CHAPTER – 1

INTRODUCTION

1. INTRODUCTION OF IOT:

The term IOT, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves.

You likely use IOT devices every day. Some that you may be familiar with include watches, smart thermostats and kitchen appliances, fitness – tracking self- driving cars, and home security system. Personal medical devices like pacemakers are also IOT devices.

1.1. IOT IS USED FOR THE FOLLOWING PURPOSE:

1.1(a). Energy management

IoT devices can communicate with utilities to balance power generation and optimize energy consumption.

1.1(b). Remote control

Users can remotely control IoT devices such as powering ON or OFF heating systems, controlling ovens, and changing lighting conditions.

1.2. THE IOT HAS MANY APPLICATIONS INCLUDING:

1.2(a). Health care

IOT based system can collect and transmit real – health data, which can be stored in the cloud and accessed by authorized individuals.

1.2(b). Smart grids

IoT can remotely monitor and manage lighting, electricity, traffic signals, parking, and more.

1.2 (c). Smart cities

IoT can improve infrastructure and quality of life through efficient communication between devices.

1.2(d). Hospitality

IoT can help automate processes, improve the guest experience, and save money on energy can maintenance.

1.2(e). Smart agriculture

IoT can help with automatic irrigation and fertilization, crop growth monitoring, and pest and disease detection.

1.2(f). Autonomous driving

IoT can help vehicles drive on their own without human intervention.

1.2(g). Transportation

IoT can help with fleet management by tracking vehicles in real – time, which can help optimize routes, reduce fuel consumption, and improve service delivery.

TYPES OF COMPONENTS

1. ARDUINO UNO

Arduino uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

The Arduino uno is an open-source microcontroller board that's popular with beginners in electronics and programming.

Pins: The UNO has 14 digital input/output pins and 6 analog inputs.

Power: The UNO can be powered by a USB port, an external adapter, or a battery. It can also handle external power sources up to 12V.

Storage: The UNO has 13KB of flash memory for storing instructions as code. It also has a Micro SD card slot for extra storage.

Reset button: The UNO has a reset button to restart the microcontroller.

LED indicators: The UNO has led indicators that can be used for debugging or to indicate a signal.

USB interface: The UNO has a USB port for connecting to a computer and developing serial communication.

Microcontroller: The UNO is based on the microchip ATmega328P Microcontroller.

Ease of use: The UNO is considered easy to use and beginner friendly.

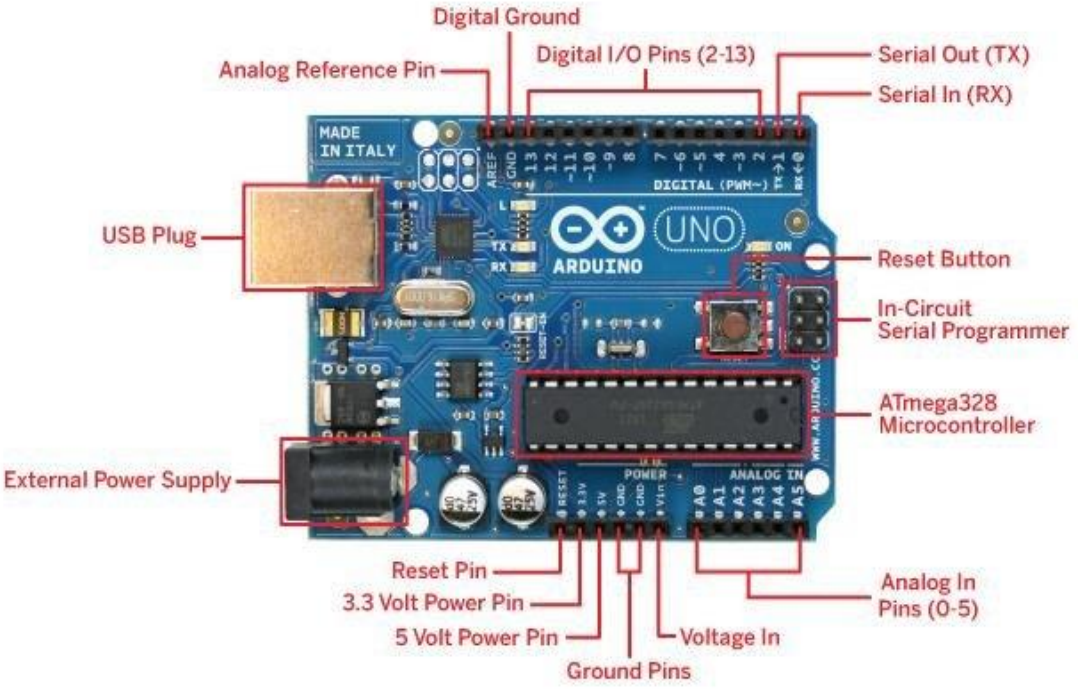


Fig of Arduino UNO

2. BREAD BOARD

A breadboard provides an easy way to create electronic circuits. It is a plastic board with lines of holes for holding either electronic component or connecting wires (jumper wires). The lines of holes are connected as shown by the red arrows in the diagram below.

A bread consists of plastics blocks holding a matrix of electrical sockets of a size suitable for gripping thin connecting wire, component wires or the pins of transistors and integrated circuits (ICs). The sockets are connected inside the board, usually in rows of five sockets. A breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode).

