KCA 101 : FUNDAMENTAL OF COMPUTERS & EMERGING TECHNOLOGIES

for

Master of Computer Application (MCA)

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Unit-III

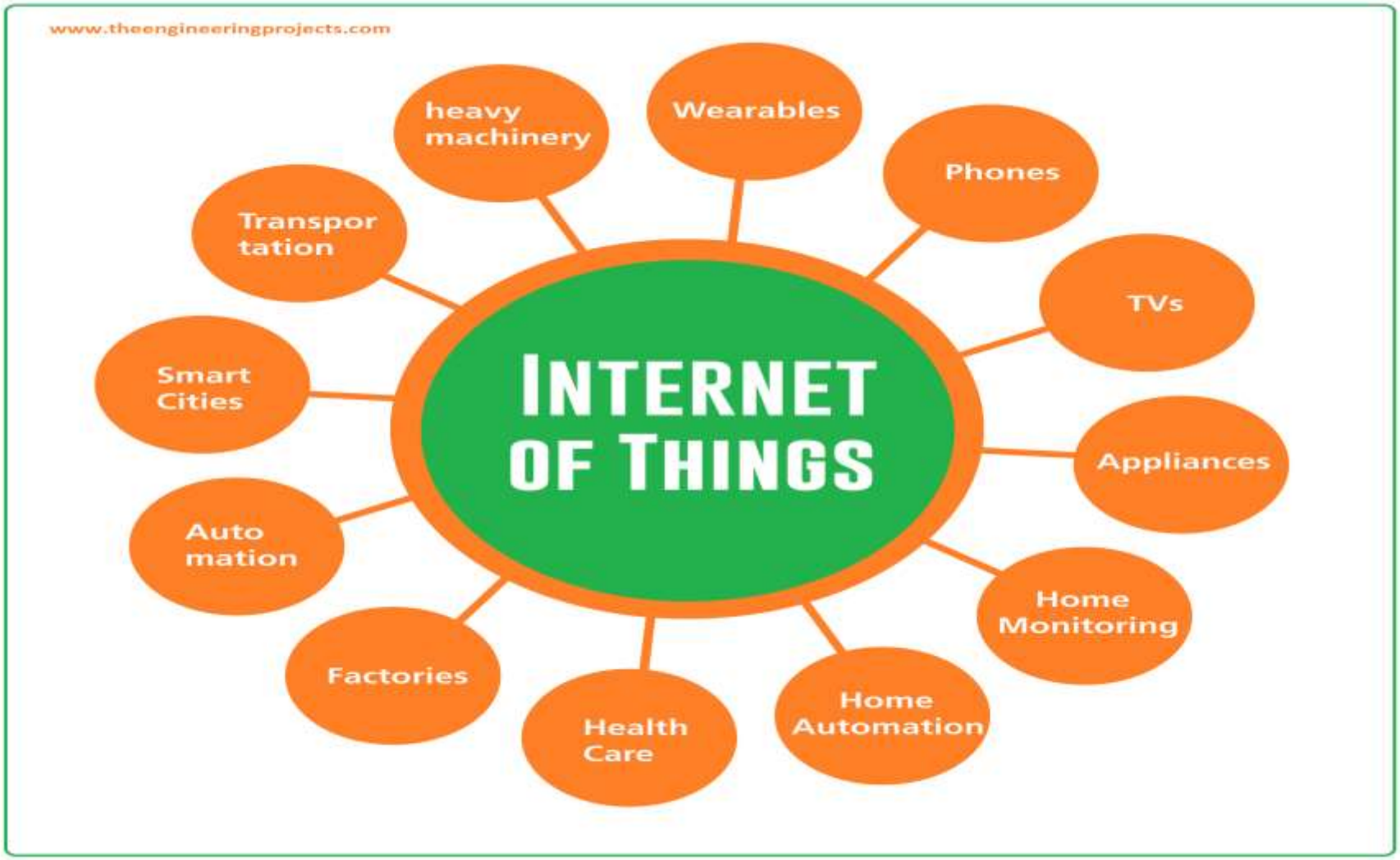
- **Internet :** Overview, Architecture, Functioning, Basic services like WWW, FTP, Telnet, Gopher etc., Search engines, E-mail, Web Browsers.
- **Internet of Things (IoT):** Definition, Sensors, their types and features, Smart Cities, Industrial Internet of Things.

