INTERNET OF THINGS LAB

AUTOMATIC LIGHTS USING ARUDUINO

<u>BATCH-7</u>

A Project report submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY
IN
INFORMATION TECHNOLOGY

Submitted By:

MD.GULKHAN (A21126511038)
N. SUBRAHMANYAM (A21126511044)
P. DIVYANJALI (A21126511045)
P. SAI KIRAN (A21126511050)
T. SAI HRUTIK (A21126511060)
CH. NAVEEN (A21126511203)

PRAGNANAM BRAHMA
ANITS

DEPARTMENT OF INFROMATION TECHNOLOGY
ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES

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Submitted By:

MD. GULKHAN (A21126511038)

N. SUBRAHMANYAM (A21126511044)

P. DIVYANJALI (A21126511045)

P. SAI KIRAN (A21126511050)

T. SAI HRUTIK (A21126511060)

CH. NAVEEN (A21126511203)

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES
(UGC AUTONOMOUS)

(*Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'A' Grade*)

Sangivalasa, Bheemili Mandal, Visakhapatnam dist.(A.P)

PRAGNANAM BRAHMA
ANITS

CERTIFICATE

This is to certify that the project reported entitled **"AUTOMATIC LIGHTS USING ARDUINO"** submitted by **Md.Gulkhan, N.Subrahmanyam, P.Divyanjali, P.Sai Kiran, T.Sai Hrutik, Ch.Naveen** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Information Technology** of **Anil Neerukonda Institute of Technology and Sciences**, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

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Lecturer Incharge	**Head of the Department**
Mrs.A.Surekha	**Prof.M.Rekha Sundari**
Department of IT	**Department of IT**
ANITS	**ANITS**

DECLARATION

We hereby declare that the project work entitled "AUTOMATIC RAIN SENSING CAR WIPERS" submitted to Anil Neerukonda Institute of Technology and Sciences is a record of an original work done by MD.GULKHAN (A21126511038), N.SUBRAHMANYAM (A21126511044), P.DIVYANJALI(A21126511045), P.SAI KIRAN(A21126511050), T.SAI HRUTIK (A21126511060), CH.NAVEEN (A21126511203), under the esteemed guidance of Mrs. A. SUREKHA Assistant Professor of Information Technology, Anil Neerukonda Institute of Technology and Sciences and this project work is submitted in partial fulfillment of the requirements for the award of degree bachelor of technology in information technology . This entire project is done to the best of our knowledge and not submitted for the award of other degree in any other universities.

PROJECT STUDENTS

MD.GULKHAN (A21126511038)

N. SUBRAHMANYAM (A21126511044)

P. DIVYANJALI (A21126511045)

P. SAI KIRAN (A21126511050)

T. SAI HRUTIK (A21126511060)

CH. NAVEEN (A21126511203)

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ABSTRACT

AUTOMATIC LIGHTS USING ARDUINO AND PIR SENSOR

The "Automatic Lights using Arduino and PIR Sensor" project proposes a smart lighting system designed to streamline energy consumption and enhance convenience through motion detection technology. Utilizing Arduino microcontroller and Passive Infrared (PIR) sensor, the system detects human presence and automatically activates or deactivates lights accordingly, eliminating the need for manual switching. Key components include an Arduino board, PIR sensor, and relay module for seamless integration. Customizable parameters such as sensitivity and delay time ensure adaptability to diverse environments and user preferences. With applications ranging from home automation to commercial spaces, the system offers hands-free operation, energy efficiency, and improved user experience, contributing to sustainable and comfortable living environments.

1. INTRODUCTION

In our modern world, we're always looking for ways to make things easier and more efficient. One area where this is important is in how we control our lights. Think about it - having to turn lights on and off manually can be a hassle, especially if you're in a room for only a short time. That's where our project comes in. We're creating a smart system that automatically turns lights on and off based on whether someone is in the room or not. We're using two main things to make this happen: an Arduino (a tiny computer) and a sensor called a PIR sensor. The Arduino controls the lights, and the PIR sensor detects when someone enters or leaves the room by sensing their body heat. This means no more fumbling for light switches - the lights will just come on when you enter and turn off when you leave. Not only is this super convenient, but it also saves energy by only using lights when they're needed. We'll explain more about how it all works in the rest of this report

1.1.OBJECTIVE

The objective of implementing an automatic lights control system using Arduino and PIR sensor technology is to revolutionize indoor lighting environments by enhancing user convenience, energy efficiency, and safety. The project aims to develop a smart lighting solution that eliminates the need for manual switching, instead utilizing motion detection capabilities to automatically activate and deactivate lights based on human presence. By dynamically adjusting lighting levels according to occupancy, the system seeks to optimize energy usage, thereby reducing electricity consumption and promoting sustainability. Customizable parameters such as sensitivity and delay time will be incorporated into the system design to accommodate various environmental conditions and user preferences, enhancing flexibility and usability. Additionally, the project aims to implement a user-friendly interface that allows for easy setup and operation of the automatic lights control system, empowering users to monitor system status and make manual adjustments if desired. Compatibility and seamless integration with existing lighting infrastructure will be prioritized to facilitate widespread adoption of the system in residential, commercial, and public spaces. Thorough testing and optimization will be conducted to ensure the reliability, stability, and performance of the system under different operating conditions, ultimately delivering a robust and dependable solution for enhancing indoor lighting environments.