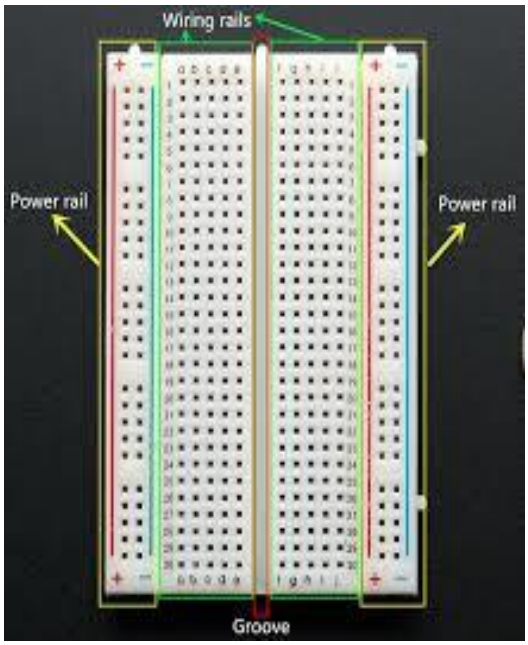


Figure of Breadboard

The bread board has strips of metal which run underneath the board and connect the holes on the board. The metal strips are laid out as shown below.

3. JUMPER WIRE

Jumper wire are electrical wires with connector pins on each end that are used to connect two points in a circuit without soldering. They are commonly used in prototyping and testing circuits, and in the internet of things (IOT) for a variety of purposes, including:

- Connecting components jumper wires are used to connect components to a breadboard or other prototyping tool, or to connect to the pins of a microcontroller to from circuits.
- Configuring settings jumper wires can be used to configure setting for computer peripherals, such as enabling or disabling intrusion detection on a motherboard.
- Short-circuiting Jumper wires can be used to short-circuit a circuit.
- Diagnosing problems Jumper wires can be used to diagnose problems in a circuit, such as bypassing a part of the circuit that is suspect to be bad.
- Jumper wires are inexpensive and easy to purchase, but you can also make your own using insulated wire and wire strippers.

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

Figure of Jumper Wire

4. LED (light emitting diode)

Light-emitting diode (LED) is a widely used standards source of light in electrical equipment. It has a wide range of applications ranging from your mobile phone to large advertising billboards. They mostly find applications in devices that show the time and display different types of data.

LED used in the IOT are smart lighting system that can communicate with a network and be controlled remotely. They offers a variety of benefits, including: Energy efficiency, Security, Cost reduction, Environmental response, Data analytics, Customization.

Here are some examples of how IOT-enabled LED lighting is used:

Street lighting, Home lighting, Retail spaces, Corporate offices.

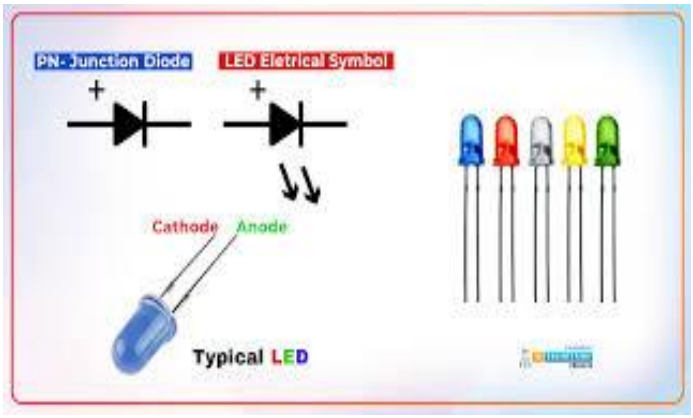


Figure of LED

5. SENSOR

A sensor is defined as a devices that receives a signal or stimulus and responds to it by generating an electrical signal. The output signals correspond to some forms of electrical signal, such as current or voltage, which can be easily measured.

- **ULTRASONIC SENSOR:** Ultrasonic sensors are used in the IOT for a variety of applications, including smart cities and smart control systems. They are commonly used for distance measurement and proximity sensing.

An ultrasonic sensor is an instrument that measure the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an objects proximity.

An ultrasonic sensor is an electronic devices that measure the distance of a target object by emitting ultrasonic sound wave, and converts the reflected sound in an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (they the sound that humans can hear).

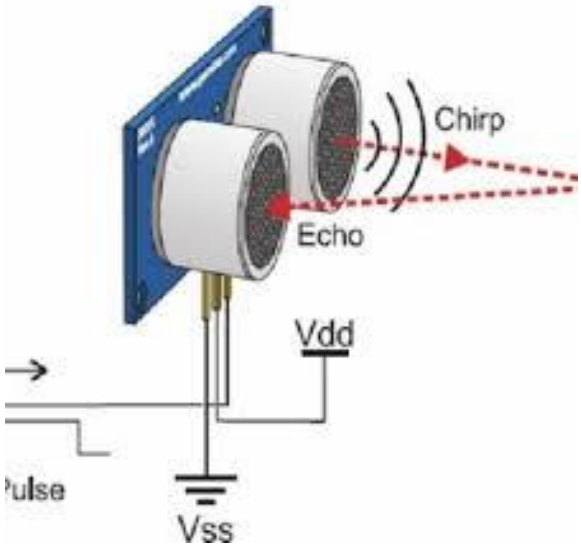


Figure: Ultrasonic Sensor

- Ultrasonic sensor can measure the distance to a wide range of objects regardless of shape, color or surface texture. They are also able to measure an approaching or resending object.