IOT-Definition

- The **Internet of things** (**IoT**) describes physical objects (or groups of such objects) with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the internet or other communications networks. In Internet of things, devices do not need to be connected to the public internet, they only need to be connected to a network and be individually addressable.

- look closely at our mobile device which contains GPS Tracking, Mobile Gyroscope, Adaptive brightness, Voice detection, Face detection etc.
- These all communicate with each other to provide a better environment? For example, the phone brightness is adjusted based on my GPS location or my direction.
- Connecting everyday things embedded with electronics, software, and sensors to internet enabling to collect and exchange data without human interaction called as the Internet of Things (IoT).
- The term "Things" in the Internet of Things refers to anything and everything in day to day life which is accessed or connected through the internet.
- IoT is an advanced automation and analytics system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance.

IOT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- As we have a platform such as a cloud that contains all the data through which we connect all the things around us. For example, a house, where we can connect our home appliances such as air conditioner, light, etc. through each other and all these things are managed at the same platform. Since we have a platform, we can connect our car, track its fuel meter, speed level, and also track the location of the car.
- If there is a common platform where all these things can connect to each other would be great because based on my preference, I can set the room temperature. For example, if I love the room temperature to be set at 25 or 26-degree Celsius when I reach back home from my office, then according to my car location, my AC would start before 10 minutes I arrive at home. This can be done through the Internet of Things (IoT).

IOT Characteristics

1. Connectivity

   Connectivity is an important requirement of the IoT infrastructure. Things of IoT should be connected to the IoT infrastructure. Anyone, anywhere, anytime can connect, this should be guaranteed at all times. For example, connection between people through internet devices like mobile phones ,and other gadgets, also connection between Internet devices such as routers, gateways, sensors, etc.

2. Scalability

   The number of elements connected to the IoT zone is increasing day by day. Hence, an IoT setup should be capable of handling the massive expansion.

   The data generated as an outcome is enormous, and it should be handled appropriately.

IOT Characteristics

3. Safety

   There is a danger of the sensitive personal details of the users getting compromised when all his/her devices are connected to the internet. This can cause a loss to the user. Hence, data security is the major challenge. Besides, the equipment involved is huge. IoT networks may also be at the risk. Therefore, equipment safety is also critical.

4. Self Configuring

   This is one of the most important characteristics of IoT. IoT devices are able to upgrade their software in accordance with requirements with a minimum of user participation. Additionally, they can set up the network, allowing for the addition of new devices to an already-existing network.

IOT Characteristics

5. Architecture

IoT architecture cannot be homogeneous in nature. It should be hybrid, supporting different manufacturer's products to function in the IoT network. IoT is not owned by anyone engineering branch. IoT is a reality when multiple domains come together

6. Dynamic and Self-Adapting

IoT devices should dynamically adapt themselves to the changing contexts and scenarios. Assume a camera meant for the surveillance. It should be adaptable to work in different conditions and different light situations (morning, afternoon, night).

