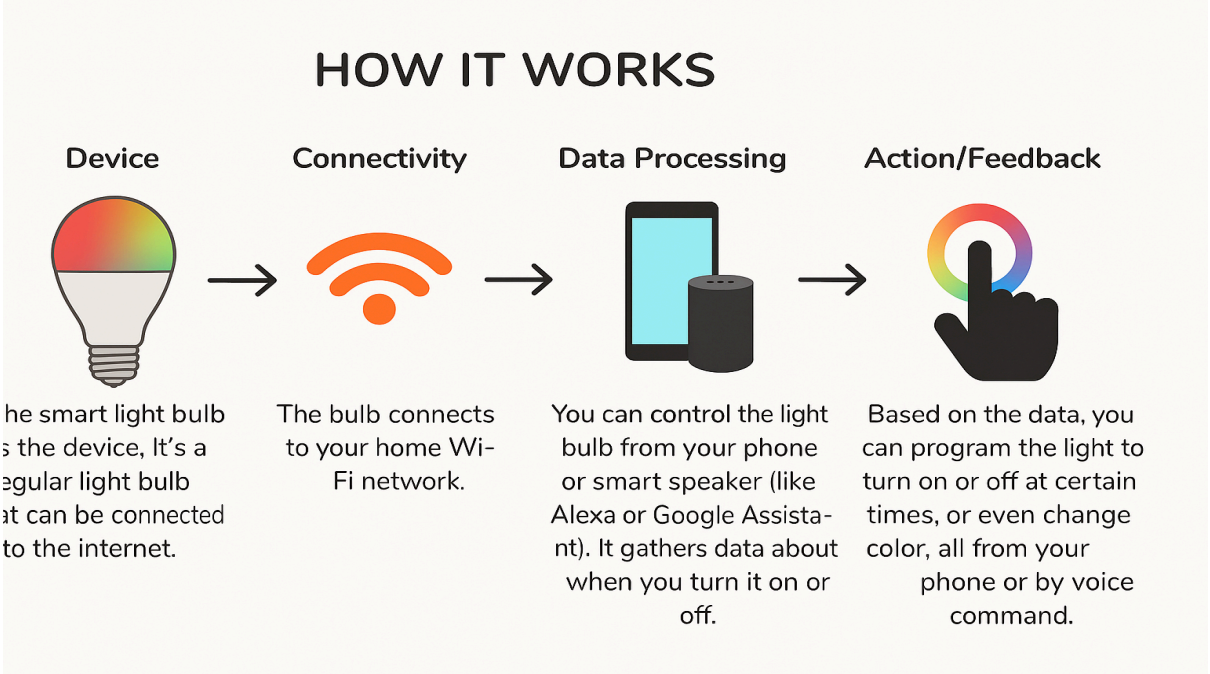
IoT Overview

The **Internet of Things (IoT)** refers to a network of physical devices that are connected to the internet, allowing them to collect, share, and exchange data. These devices range from everyday objects like smart thermostats and wearable health devices to more complex machinery such as industrial equipment and smart cars. The goal of IoT is to create a seamless interaction between the physical and digital worlds, making life more efficient, automated, and connected.

An example of the Internet of Things (IoT) is a **Smart light bulb**.

How it works:

1. **Device**: The smart light bulb is the device. It's a regular light bulb that can be connected to the internet.
2. **Connectivity**: The bulb connects to your home Wi-Fi network.
3. **Data Processing**: You can control the light bulb from your phone or smart speaker (like Alexa or Google Assistant). It gathers data about when you turn it on or off.
4. **Action/Feedback**: Based on the data, you can program the light to turn on or off at certain times, or even change color, all from your phone or by voice command.