- **IR SENSOR:** An infrared sensor is a radiation-sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength range 780 nm. IR sensor are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm system to detect unwelcome guests.
  IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings.

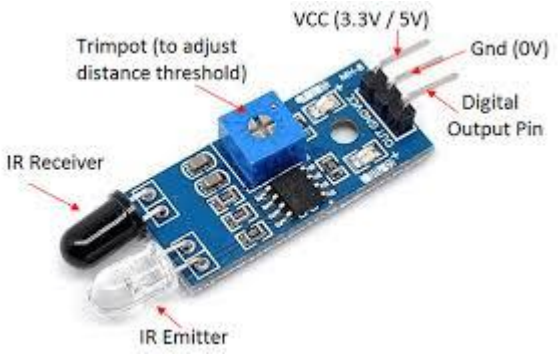


Figure: IR Sensor

6. SERVO MOTOR: Servo motor is a type of DC motor that includes a gear train, a shaft encoder, and control logic, allowing for precise control of its position. It typically has a limited rotation of 180 degree and is commonly used in application such as remote-control model airplanes and small robots.

Servo motors are used in the IOT to precisely control the movement and position of parts in machines. They are essential for tasks such as adjusting smart home devices, controlling robotic arms, and managing automated systems.

Servo motor are closed-loop system that use a control signal to move the output shaft to a specific position, velocity, or acceleration. They receive control signals, usually in the form of pulse-width modulation (PWM), which tell the motor how far to rotate.

Figure: Servo Motor

TYPES OF SENSORS IN IOT

1. Temperature Sensors:

Measure the temperature of an objects or area, and are used in many industries, including agriculture and manufacturing.

2. Pressure Sensors:

Detect changes in pressure in liquids or gases, and are used in water and heating systems.

3. Proximity Sensors:

Detect the presence or absence of objects without physical contact, and are used in security systems, automatic doors, and robotic vacuum cleaners.

4. Motion sensors:

Detect movement or changes in position, and are used in security systems, activity trackers, and video game controllers.

5. Humidity sensors:

Measure the amount of water vapor in the air, and are used in HVAC systems, greenhouses, and weather monitoring.

6. Image sensors:

Convert optical image into signals and are used to display or store files electronically.

7. Chemical and Gas sensors:

Monitor air quality for the presence of toxic or hazardous gases.

6. BUZZER

A buzzer, also known as a beeper, is an audio signaling device that makes a buzzing sound. Buzzers can be mechanical, electromechanical, or piezoelectric. They are used in many applications, including:

- Alarm devices: Buzzer are used in alarm systems and clock and timer alarms.
- Doorbells: Electromechanical buzzers are used in doorbells.
- Music and melody playback: Buzzer can be used to play music and melodies.
- Automation and control systems: Buzzers are used in automation and control systems.
- Education and learning project: Buzzers aue used in education and learning projects.

Figure: Buzzer

ADVANTEGES OF IOT

The Internet of Things (IOT) has many advantages, including:

- **Improved customer experience:** IOT can help business provide more personalized services and better customer support. Business can gather customer data to anticipate needs and tailor their offerings.
- **Reduced Costs:** IOT can help business reduce costs by streamlining operations and increasing profitability. IOT device can help keep equipment running efficiently, which can reduce maintenance costs.
- **Improved operational efficiency:** IOT can help business automate processes and reduce labor costs. IOT devices can also help business reduce waste.
- **Improved work safety:** IOT devices can help business improve work safety by reducing the likelihood of human error. IOT devices can also be used for security, such as surveillance cameras and motion sensors.
- **Real-time data:** IOT can provide real-time access to information, including asset visibility and predictive insights.
- **Data-driven decision-making:** IOT can provide data-driven insights that can help business make quick decisions.
- **Improved mobility:** IOT can improve mobility in smart cities through transportation connectivity, smart city systems, and connected micromobility transportation methods.

Characteristics of the IOT

The internet of things (IOT) is characterized by the following key features that are mentioned below:

1. Connectivity

Connectivity is an important requirement of the IOT infrastructure. Things of IOT should be connected to the IOT should be connected to the IOT infrastructure. Anyone, anywhere, anytime can connected, this should be guaranteed at all times.

2. Intelligence and Identity:

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

3. 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.

4. Dynamic and self-Adapting (Complexity):

IOT devices should dynamically adapt themselves to changing contexts and scenarios. Assume a camera meant for surveillance.

5. Architecture:

IOT architecture cannot be homogenous in nature. It should be hybrid, supporting different manufacturers product to function in the IOT network.

6. Safety:

There is a danger of the sensitive personal details of the uses getting compromised when all his/her devices are connected to the internet. This can cause a lass to the user.

7. Autonomous operation:

Autonomous operation refers to the ability of IOT devices and systems to operate independently and make decisions without human intervention.

8. Security:

Security is a critical concern for the IOT, as IOT devices and systems handle sensitive data and are connected to critical infrastructure. The increasing number of connected devices and the amount of data being transmitted over the Internet make IOT system a prime target for cyberattacks.

CHAPTER-2

3-D PRINTING

1. INTRODUCTION OF 3-D PRINTING:

3D printing is a process that creates a three-dimensional object from a digital design, usually by layering material:

Three- dimensional (3D) printing is an additive manufacturing process that creates a physical object from a digital design. The process works by laying down thin layers or powdered plastic, metal or cement, and then fusing the layers together.