1.2 IOT DEFINITION

IoT stands for the Internet of Things. It refers to a network of physical devices, vehicles, appliances, and other objects embedded with sensors, software, and connectivity capabilities that enable them to connect and exchange data over the internet. In simple terms, IoT is the concept of connecting everyday objects and enabling them to communicate and interact with each other, as well as with users, through the internet. The fundamental idea behind IoT is to bridge the gap between the physical and digital worlds, allowing objects to collect and share data, perform tasks autonomously, and provide enhanced functionality and convenience to users. These objects, often referred to as "smart" devices, can range from small sensors and wearable devices to larger systems like smart homes, industrial machinery, and even entire cities

The key components of IoT include:

Devices: These are the physical objects or "things" that are equipped with sensors, actuators, and connectivity capabilities. Examples include smart thermostats, wearable fitness trackers, industrial machines, and even agricultural sensors.

Sensors and Actuators: Sensors gather data from the device's surroundings, such as temperature, motion, light, or humidity, while actuators allow the device to perform actions based on the data received. For example, a sensor in a smart thermostat measures room temperature, while the actuator adjusts the thermostat settings accordingly.

Connectivity: IoT devices are connected to the internet or local networks, enabling them to transmit data to other devices or central servers for processing and analysis. Connectivity options include Wi-Fi, Bluetooth, cellular networks, and low-power wide-area networks (LPWAN).

Data Processing and Analytics: The data collected by IoT devices is processed and analyzed to extract valuable insights, monitor performance, and make informed decisions. This may involve cloud-based platforms, edge computing devices, or centralized servers.

Applications and Services: IoT data and insights are utilized to create various applications and services that offer value to businesses, consumers, and industries. Examples include smart home automation, predictive maintenance in manufacturing, remote health monitoring, and intelligent transportation systems.

2. SYSTEM SPECIFICATIONS

2.1. FUNCTIONAL REQUIREMENTS

The functional requirements for the automatic lights control system using Arduino and PIR sensor technology encompass the essential features and capabilities necessary for its successful operation. These requirements are as follows:

1. **Motion Detection:** The system must accurately detect human presence within its detection range using the Passive Infrared (PIR) sensor. This means that when someone enters the room or moves within its vicinity, the sensor should reliably trigger the system to activate the lights.
2. **Automatic Activation/Deactivation:** Upon detecting motion, the system should automatically activate the lights. Conversely, if no motion is detected for a predefined period, the system should deactivate the lights to conserve energy. This ensures that lights are only on when needed, enhancing energy efficiency.
3. **Adjustable Sensitivity:** Users should have the ability to adjust the sensitivity of the PIR sensor to suit different environmental conditions and personal preferences. This allows for fine-tuning of the system's responsiveness to motion, preventing false triggers or ensuring detection in varying lighting conditions.
4. **Delay Time Customization:** The system should allow users to customize the delay time before the lights are automatically turned off after motion ceases. This feature enables users to tailor the system to their specific needs, such as extending the duration of lighting in areas with frequent activity or shortening it in less-used spaces to save energy.
5. **Dynamic Lighting Control:** The system should be capable of dynamically adjusting the brightness or intensity of the lights based on the detected motion or ambient light levels. This ensures that lighting levels are optimized for comfort and visibility, adapting to changes in occupancy and external lighting conditions.
6. **Manual Override:** Users should have the option to manually override the automatic lighting control system and toggle the lights on or off as needed. This provides flexibility for users to control the lights directly, independent of the automated system, to accommodate specific preferences or activities.
7. **User Interface:** An intuitive user interface should be provided for configuring system settings, monitoring status, and interacting with the automatic lights control system. This ensures ease of use and enables users to conveniently adjust settings or troubleshoot issues as needed.
8. **Reliability and Stability:** The system should be compatible with a variety of light fixtures and existing lighting infrastructure commonly found in residential, commercial, and public spaces. This ensures seamless integration with different types of lighting systems, allowing for widespread deployment and ease of installation.

2.2.NON FUNCTIONAL REQUIREMENTS

The automatic lights control system using Arduino and PIR sensor technology must also meet several non-functional requirements. Those requirements include the following.

1. **Performance:** The system should exhibit high performance in terms of responsiveness, accuracy, and reliability in detecting motion and controlling the lights.
2. **Scalability:** The system should be scalable, capable of accommodating additional sensors or expanding to control a larger number of lights or lighting zones if required.
3. **User Experience:** The user interface should be intuitive, user-friendly, and aesthetically pleasing, enhancing the overall user experience and ease of use.
4. **Accessibility:** The system should be accessible to users with disabilities, complying with accessibility standards and providing alternative methods of interaction if necessary.
5. **Security:** The system should incorporate security measures to prevent unauthorized access or tampering, ensuring the privacy and integrity of user data and settings.
6. **Reliability:** The system should be highly reliable, with minimal downtime or disruptions in operation, even under challenging environmental conditions or power fluctuations.
7. **Compatibility:** The system should be compatible with a wide range of Arduino microcontroller boards, PIR sensors, and lighting fixtures, ensuring interoperability and ease of integration.
8. **Interoperability:** The system should support standard communication protocols and interfaces, facilitating interoperability with other smart home or building automation systems.
9. **Power Efficiency:** The system should be designed for optimal power efficiency, minimizing energy consumption during operation and standby modes to reduce overall environmental impact and operating costs.
10. **Maintenance:** The system should be easy to maintain, with provisions for remote diagnostics, software updates, and troubleshooting to minimize downtime and support ongoing performance optimization.
11. **Documentation:** Comprehensive documentation should be provided, including user manuals, installation guides, and technical specifications, to assist users in setup, configuration, and troubleshooting.

