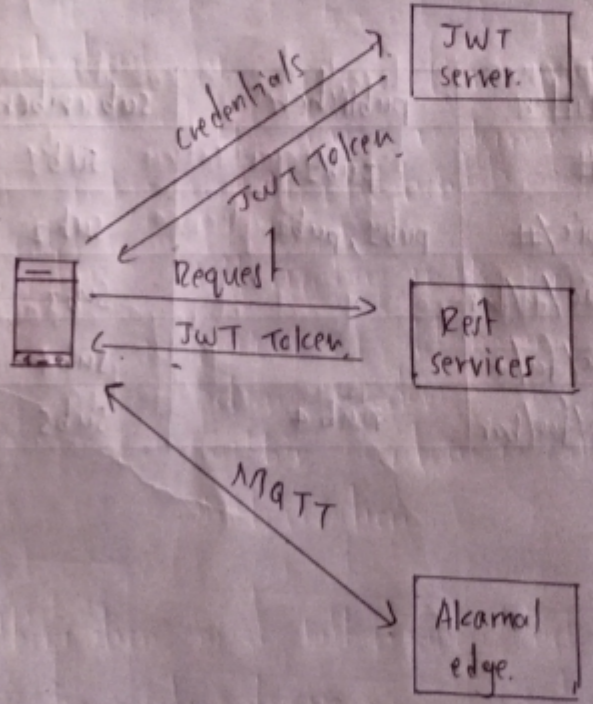
-> schematic of a typical VIN.



2. user-based Authentication and Authorization

-> The person in the focus of user based used-based Authentication and Authorization rather than the device.

-> Device must still offer a unique device ID



-> Explain diagram.

Topic filters	publishers	subscribers
topic#	PUB1	SUB1
device/+/c/up		SUB2
device/+/c/down	PUB2	
user/+/u/up		SUB3
user/+/u/down	PUB3	

Topic filters	publishers	subscribers
topic#	pub1	sub1
My/topic/#	pub1, pub2	sub2
My/topic/+/bar		sub3
my/topic/foo/+		sub4
My/topic/foo/bar	pub4	sub5

* Device data storage on cloud/local server

-> Device data storage refers to the storage of data generated by devices such as sensors, actuators, and other IoT devices.

-> The data can be stored on a local server or cloud based server.

- Cloud based storage
  - Scalability: cloud storage can scale up(or) down.
  - Accessibility: data can be accessed from anywhere at any time, using any device with internet connection.
  - Redundancy: cloud storage providers often have built in redundancy.
  - Security: cloud storage providers typically have robust security.

o Local server storage

- control: Data is stored on premises, more control over data security and management.
- Low latency: Data can be accessed quickly as it is stored locally.
- compliance: local storage can be more suitable for organizations with strict data compliance.
- cost effective: local storage can be more cost effective.

Unit - 5

⇒ IoT case studies and mini projects :-

Def :- IoT case studies and mini projects describes how IoT can be used in various applications such as in Industrial, transportation, Agriculture, healthcare, home automation etc.

1) Industrial Automation :-

Def :- Industrial Automation in IoT refers to the use of IoT technologies to automate, monitor, and control industrial processes machines is called Industrial automation.

→ the goal of Industrial automation is a Reduce human intervention, and Improve efficiency.

→ components used in Industrial Automation

* sensors and Actuators.
* Industrial control systems.
* programmable logic controllers.
* IoT devices.
* AI and ML
* cloud computing and analysis.

* the essential of an Industrial IOT :

→ Industry things : PLs, IPC, HMI, Robots, vision cameras and sensors etc.

→ connectivity : using 4G/cellular, wifi, ethernet, connections etc.

→ datas : the value of IOT is centred on datas, and how it is collected, stored and processed.

→ cloud perform : A cloud perform is a cloud based services and infrastructure the enables users.

→ analytics dashboard : for data analytics and machine monitoring.

→ It is very difficult to imagine a production line without automation systems.

* example to understand Industrial automation :

→ consider a manual Industrial production process, where an operator is observing the temperature of an oven.