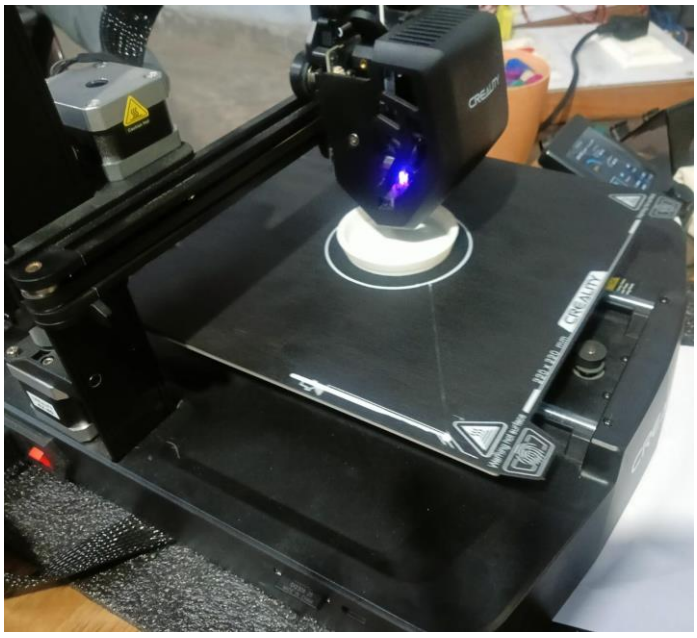


Figure: 3D Printing Machine

How it works:

A 3D printer uses a CAD (Computer-Aided design) file to create a 3D model, which is then translate into a physical object. The printer deposits material in

layers, which are then fused together. The material can be a liquid, powder, or plastic.

Materials:

3D printing can be done with a variety of materials, including plastics, metals, concrete, and bio-materials.

3D printing uses a variety of materials, depending on the type of printer and the intended application. Some of the most common materials include:

1. Plastics:

PLA (Polylactic Acid): A biodegradable, user-friendly material, commonly used

For prototyping and educational use.

ABS (Acrylonitrile Butadiene Styrene): Known for its toughness, durability, and

Heat resistance, often used in automotive and consumer goods.

PETG (Polyethylene Terephthalate Glycol): Offers a balance of strength and flexibility, commonly used in food packaging and medical devices.

Nylon: A strong, flexible material, ideal for producing functional prototypes

And parts that require wear resistance.

2. Resins:

Standard Resin: Often used for high-detail prints like jewelry, dental models, or

Miniatures.

Tough Resin: Provides greater durability and impact resistance, used in

Engineering prototypes and parts.

3. Metals:

Stainless Steel: Used in industrial applications, aerospace, and automotive for durable parts.

Titanium: Known for its strength, light weight, and resistance to heat, often used in aerospace and medical implants.

4. Ceramics:

Ceramic materials can be 3D printed to create items like art, pottery, and custom Ceramic parts for applications.

Types of 3D printing:

There are several different 3D printing processes, including direct energy deposition and multi jet fusion.

Applications

3D printing is used in many industries, including healthcare, dentistry, and construction. For examples, 3D printing is used to make molds for clear aligners, crowns, dentures, and surgical guides. During the COVID-19 pandemic, 3D printing was used to make personal protective equipment and parts to fix ventilators.

3D printing machines have a wide range of applications across various industries. Some of the key applications include:

1. Prototyping: Rapid prototyping allows designers to quickly create and test physical models of new products before moving to mass production, saving time and cost.

2. Manufacturing: 3D printing is used for producing complex, customized, or small-batch parts in industries like aerospace, automotive, and electronics.

3. Healthcare: 3D printing is used to create custom prosthetics, implants, and anatomical models for surgical planning and education. It's also utilized in bioprinting to create tissues and organs.

4. Construction: Large-scale 3D printing is used in the construction industry to print building components or even entire houses, offering potential for reducing labor costs and construction time.

5. Fashion and Jewelry: Designers use 3D printing for creating intricate and customizable pieces, ranging from clothing to accessories.

6. Education and Research: 3D printing is increasingly used in educational settings for hands-on learning, creating teaching aids, and conducting scientific research.

7. Art and Design: Artists and designers use 3D printing to create detailed sculptures, installations, and prototypes for creative projects.

8. Food Production: 3D printers are being developed to print food, such as chocolate, pizza, and even more complex meals.

9. Aerospace: 3D printing is used to produce lightweight, high-performance parts for aircraft and spacecraft, optimizing design and material usage.

10. Automotive: In the automotive industry, 3D printing is used for prototyping parts, producing customized components, and even making end-use products like engine parts or interior accessories.

These applications demonstrate the versatility and growing potential of 3D printing technology across many sectors.

2. 3D PRINTING IS USED IN MANY INDUSTRIES, INCLUDING:

- **Dentistry:** 3D printing is used to create dental restorations and working models from intraoral scans. This technology is more accurate and consistent than traditional methods, and it can reduce clinical time and waste.

- **Construction:** 3D printing is used to make a variety of construction items, including hardware, tools, and even entire houses.

- **Jewelry:** 3D printing is used to make high- quality jewelry with smooth surfaces. Jewelers are also use 3D printing to create patterns for investment casting.