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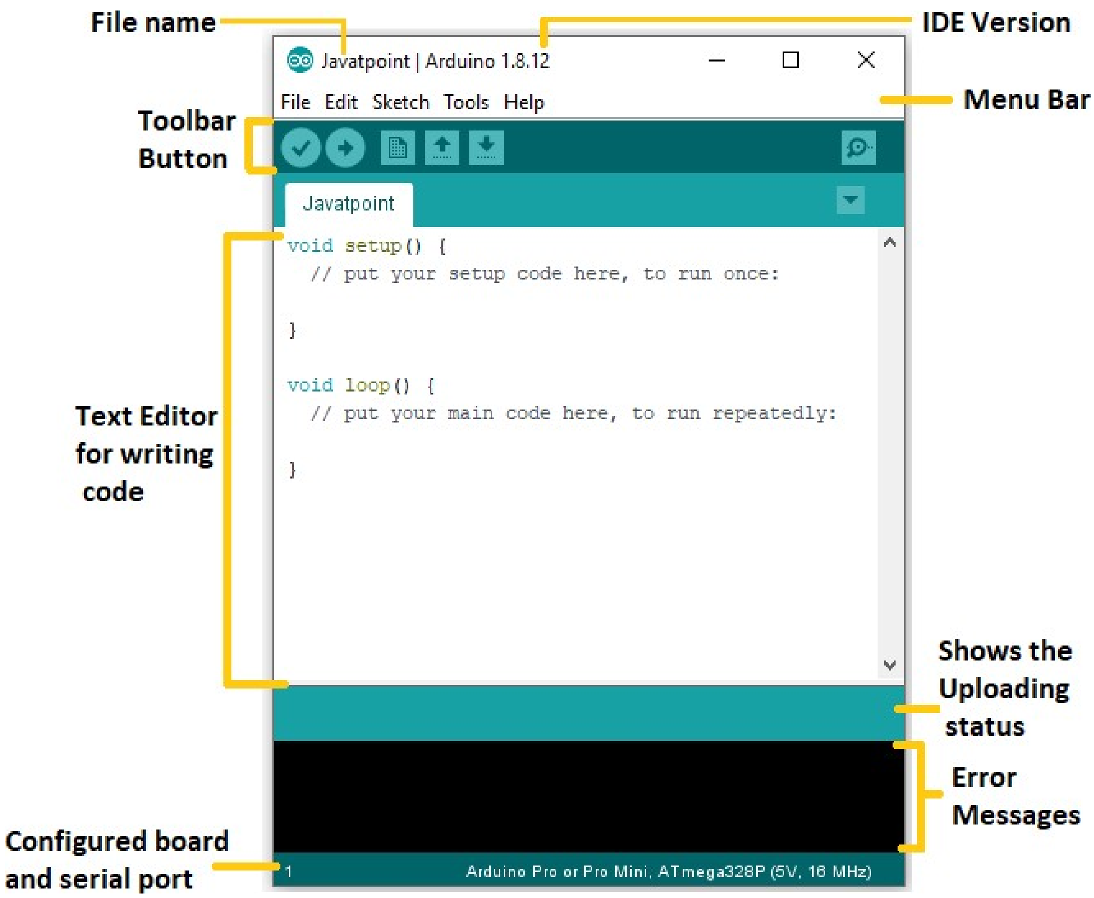
3. SYSTEM SOFTWARE

3.1 ARDUINO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

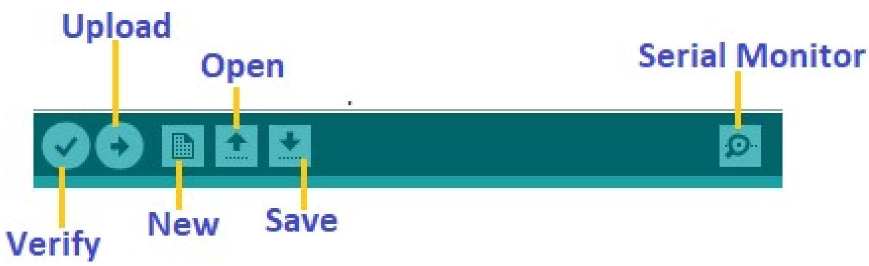
The Arduino IDE will appear as:



The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, **IDE** stands for **Integrated Development Environment**.

The icons displayed on the toolbar are **New, Open, Save, Upload,** and **Verify**.

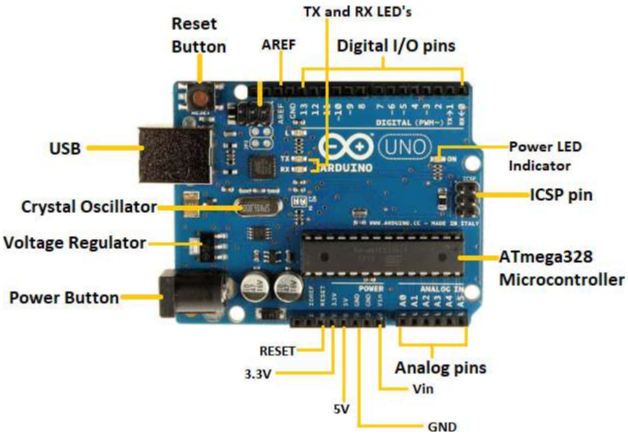
It is shown below:



4. SYSTEM HARDWARE

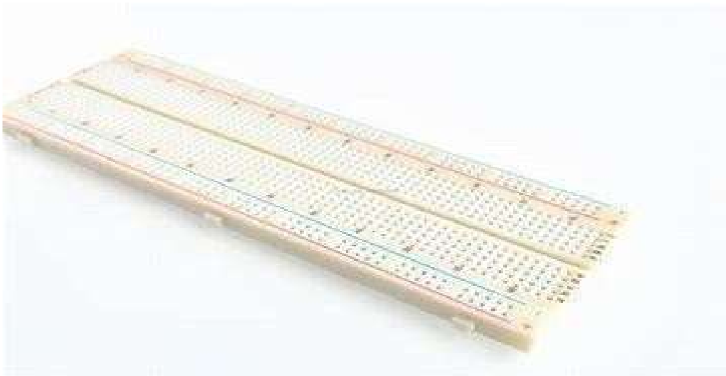
4.1. ARDUINO BOARD

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.