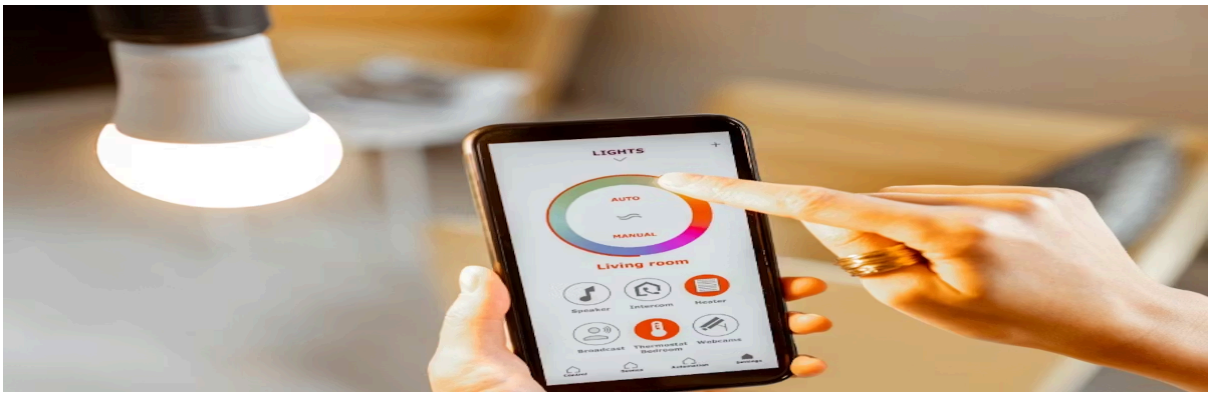
Why is it IoT?

- The light bulb is connected to the internet and can be controlled remotely, making it more convenient and energy-efficient.

1. What IoT device do you use or know about?

❖ **Smart Doorbell** (e.g., **Ring**):
It lets you see and speak to visitors at your door through your phone, even when you're not home. It connects to the internet and sends alerts when someone is at your door.

❖ **Smart Light Bulb** (e.g., **Philips Hue**):
It allows you to control the lighting in your home remotely through an app. You can turn lights on/off, dim them, or change their colors from anywhere.

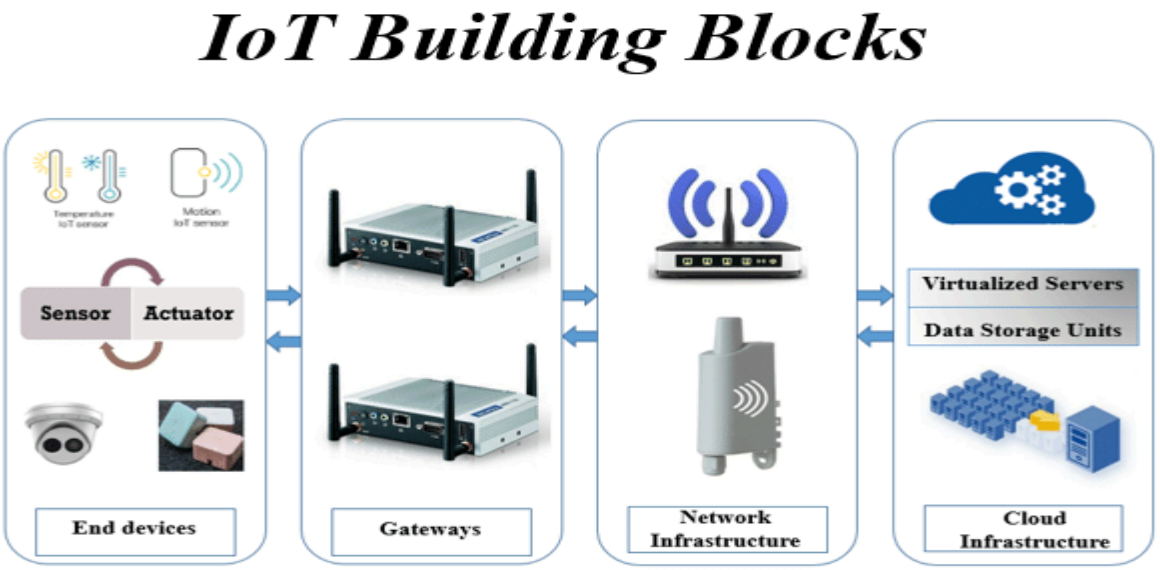


❖ **Smart Refrigerator** (e.g., **Samsung Family Hub**):
This fridge connects to the internet and lets you see what's inside through an app. You can also set reminders, create grocery lists, and even stream music or

videos from the fridge's touchscreen.