- **Architecture:** 3D printing allows architects to quickly convert their ideas into tangible products. Changes can be easily incorporated into the design, and models can be generated accordingly.

- **Medicine:** 3D printing is used to create medical devices, such as prosthetics and implants. It can also be used to create human tissue and organs for transplantation.

- **Engineering, Architecture, and Manufacturing**: 3D printing is used in these industries for rapid prototyping to speed up workflows and save money.

3.COMPONENT DESCRIPTION:

This chapter includes the description of various different components used in the development of the system project. It is really very necessary to describe the features of the components that are used in the designing of the system.

3.1. <u>FRAME:</u> Selection of frame is an essential part for system designing. This frame gives the support to the printer. All the axes of the motor added to this frame.

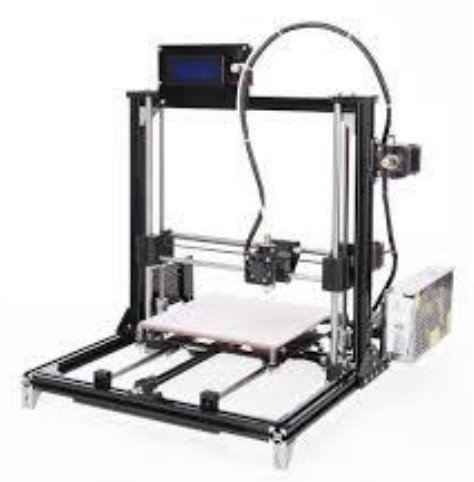


Figure: Frame

3.2. Extruder: Extruder consists of two parts, a cold top part that feeds the plastic filament, hot part at bottom that melts and extrudes the plastics.

Figure: Extruder

3.3. Stepper Motor: The stepper motor is an electromagnetic device that converts digital pulses into mechanical shaft rotation. Many advantages are achieved using this kind of motors, such as higher simplicity, since no brushes or contacts are present, low cost, high reliability, high torque at low speeds, and high accuracy of motion.

Figure: Stepper Motor

3.4. Polylactic Acid (PLA) Plastics: IT is a biodegradable plastics material which is made from renewable resources such as corn starch and sugarcane.

Figure: Filament

3.5. Framework: After assembling the whole electronics part now, it is the time for the mechanical structure to be decided and to fit our electronics in it.

3.6. Printing Bed: Also known simply as a print bed, a 3D printing bed is a flat surface on which a 3D printer builds an object. Most types of 3D printers, including fused filament fabrication (FFF) 3D printers, are designed to deposit material through a nozzle. As the printer head moves, it releases material.

Figure: BED

CHAPTER - 01

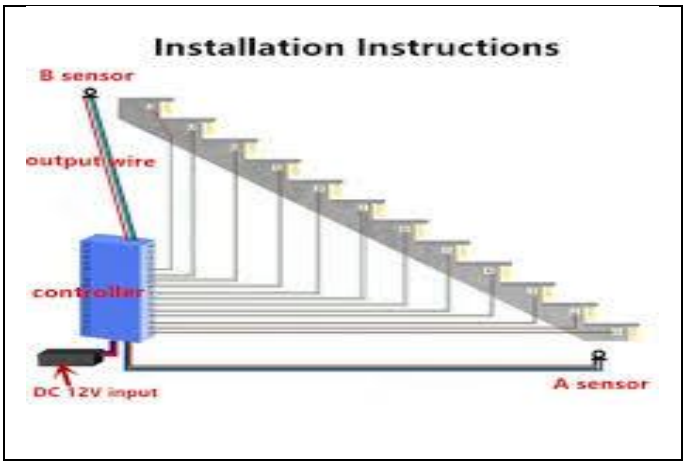
AUTOMATIC STAIR LIGHT

1. INTRODUCTION:

The automatic staircase light system is a smart lighting solution designed to automate the process of turning on and off lights on staircases based on human movement. It uses an Arduino uno microcontroller in combination with a passive infrared (PIR) sensor and a relay module to control the lighting system. The primary goal of this project is to provide convenience improve safety, and promote energy efficiency.

I built this Arduino based automatic LED light controller for a set of poorly lit stairs in our new home. The stairs are quite dangerous- especially at night- but not any more thanks to the motion activated automatic LED stairs lighting with Arduino.

In a modern, smart home or building, automating the lighting system, especially for areas like staircases, is an important feature. A staircase can often be a place where manual light switches are inconvenient or can cause accidents when the switch is missed or not sound in the dark. By using sensors to detect human movement and control the lighting system, we can ensure that the lights turn on automatically when someone approaches and turn off when there is no movement.



An infrared (IR) sensor can be used to detect the presence of a person in the staircase area. When the sensor detects or movement, the Arduino UNO will trigger

a relay to switch on the light. This eliminates the need for manual operation and improves both safety and energy efficiency.

2. COMPONENT:

List all the components you used in the project:

- **Arduino Uno** (Microcontroller)
- **IR Motion sensor**
- **LED** (for lighting)
- **Jumper wires**
- **Breadboard** (for Arduino and relay)

Automatic motion stair lights use a combination of motion sensor, power supplies, light strips or LED and controllers.