4.2.BREAD BOARD

A breadboard is a widely used tool to design and test circuit. You do not need to solder wires and components to make a circuit while using a bread board. It is easier to mount components & reuse them. Since, components are not soldered you can change your circuit design at any point without any hassle. There are a number of holes on the plastic box, arranged in a particular fashion. A typical bread board layout consists of two types of region also called strips. Bus strips and socket strips. Bus strips are usually used to provide power supply to the circuit.

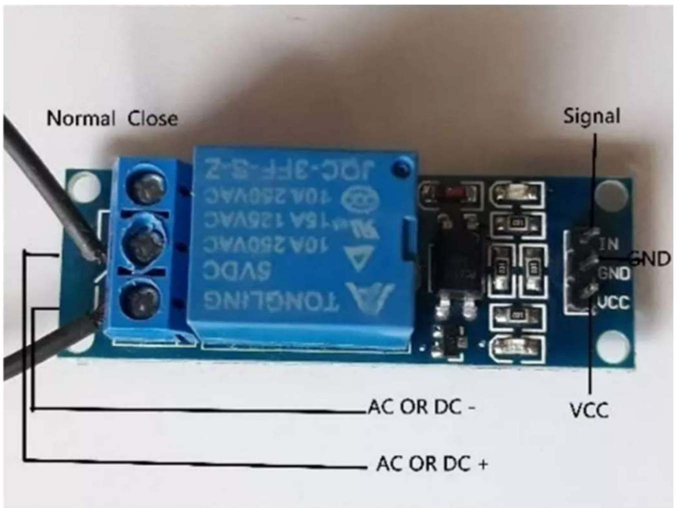


4.3.JUMPER CABLES

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.

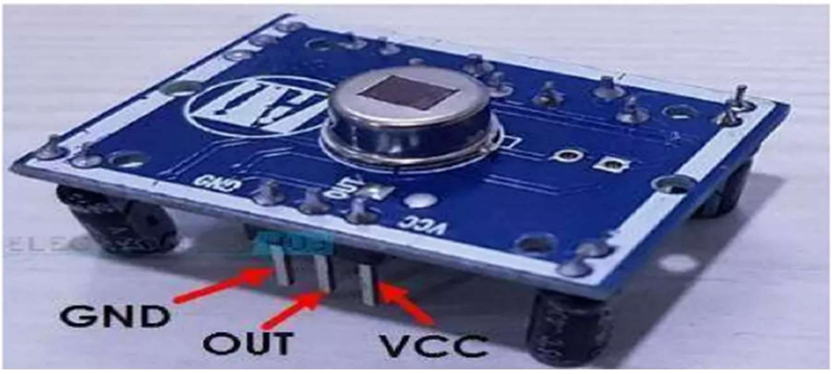
4.4. 5V RELAY MODULE

A relay is a digital switch that controls much higher currents and voltages. This device is widely used in power protection. The benefits of this device are small in size, stability and long-time reliable and it can be also used for both ac and de systems. Relay has three terminals that are normally closed terminal, normally open terminal and common terminal. It has three pins GND, VCC and input signal.



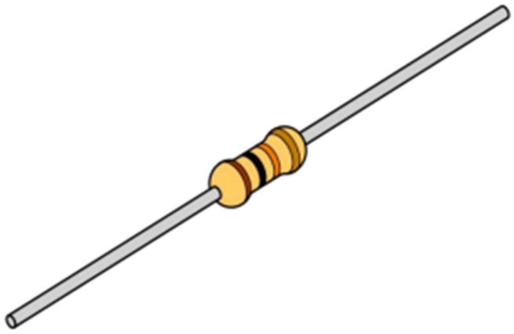
4.5. PIR SENSOR

The sensing unit is used to get input parameters from surrounding which is required for automation. Zor particular area of room, the following points must be kept in mind to perform operation in good order. This PIR sensor is "Passive Infrared", which is also called as "Pyroelectric", or "IR motion"sensors. The working of PIR sensor is to detect the motion of a person when person comes in the sensing range of the sensor. The specialty of this sensor is it is little, affordable, low power, easy to use and do not exhaust. Hence, this sensor is used in many home automation appliances.



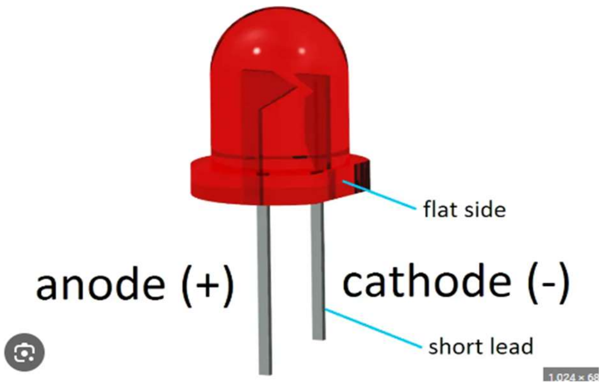
4.6. RESISTOR

Physical materials resist the flow of electrical current to some extent. Certain materials such as copper offer very low resistance to current flow, and hence they are called conductors. Other materials such as ceramic which offer extremely high resistance to the current flow are called as insulators. In electric and electronic circuits there is a need for materials with specific values of resistance in the range between that of a conductor and an insulator. These materials are called resistors and their values of resistance are expressed in ohms.