- **Smart Smoke Detector** (e.g., **Nest Protect**):
  It detects smoke and carbon monoxide and sends alerts to your phone. It also has a voice feature that tells you where the danger is (e.g., "Smoke in the kitchen").

2.IoT Building Blocks



1. End Devices

- These are the physical components that interact with the environment.
- Includes:
    - Sensors (e.g., temperature, motion) — they collect data.
    - Actuators (e.g., motors, lights) — they perform actions based on commands.
    - Cameras — capture visual data.
- These devices are the starting point of the IoT data flow.

2. Gateways

- Gateways act as bridges between end devices and the broader network.
- They:
    - ❖ Aggregate data from multiple sensors.
    - ❖ Translate protocols so devices can communicate with the cloud.
    - ❖ Often include wireless communication like Zigbee, LoRa, or Wi-Fi.

3. Network Infrastructure

- This layer handles data transmission.
- Includes:
    - Routers and network antennas.
    - Responsible for sending data from gateways to the cloud.
- Think of it as the highway that connects local devices to remote servers.

4. Cloud Infrastructure

- The brain of the IoT system.
- Includes:
    - Virtual servers and data storage.
    - Performs data processing, analytics, and decision-making.
- Enables services like dashboards, alerts, automation, and AI-based insights.

3.Some IoT Use Cases

1. Smart Agriculture

In smart agriculture, IoT devices such as soil moisture and temperature sensors are used to monitor environmental conditions. These sensors send real-time data to a

cloud-based or on-premises server, which analyzes the information. Based on the data, automated irrigation systems can be triggered when the soil moisture reaches a certain threshold, ensuring crops receive the right amount of water. This approach optimizes water usage, reduces waste, and enhances crop productivity.

2. Smart Health

IoT devices like wearable heart rate monitors and oxygen sensors collect vital health data from individuals and send it to a hospital's cloud system. This continuous monitoring allows healthcare providers to track patients' conditions in real time. If any abnormal readings, such as irregular heart rates or low oxygen levels, are detected, alerts are sent to healthcare professionals or caregivers, enabling quicker intervention and improving patient care.

3. Smart Cities

In smart cities, IoT devices such as traffic sensors, smart streetlights, and pollution monitors help manage urban environments more efficiently. Traffic data is analyzed to optimize traffic flow, while pollution levels are tracked to monitor air quality. Smart streetlights adjust based on movement, saving energy. All data is sent to central

monitoring systems, allowing city planners to make data-driven decisions, such as adjusting traffic lights or notifying citizens about air quality via apps, creating a safer and more sustainable urban life.

4.Sensors / Actuators

1. **Common IoT Sensors:**
   - ➢ **Temperature Sensor** – Measures temperature.
   - ➢ **Humidity Sensor** – Measures moisture level in the air.
   - ➢ **Proximity Sensor** – Detects the presence or absence of an object.
   - ➢ **Light Sensor** – Measures light intensity.
   - ➢ **Motion Sensor** – Detects movement.
   - ➢ **Pressure Sensor** – Measures pressure of gases or liquids.
   - ➢ **Gas Sensor** – Detects gases (e.g., CO, methane).
   - ➢ **Accelerometer** – Measures acceleration or tilt.
   - ➢ **Gyroscope Sensor** – Measures rotation or angular velocity.
   - ➢ **Sound Sensor** – Detects sound or vibrations.