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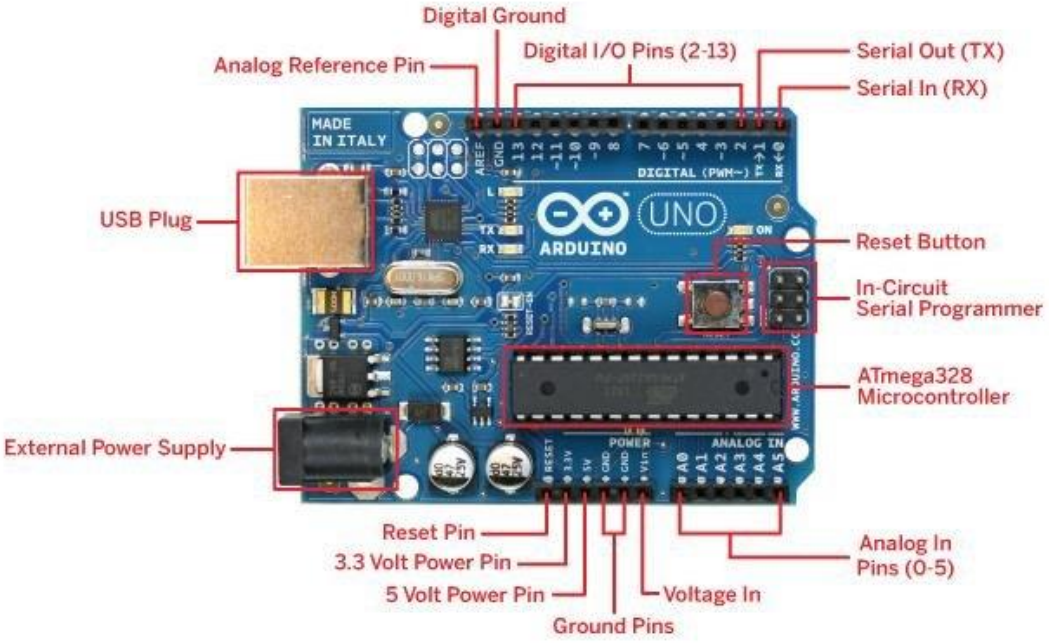

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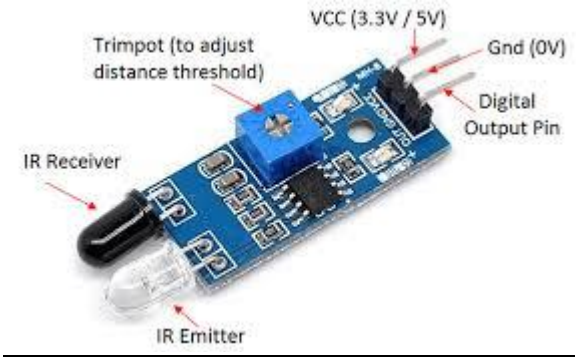

Figure: IR Sensor

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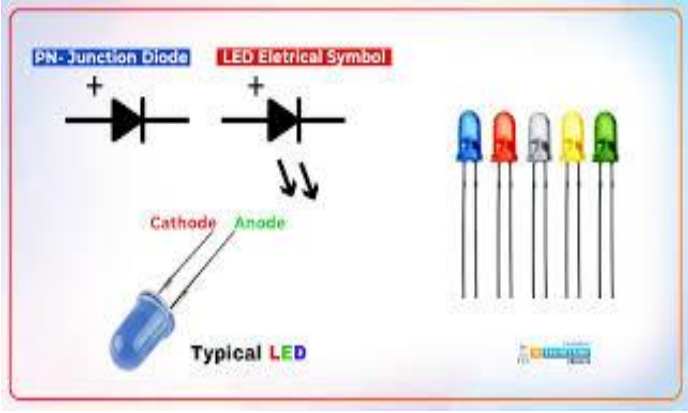

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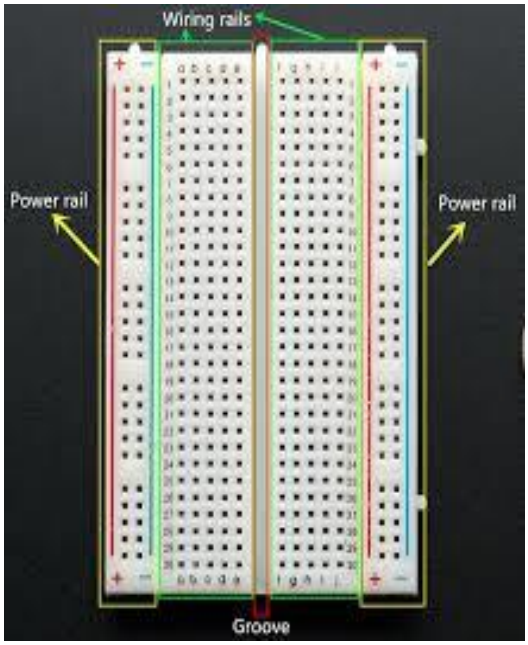