4.7. LED

The LED, a staple in modern electronics, efficiently converts electrical energy into visible light, serving a wide array of applications with its compact size, low power consumption, and durability. With its versatility in colors and configurations, LEDs are utilized in lighting, displays, indicators, and decorative elements. Their solid-state construction ensures longevity and resilience in diverse environments.



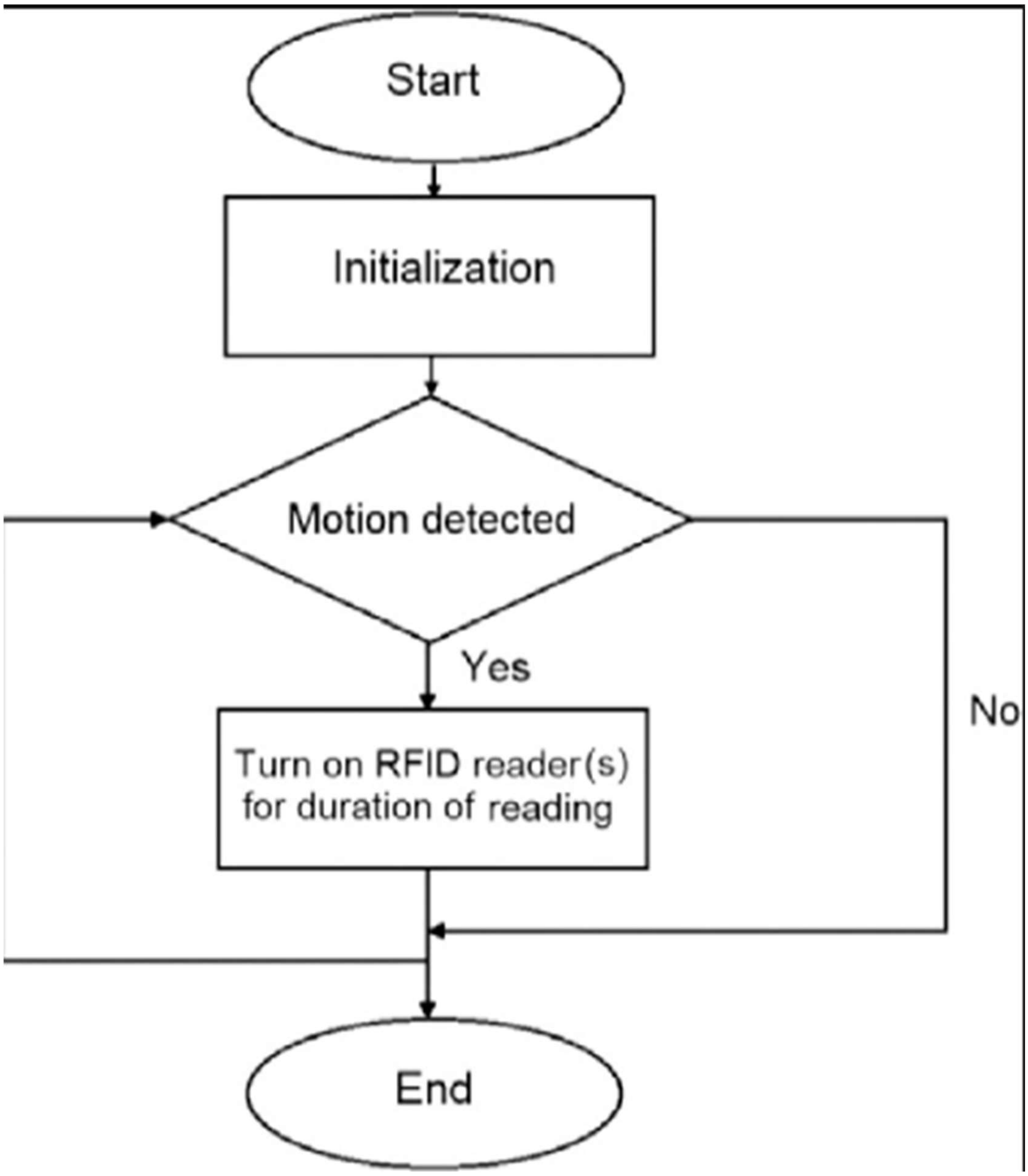
4.8. BATTERY 12V

A 12V power supply is a crucial component in electronic systems, providing a stable source of voltage for various devices and circuits. Typically used in applications such as automotive, industrial, and consumer electronics, the 12V power supply ensures compatibility with a wide range of equipment. Whether for powering LED lighting systems, motors, sensors, or microcontrollers, its consistent voltage output enables reliable operation.

5. FLOWCHART

A flowchart can also be defined as a diagrammatic representation of an algorithm, a step-by-step approach to solving a task.

It is a generic tool that can be adapted for a wide variety of purposes, and can be used to describe various processes, such as a manufacturing process, an administrative or service process, or a project plan.



1. METHODOLOGY

1.1 DESCRIPTION OF METHODOLOGY

The methodology for automatic lighting control involves a systematic approach to detect motion and adjust lighting levels accordingly. Here's a breakdown of the methodology:

Motion Detection Sensor: The core component of automatic lighting control is the motion detection sensor, typically a Passive Infrared (PIR) sensor. This sensor detects changes in infrared radiation caused by the movement of objects, such as humans, within its field of view.

Sensor Placement: The motion detection sensor is strategically placed in areas where motion is expected, such as hallways, entryways, or rooms. The sensor's placement ensures maximum coverage of the area and effective detection of motion.

Data Processing: The signal from the motion detection sensor is sent to a control unit, often an Arduino microcontroller or a dedicated control module. This control unit processes the data received from the sensor and determines the presence and movement of objects within its range.

Threshold Setting: The control unit applies a predefined threshold to the sensor data to distinguish between significant motion, such as a person walking, and background noise or minor movements, such as a passing shadow.