2. **Common IoT Actuators:**
   - ➢ **Motors** – Convert electrical energy into mechanical motion (e.g., used in robots, fans, or automated systems).
   - ➢ **Solenoids** – Control the movement of a mechanical component, typically used to lock/unlock doors or control valves.
   - ➢ **Relays** – Act as a switch to control electrical circuits, turning devices on or off remotely.
   - ➢ **Servos** – Provide precise control of angular position, commonly used in robotics and remote-controlled devices.
   - ➢ **Heaters** – Regulate temperature by converting electrical energy into heat (e.g., used in smart thermostats).

- ➢ **Lights** – Provide illumination, often adjustable remotely (e.g., smart light bulbs).
- ➢ **Pumps** – Move fluids or gases, often used in irrigation systems or HVAC systems.
- ➢ **Valves** – Control the flow of liquids or gases by opening or closing, typically used in industrial processes.
- ➢ **Speakers** – Output sound, used in smart home devices for audio feedback or alarms.
- ➢ **Displays** – Show visual information (e.g., smart screens, digital signage).

3. Common IoT Actuators:

Simulation tools like **TinkerCAD, ThingSpeak, Wokwi**, or **Proteus** can be used to test and visualize this system before real-world implementation.

1. **Components**: Include sensors (soil moisture), actuators (irrigation valves), and a cloud platform to process data.
2. **Data Collection**: Sensors measure soil moisture and send data to the cloud.
3. **Data Processing**: The cloud analyzes the moisture level. If it's low, it triggers the irrigation valve.
4. **Actuation**: The irrigation valve opens to water the crops when moisture is below the threshold.
5. **Feedback**: The system continuously monitors soil moisture, adjusting irrigation as needed.

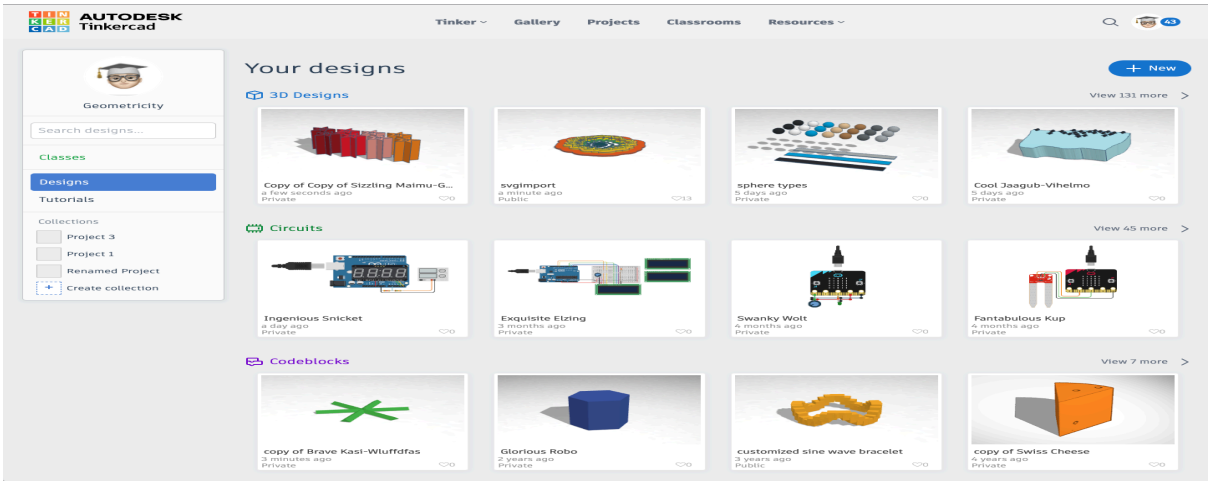


Fig. Tinkercad Interface

Fig. Wokwi Interface

4.Reflections

- Which sensors and actuators would you use to make your home smarter?
- How would IoT change agriculture in rural communities of your country?
- What risks might come from connecting too many devices to the internet?