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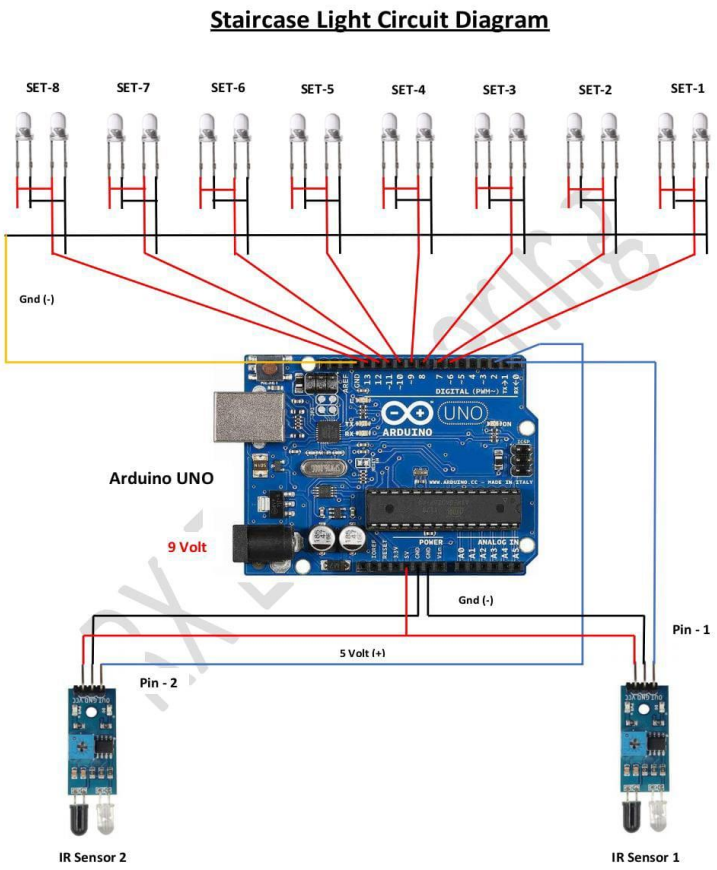
Figure of Jumper Wire

CIRCUIT DIAGRAM:



WORKING PRINCIPLE:

1. Motion detection: The IR sensors are placed at strategic locations (such as at the bottom and top of the staircase). When a person moves within the detection range, the sensor sends a signal to the Arduino.

2. Arduino Processing: The Arduino receives the input from the IR sensor and processes the signals. If motion is detected, it sends an output to the relay module to turn on the light.

3. Relay Control: The relay is connected to the light (LED or bulb) and acts as a switch. When the relay is triggered by the Arduino, it closes the circuit, allowing electricity to flow to the light, turning it on.

4. Timer Function (Optional): To save energy, you can add a timer function. After a set period (e. g., 30 seconds to a minute) without and further motion detected, the Arduino can automatically send a signal to the relay to turn off the light.

5. Automatic Operation: As a person walks up or down the stairs, the sensors continuously detect movement and the Arduino turns the light on or off accordingly. The system ensures the light is only on when needed, making it energy-efficient.

Project figure 1:

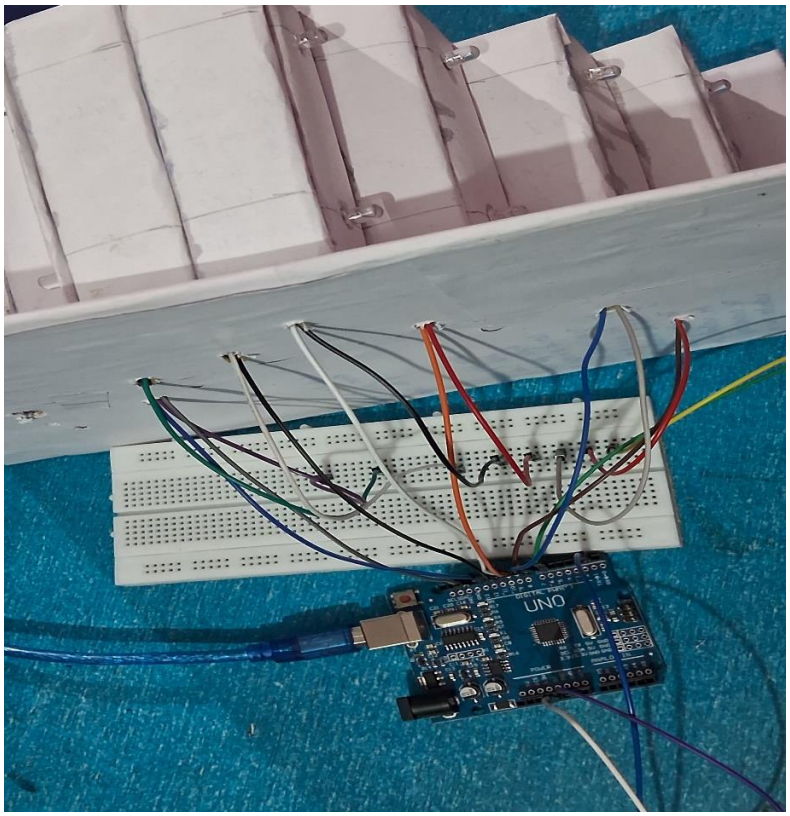
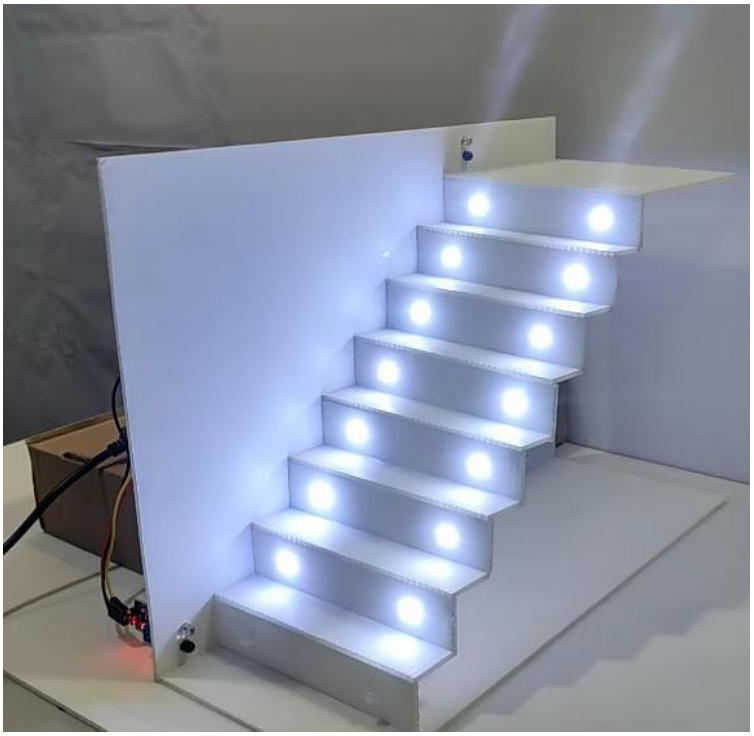