Lighting Control Algorithm: The control unit runs a programmed algorithm that determines the appropriate action based on the detected motion. This algorithm may include logic to turn the lights on when motion is detected and turn them off after a period of inactivity.

Adjustable Parameters: The system may incorporate adjustable parameters, such as sensitivity and delay time, to customize the response to motion detection. These parameters allow users to fine-tune the system according to their specific needs and preferences.

Actuation: Once motion is detected and the decision to turn the lights on is made, the control unit sends signals to a relay module or lighting control system to activate the lights. Similarly, when no motion is detected for a predefined period, the control unit signals to turn the lights off.

Integration with Other Systems: Automatic lighting control systems can be integrated with other smart home or building automation systems. This integration allows for coordinated responses, such as adjusting the thermostat or activating security cameras, based on detected motion.

1.2 OVERALL FLOW OF PROJECT:

Step 1: Collect the necessary components including an Arduino UNO board, a Passive Infrared (PIR) sensor, a relay module, and appropriate wiring. Ensure you have a clean and well-lit workspace with access to a power source for the Arduino board.

Step 2: Place the Arduino UNO board securely onto the breadboard to provide stability during wiring.

Step 3: Use jumper wires to connect the 5V pin on the Arduino UNO board to the corresponding power rail on the breadboard. Connect the GND (ground) pin of the Arduino UNO board to the ground rail on the breadboard to establish a common ground for all components.

Step 4:

- Use jumper wires to connect the PIR sensor to the Arduino UNO board and breadboard:
- Connect the VCC (power) pin of the PIR sensor to an available slot on the breadboard's power rail.
- Connect the GND (ground) pin of the PIR sensor to an available slot on the breadboard's ground rail.

- Connect the output (signal) pin of the PIR sensor to a digital input pin (e.g., Pin 2) on the Arduino UNO board.

Step 5:

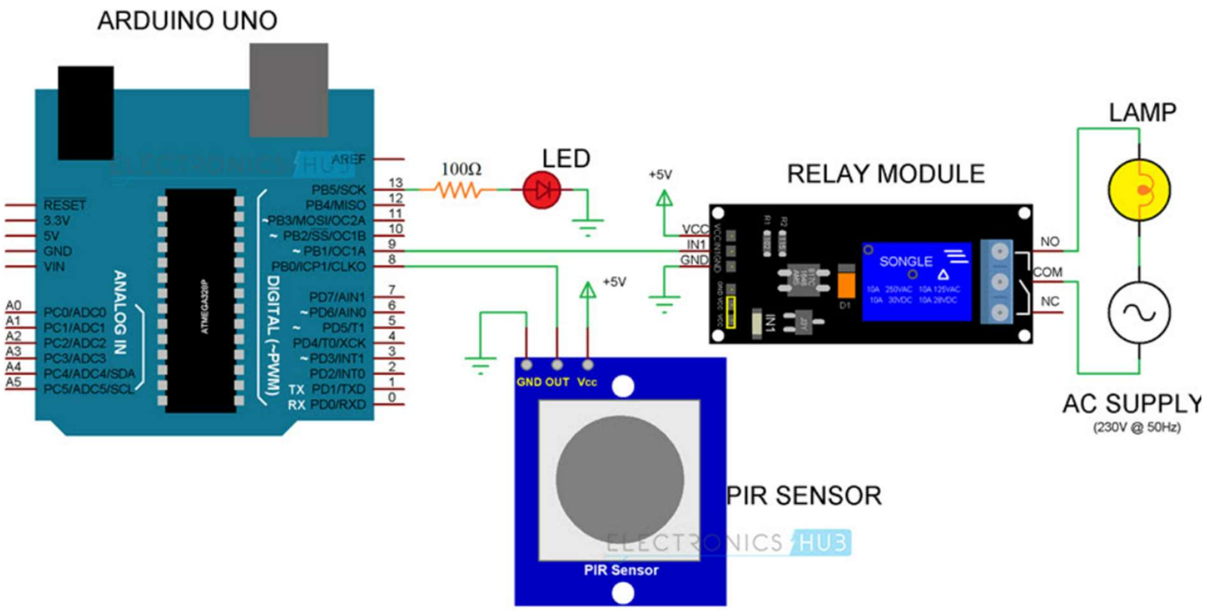
- Use jumper wires to connect the relay module to the Arduino UNO board and breadboard:
- Connect the VCC (power) pin of the relay module to an available slot on the breadboard's power rail.
- Connect the GND (ground) pin of the relay module to an available slot on the breadboard's ground rail.
- Connect the control pin (e.g., IN1) of the relay module to a digital output pin (e.g., Pin 3) on the Arduino UNO board.

Step 6: Connect the lighting fixtures to the relay module's output terminals, ensuring proper wiring and connections. Make sure the lighting fixtures are securely mounted and positioned as desired for effective illumination.

Step 7: Double-check all connections to ensure they are secure and properly aligned. Verify that there are no loose wires or potential short circuits that could affect system operation.

Step 8: Power on the Arduino UNO board and observe the system behavior. Test the automatic lights control system by moving in front of the PIR sensor and verifying that the lights turn on and off automatically as expected.