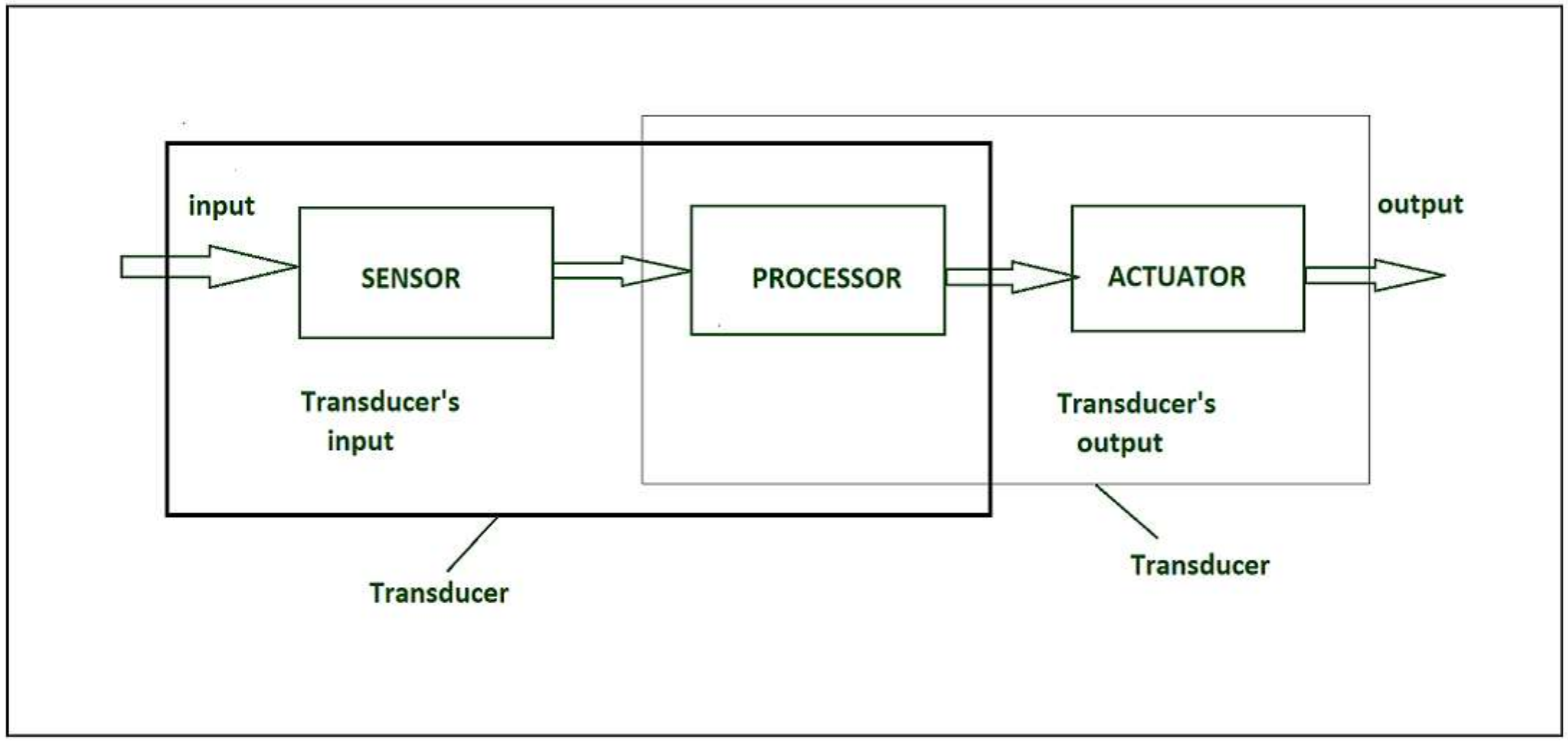
7. Intelligence and Identity

The extraction of knowledge from the generated data is very important. For example, a sensor generates data, but that data will only be useful if it is interpreted properly. Each IoT device has a unique identity.

This identification is helpful in tracking the equipment and at times for querying its status.

Sensors and types of Sensor in IOT

- **Sensors** are used for sensing things and devices etc. A device that provides a usable output in response to a specified measurement. The sensor attains a physical parameter and converts it into a signal suitable for processing (e.g. electrical, mechanical, optical) the characteristics of any device or material to detect the presence of a particular physical quantity.
- The output of the sensor is a signal which is converted to a human-readable form like changes in characteristics, changes in resistance, capacitance, impedance etc.



Types of Sensor

1. Temperature Sensor
2. Humidity Sensor
3. Pressure Sensor
4. Proximity Sensor
5. Gas Sensor
6. Gyroscope
7. Level Sensor
8. Accelerometers
9. Infrared Sensor
10. Optical Sensor

Temperature Sensor

Temperature sensors measure the amount of heat energy in a source, allowing them to detect temperature changes and convert these changes to data. Machinery used in manufacturing often requires environmental and device temperatures to be at specific levels. Similarly, within agriculture, soil temperature is a key factor for crop growth.

Humidity Sensor

These types of sensors measure the amount of water vapor in the atmosphere of air or other gases. Humidity sensors are commonly found in heating, vents and air conditioning (HVAC) systems in both industrial and residential domains. They can be found in many other areas including hospitals, and meteorology stations to report and predict weather.

Pressure Sensor

A pressure sensor senses changes in gases and liquids. When the pressure changes, the sensor detects these changes, and communicates them to connected systems. Common use cases include leak testing which can be a result of decay. Pressure sensors are also useful in the manufacturing of water systems as it is easy to detect fluctuations or drops in pressure.