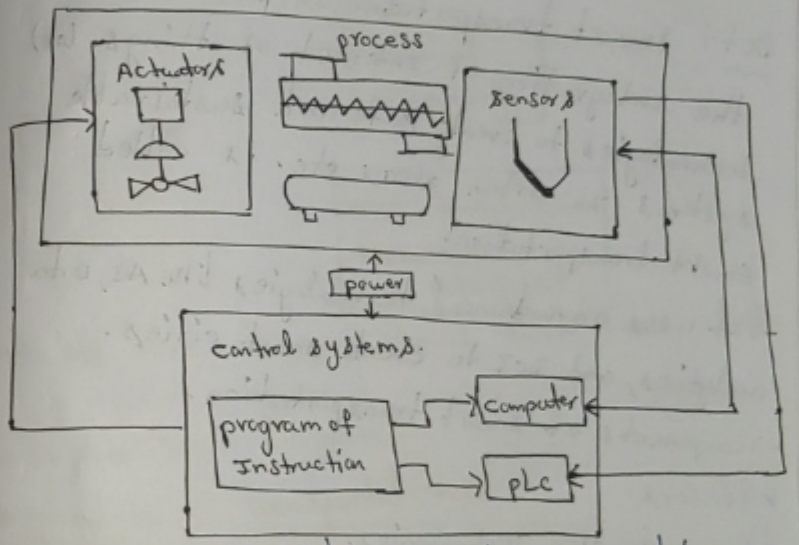
→ so, the operator has first adjust the amount of fuel to the oven by controlling a valve to rise temperature.

→ temperature sensor placed near the oven, which reports temperature to the computer.

→ controlling valve controlled by computers.

→ once the desired temperature is acheived the valve is stopped off.

→ diagramatic representation :



→ the above block diagram shows working of manual Industrial process.

→ explain block diagram.

* levels of Industrial Automation

advantages :

→ Increased productivity
→ Improved safety.
→ cost savings.

disadvantages :

→ Initial Investment
→ maintenance and Repairs.
→ lack of flexibility.

⇒ transportation :

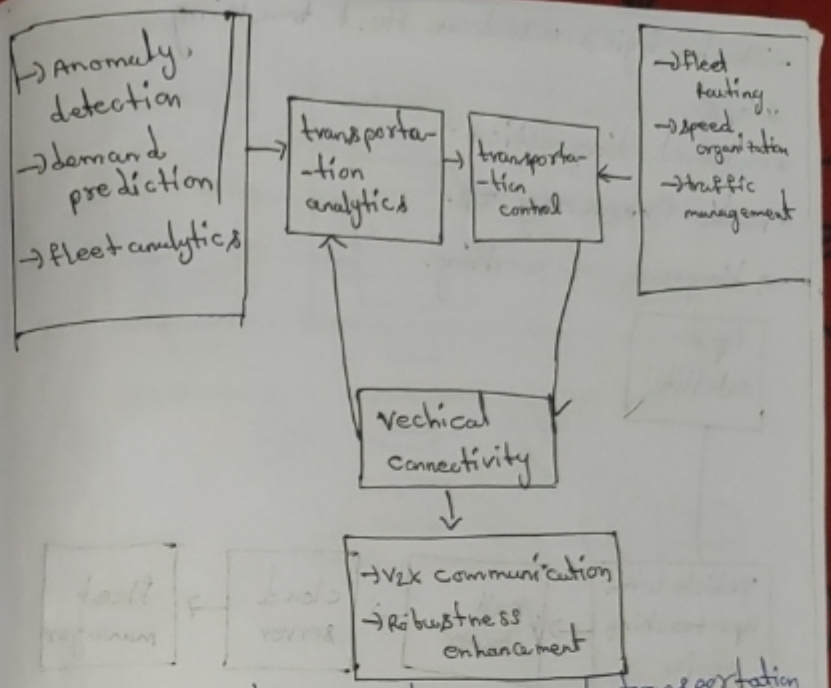
Def : smart transportation In IoT refers to the integration of Internet of things (or) technologies to create safe and sustainable systems In urban areas etc. is called smart transportation.

→ It uses advanced technologies like AI, data analytics, and IoT to create smart cities.

→ components of smart transportation.

* sensors
* communication Technologies.
* data analytics and management
* IoT devices.
* cloud computing and edge computing.

→ diagramatic representation.



→ above block diagram shows smart transportation is smart cities.

→ explain block diagram.

* example of transportation :

1) fleet tracking : fleet tracking was the IoT to monitor and manage fleet of vehicles In real time.

→ fleet tracking defines virtual boundaries, with geo-fenching, setting zones, speed limits etc //

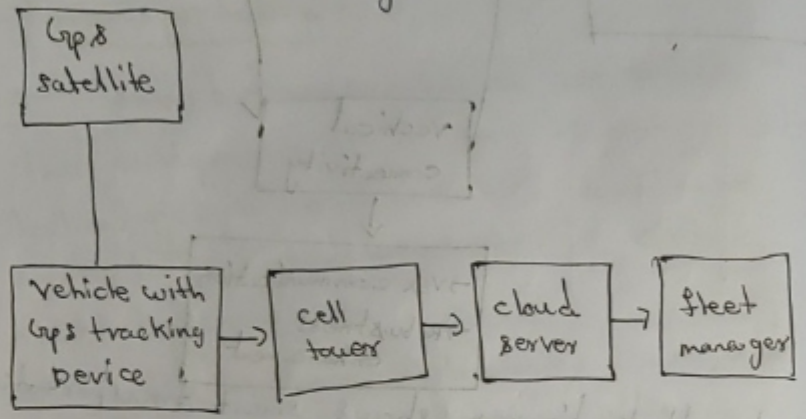
→ fleet tacking Includes :

* Real-time visibility
* Improved efficiency
* enhanced security.
* Improved driver safety.