1.3 ENVIRONMENTAL SETUP



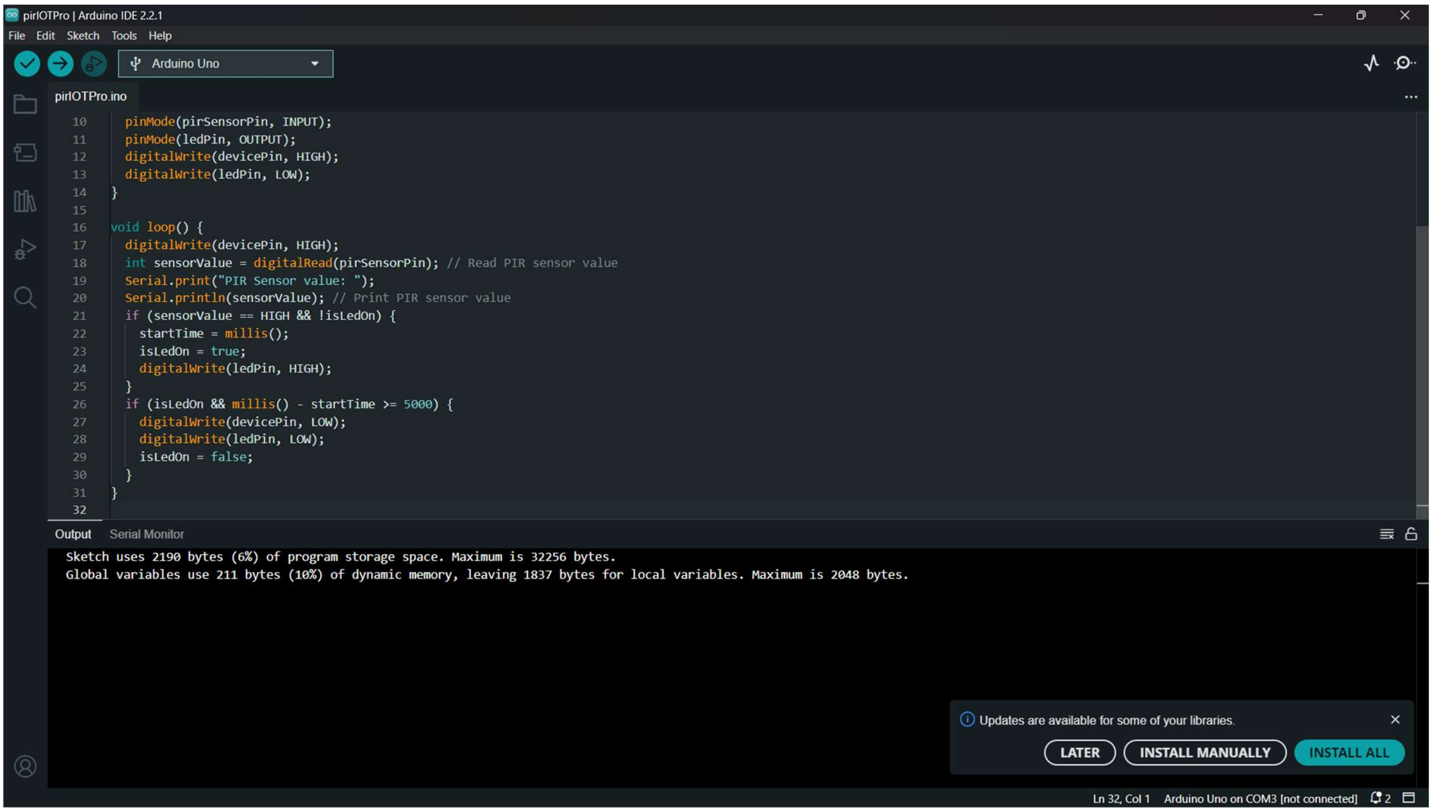
2. IMPLEMENTATION

2.1 CODE

```
int devicePin = 9;
int pirSensorPin = 8;
int ledPin = 13;
unsigned long startTime = 0;
boolean isLedOn = false;

void setup() {
  Serial.begin(9600);
  pinMode(devicePin, OUTPUT);
  pinMode(pirSensorPin, INPUT);
  pinMode(ledPin, OUTPUT);
  digitalWrite(devicePin, HIGH);
  digitalWrite(ledPin, LOW);
}

void loop() {
  digitalWrite(devicePin, HIGH);
  int sensorValue = digitalRead(pirSensorPin); // Read PIR sensor value
  Serial.print("PIR Sensor value: ");
  Serial.println(sensorValue); // Print PIR sensor value
  if (sensorValue == HIGH && !isLedOn) {
    startTime = millis();
    isLedOn = true;
    digitalWrite(ledPin, HIGH);
  }
  if (isLedOn && millis() - startTime >= 5000) {
    digitalWrite(devicePin, LOW);
    digitalWrite(ledPin, LOW);
```