Proximity Sensor

Proximity sensors are used for non-contact detection of objects near the sensor. These types of sensors often emit electromagnetic fields or beams of radiation such as infrared. Proximity sensors have some interesting use cases.

In retail, a proximity sensor can detect the motion between a customer and a product in which he or she is interested. The user can be notified of any discounts or special offers of products located near the sensor.

Proximity sensors are also used in the parking lots of malls, stadiums and airports to indicate parking availability.

They can also be used on the assembly lines of chemical, food and many other types of industries.

Gas Sensor

- These types of sensors monitor and detect changes in air quality, including the presence of toxic, combustible or hazardous gasses. Industries using gas sensors include mining, oil and gas, chemical research and manufacturing.
- A common consumer use case is the familiar carbon dioxide detectors used in many homes.

Gyroscope

Gyroscope sensors measure the angular rate or velocity, often defined as a measurement of speed and rotation around an axis.

Use cases include automotive, such as car navigation and electronic stability control (anti-skid) systems.

Additional use cases include motion sensing for video games, and camera-shake detection systems.

Accelerometer Sensor

- Accelerometers detect an object's acceleration i.e. the rate of change of the object's velocity with respect to time.
- Accelerometers can also detect changes to gravity. Use cases for accelerometers include smart pedometers and monitoring driving fleets.
- They can also be used as anti-theft protection alerting the system if an object that should be stationary is moved.

Level Sensor

Level sensors are used to detect the level of substances including liquids, powders and granular materials.

Many industries including oil manufacturing, water treatment and beverage and food manufacturing factories use level sensors.

Waste management systems provide a common use case as level sensors can detect the level of waste in a garbage can or dumpster.

Infrared Sensor

- These types of sensors sense characteristics in their surroundings by either emitting or detecting infrared radiation. They can also measure the heat emitted by objects. Infrared sensors are used in a variety of different IoT projects including healthcare as they simplify the monitoring of blood flow and blood pressure. Televisions use infrared sensors to interpret the signals sent from a remote control. Another interesting application is that of art historians using infrared sensors to see hidden layers in paintings to help determine whether a work of art is original or fake or has been altered by a restoration process.

Optical Sensor

Optical sensors convert rays of light into electrical signals. There are many applications and use cases for optical sensors. In the auto industry, vehicles use optical sensors to recognize signs, obstacles, and other things that a driver would notice when driving or parking. Optical sensors play a big role in the development of driverless cars. Optical sensors are very common in smart phones. For example, ambient light sensors can extend battery life. Optical sensors are also used in the biomedical field including breath analysis and heart-rate monitors

IOT Applications

1. Wearable
   - Wearable technology is the hallmark of IoT applications and one of the earliest industries to deploy IoT.
   - We have fit bits, heart rate monitors and smart watches these days.
   - Guardian glucose monitoring device has been developed to help people with diabetes.
   - It detects glucose levels in our body, uses a small electrode called the glucose sensor under the skin, and relates it to a radiofrequency monitoring device.

2. Smart Home Applications
   - The smart home is probably the first thing when we talk about the IoT application.
   - The example we see the AI home automation is employed by **Mark Zuckerberg. Alan Pan's** home automation system, where a string of musical notes uses in-house functions.

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3. Health Care

- IoT applications can transform reactive medical-based systems into active wellness-based systems.
- Resources that are used in current medical research lack important real-world information.
- It uses controlled environments, leftover data, and volunteers for clinical trials. The **Internet of Things** improves the device's **power, precision** and **availability**.
- IoT focuses on building systems rather than just tools. Here's how the IoT-enabled care device works.

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4. Smart Cities

- Most of you have heard about the term smart city.
- Smart city uses technology to provide services.
- The smart city includes improving transportation and social services, promoting stability and giving voice to their citizens.
- The problems faced by Mumbai are very different from Delhi.
- Even global issues, such as clean drinking water, declining air quality, and increasing urban density, occur in varying intensity cities.
- Therefore, they affect every city.
- Governments and engineers use the Internet of Things to analyze the complex factors of town and each city.
- IoT applications help in the area of water management, waste control and emergencies.

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- **Example of a smart city - Palo Alto.**

  - Palo Alto, San Francisco, is the first city to acquire the traffic approach.
  - He realized that most cars roam around the same block on the streets in search of parking spots.
  - It is the primary cause of traffic congestion in the city.
  - Thus, the sensors were installed at all parking areas in the city.
  - These sensors pass occupancy status to the cloud of each spot.