→ Technologies used in fleet tracking

* Gps.
* on board diagnostics.
* Radio frequency ID.

→ diagram of working.



advantages :

→ Real time monitering.
→ Reduced theft

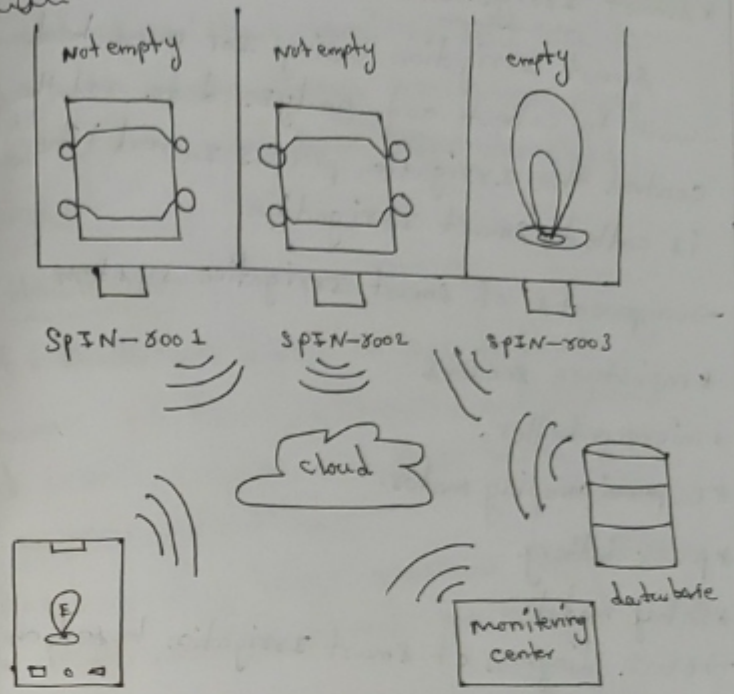
disadvantages :

→ Initial costs.
→ lack of stable Internet connection.

2) Smart parking :

Def :- Smart parking using IOT is a centralized system that uses sensors and cameras to moniter parking Iot availability and provide real time information to drivers is called smart parking.

diagram :-



→ diagram shows working of smart parking.

⇒ Agriculture :-

Def :- Agriculture using IOT is also known as precision agriculture that uses smart devices and software to improve agricultural efficiency and profitability is called smart Agriculture.

→ IOT based agriculture can help farmers to make better decisions about their crops.

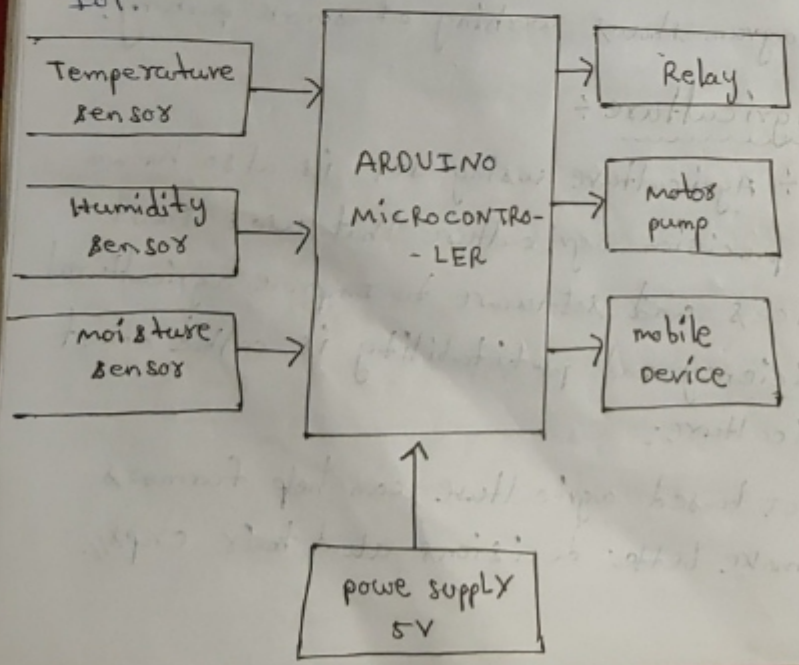
* Smart Irrigation :

Smart Irrigation using IoT uses hardware to collect and analyze data and the control the Irrigation process in real time is called Smart Irrigation.