Figure: Automatic stair light

Project figure 2:



<u>Flow of Operation:</u>

- **Step 1:** The person enters the sensors detection range.
- **Step 2:** The IR sensor sends a signal to the Arduino.
- **Step 3:** The Arduino activates the relay to switch on the lights.
- **Step 4:** The system waits for a timeout period (if no further motion is detected).
- **Step 5:** If no motion is detected after the set time, the Arduino turns off the light by deactivating the relay.

This system ensures that the lights inly turn on when needed and saves power by automatically turning off the lights when the area in unoccupied.

CODE EXPLAINATION:

```
int IRSensor1 = 1;
int IRSensor2 = 2;
void setup( )
{
   pinMode (IRSensor1, INPUT);
   pinMode (IRSensor2, INPUT);
   pinMode (6, OUTPUT);
  pinMode (7, OUTPUT);
  pinMode (8, OUTPUT);
  pinMode (9, OUTPUT);
  pinMode (10, OUTPUT);
  pinMode (11, OUTPUT);
  pinMode (12, OUTPUT);
  pinMode (13, OUTPUT);
}
void loop( )
{
   int statusSensor1 = digitalRead (IRSensor1);
   int statusSensor2 = digitalRead (IRSensor2);
   if statusSensor1 == 0)
{
   digitalWrite(6, HIGH);
   delay(500);
```

```
  digitalWrite(7, HIGH);
  delay(500);
  digitalWrite(8, HIGH);
  delay(500);
  digitalWrite(9, HIGH);
  delay(500);
  digitalWrite(10, HIGH);
  delay(500);
}
```

ADVANTAGES:

- **Energy savings:** Automatically turn off lights when no movement is detected, which can reduce electricity bills.
- **Convenience**: Automatically turns on lights when you enter a space, so you don't need to find a switch.
- **Security:** Can deter intruders by making it harder to perform unlawful activities after hours.
- **Low Cost:** Uses low-power, low-cost components**.**
- **Easy to integrate:** Can be integrated with other lighting systems.

DISADVANTAGES:

- **False Triggering:** The IR sensor may activate the lights due to unintended motion (e. g., pets, wind, or reflections), leading to unnecessary lighting usage.
- **Limited Range:** The sensors detection range might not be ideal for long staircases, requiring multiple sensors or a requiring multiple sensors or a more sophisticated setup.

- **Maintenance:** Sensors and wiring might need occasional maintenance or recalibration, especially in areas with high foot traffic or environmental factors (dust, weather).
- **Complexity in Debugging:** If the system malfunctions, troubleshooting may require knowledge of both hardware (Arduino) and software, which could be a challenge for users without technical expertise.
- **Power Consumption:** Although energy-efficient, the Arduino and sensors still require some power, which may become an issue if using a battery-powered setup.
- **Sensor Interference:** Objects or environmental factors (like heat sources or large objects in the sensors line of sight) might interfere with accurate detection, potentially causing delays or failures in turning the lights on or off.

FUTURE SCOPE:

The future scope of automatic stair lighting using Arduino and IR sensors can be expanded and improved in several ways, including:

1. Enhanced Automation and Smart Control:

- Integration with smart hoe systems (e.g., Alexa, Google Assistance) for voice control and remote management.
- Use of motion sensors to further automate the lighting based on the user's presence or movement.
- Addition of timing and scheduling features where lights turn on or off based on the time of day or occupancy patterns.

2. Energy Efficiency:

- Incorporating more advance sensors, such as passive infrared (PIR) sensors, to detect motion more effectively, reducing energy waste.

3. Wireless Connectivity:

- Development of a wireless version of the system, using technologies like Wi-Fi or Bluetooth, to enable communication between sensors and controllers without physical wiring.

4. Multi-Sensor Integration:

- In addition to IR sensors, other sensors such as ultrasonic sensors (for precise motion detection) or pressure sensors (to detect footsteps) could be integrated for more accurate operation.

5. Wireless Control:

- Incorporating wireless communication (e.g., Bluetooth or Wi-Fi) would allow users to control the system remotely via smartphone apps.

6. Security Features:

- With additional sensors like cameras or motion detectors, the system could also serve as a security feature, notifying users of unauthorized movement on the staircase.