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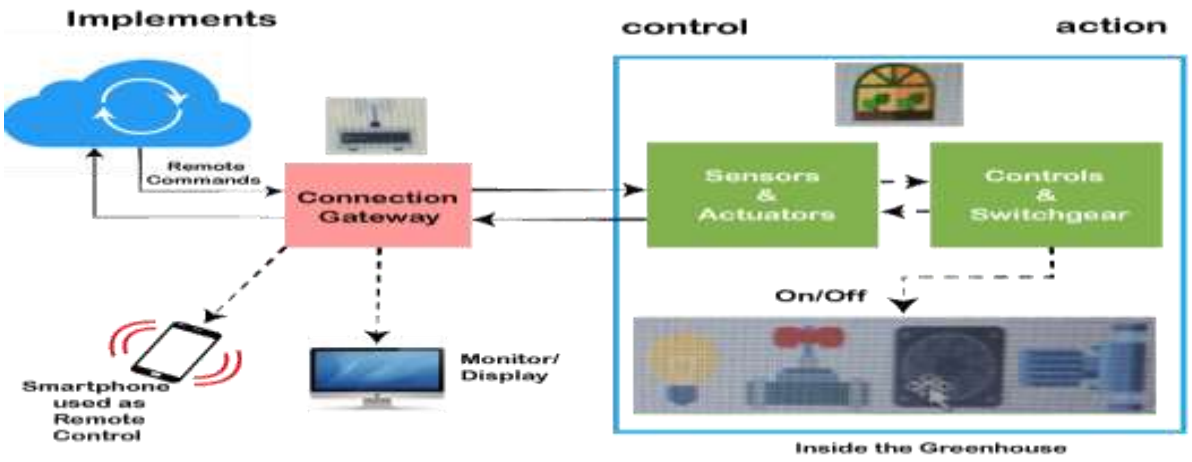
5. Agriculture

- By the year **2050**, the world's growing population is estimated to have reached about 10 billion.
- To feed such a large population, agriculture needs to marry technology and get the best results.
- There are many possibilities in this area. One of them is Smart Greenhouse.
- Farming techniques grow crops by **environmental parameters**.
- However, manual handling results in production losses, energy losses and labor costs, making it less effective.
- The greenhouse makes it easy to monitor and enables to control the climate inside it.



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6. Industrial Automation

- It is one of the areas where the quality of products is an essential factor for a more significant investment return.
- Anyone can **re-engineer** products and their packaging to provide superior performance in **cost** and **customer experience** with IoT applications.
- IoT will prove as a game-changer. In industrial automation, IoT is used in the following areas:
  - Product flow monitoring
  - Factory digitization
  - Inventory management
  - Safety and security
  - Logistics and Supply Chain Optimization
  - Quality control
  - Packaging customization

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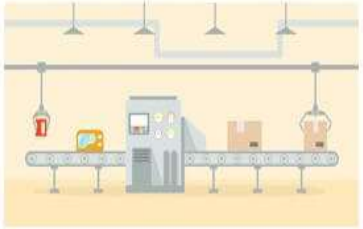
IoT Applications in Industrial Automation

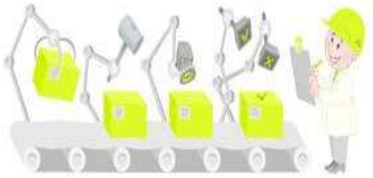
- Smart tracking for products in-transit
- Notifies users on deviations in delivery plans

- Creates Digital Factories
- Improves Line-of-Command in work units



- Monitors in near real-time through out the supply chain
- Provides cross channel visibility into inventories

- Product Quality testing in various stages of Manufacturing cycle
- Packaging Optimization



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7. Hacked Car
   - A connected car is a technology-driven car with Internet access and a WAN network.
   - The technology offers the user some benefits such as in-car infotainment, advanced navigation and fuel efficiency.
8. Smart Retail
   - IoT applications in retail give shoppers a new experience.
   - Customers do not have to stand in long queues as the checkout system can read the tags of the products and deduct the total amount from the customer's payment app with IoT applications' help.
9. Smart Supply Chain
   - Customers automate the delivery and shipping with a smart supply chain. It also provides details of real-time conditions and supply networks.