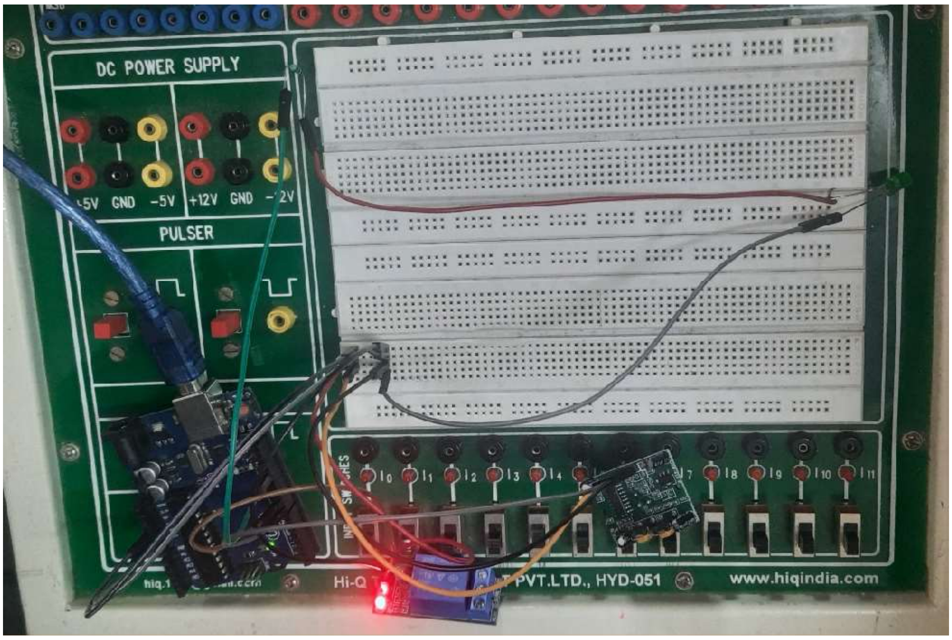
```
    isLedOn = false;

  }

}
```

2.2 COMPILATION STEP

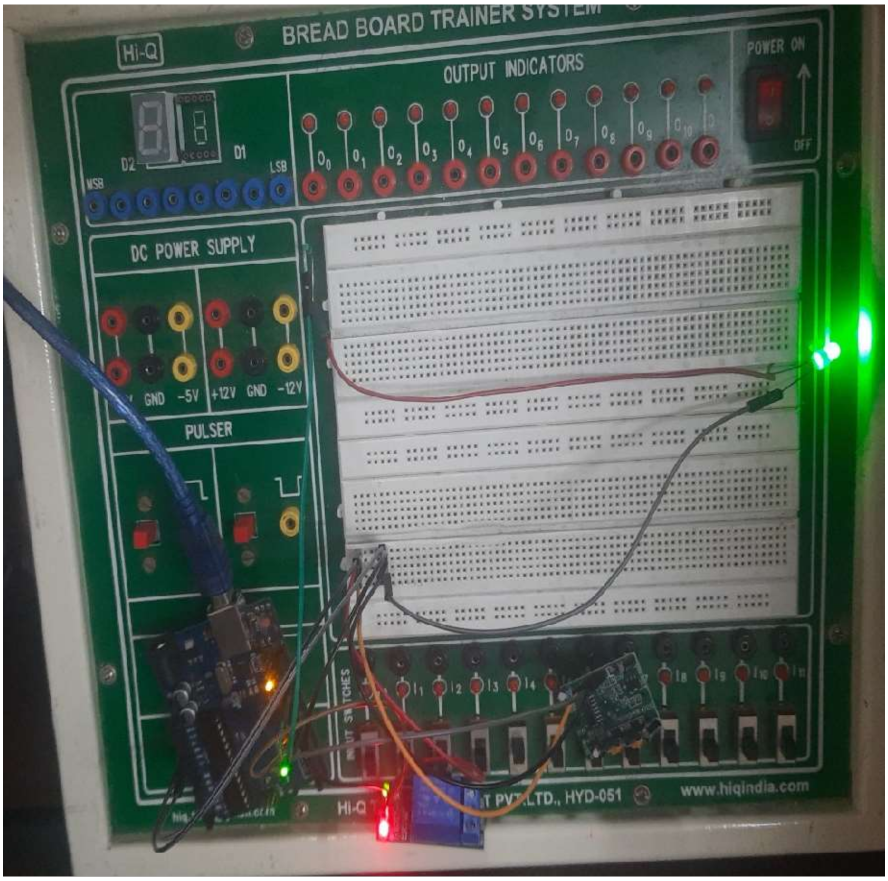


3. RESULT

LIGHT IS OFF:



LIGHT IS ON :



4. CONCLUSION

In conclusion, the implementation of an automatic lights control system using Arduino and PIR sensor technology offers significant benefits in terms of convenience, energy efficiency, and user experience in indoor lighting environments. By leveraging motion detection capabilities, the system eliminates the need for manual switching of lights, providing users with a seamless and hands-free lighting experience. The system's functionality, including automatic activation and deactivation of lights, adjustable sensitivity, and customizable delay time, ensures optimal responsiveness to varying environmental conditions and user preferences. This dynamic control not only enhances user comfort but also contributes to energy conservation by activating lights only when needed. Additionally, the inclusion of a manual override option and a user-friendly interface allows for flexibility and ease of use, empowering users to adjust settings and monitor system status as desired. Compatibility with a variety of light fixtures and existing infrastructure ensures seamless integration into different environments, making the system suitable for residential, commercial, and public spaces alike.

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5. FUTURE SCOPE

The automatic lights control system using Arduino and PIR sensor technology lays the foundation for future advancements and enhancements in the field of smart lighting and automation. Some potential future scopes include:

1. **Integration with Smart Home Systems:** The system can be further integrated with smart home ecosystems, allowing users to control lighting alongside other connected devices through voice commands or smartphone apps.

2. **Advanced Sensor Technologies:** Future iterations of the system could incorporate advanced sensor technologies, such as ultrasonic or microwave sensors, to enhance motion detection accuracy and reliability in diverse environmental conditions.

3. **Energy Harvesting Solutions:** Integration of energy harvesting solutions, such as solar panels or kinetic energy converters, could be explored to power the system, reducing reliance on external power sources and enhancing sustainability.

4. **Machine Learning Algorithms:** Implementing machine learning algorithms could enable the learn and adapt to user preferences over time, optimizing lighting control based on historical usage patterns and environmental factors.

5. **Remote Monitoring and Management:** Incorporating remote monitoring and management capabilities would allow users to monitor system status, receive notifications, and perform diagnostics remotely, enhancing convenience and troubleshooting capabilities.

6. **Environmental Sensors Integration:** Integration with environmental sensors, such as temperature, humidity, and air quality sensors, could enable the system to provide additional functionalities such as climate control and air purification.

7. **Energy Efficiency Optimization:** Further optimization of energy efficiency through advanced algorithms and optimization techniques could result in even greater energy savings without compromising user comfort or convenience.

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