→ components of smart Irrigation system

* moisture sensors.
* microcontroller.
* Dc ~~powei~~ pamping motor.
* power battery.
* Relay module

→ Block diagram of smart Irrigation based on IoT.



→ soil moisture sensors are used to determine amount of moisture level in soil and then only realse water through Irrigation pipes when moisture level falls below threshold level.

⇒ Heathcare :

Def : Healthcare based on IoT defined as network of device, software, and systems that collect, analyze, and share health data to improve patient care.

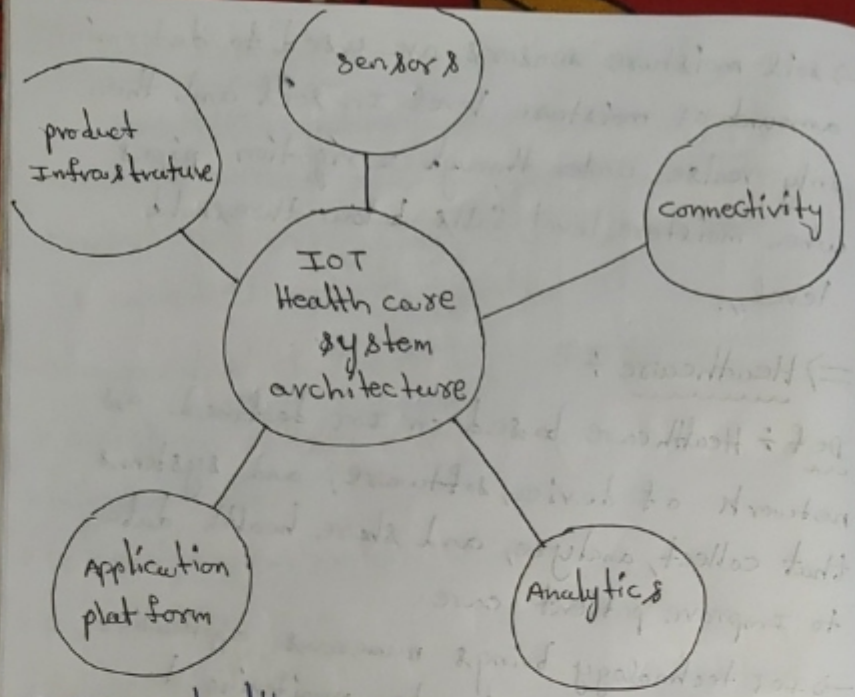
→ IoT technology brings numerous applications in healthcare from remote monitering to smart sensors.

→ It keeps the patients safe and healthy.

→ factors affecting healthcare.

* Smart devices.
* continuous Research.
* better care.
* medical Information distribution.

→ IoT healt care system architecture show in below diagram.



→ IOT In healthcare can
* Improve patient care.
* Reduce medical errors.
* Low healthcare costs.
* Improve patient.

→ wearable electrons such as smart watches, smart glasses, wristbands and fashion electronics etc.

→ body temperature, heartrate, pulse oximeter, oxygen saturation, blood pressure, ECG, electroencephalogram, are examples of body sensors.

→ An Integrated ECG, accelerometer and oxygen saturation region used.

* promoting hygenic hospitals and clinics :-

→ cleanliness is more imp than over.

→ sanitary and hygenics healthy hospitals are only provide good treatment for patient.

→ the following are the some example of low touch and no touch health and medical applications.

* contact tracing.
* pathogen detection.
* thermal sanitation.
* Automated hand hegiene.
* hygiene monitering.

⇒ Home Automation :-

def :- home Automation using IOT allows you to control and moniter you home remotely through smartphone is called home automation.

→ home automation is mentioned as sensible home (or) smart house.

→ In home automation ecosystem, we can control devices like, light, fan, TV etc.

* Smart lighting :- Smart lighting is a home automation application that uses the IoT to allows users to control lighting Remotely is called smart lighting.

→ process of smart lighting.

* choose a system that compatible with your existing setup.
* Replace existing bulbs and switch smart ones.

→ set up a centeral hub.

→ connect to your smart phone.

→ smart lighting can be used in variety of settings Including, homes, offices, streets, Industries, etc.,

→ smart lighting can switching on/off (or) dimming the light when needed.

* Smart Appliances :-

→ Smart appliances with the management are here and also provide status information to the users remotely.

→ smart washer/dryer can be controlled Remotely.

→ Smart Refrigerators can keep track of item store and update when item is out of stock.

* Smoke/gas detectors :-

→ Smoke detectors are installed In homes and buildings to detect smoke i.e typically sign of fire.

→ It uses optical detection and Air sampling technique to detect smoke.

→ gas detects harmful gases such as CO, LPG etc.