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<<Home Automation>>

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I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

Acknowledgement

We would like to express our sincere gratitude to Mr. Sugat Mann Shakya, Module Leader of Cloud Computing, and our module teachers, Mr. Shishir Subedi, Mr. Ayush Bhakta Pradhanang and Mr. Suryansh Mathema for helping us throughout this coursework. Their invaluable insights and encouragement have been instrumental in shaping our understanding of the challenges of developing IoT-based applications. We are grateful for the valuable learning experience gained from this coursework and acknowledge the collective efforts of module teachers and college staff in contributing to our development of this prototype of Home Automation.

Abstract

This report presents the design of a home automation prototype using servomotor, PIR sensor, LDR sensor, and Arduino board technology. The LDR sensor enables automatic lighting based on how dark and how bright the environment is while the servomotor automates door control by responding to the motion around it. The Arduino board acts as a central control unit, ensuring seamless synchronization between components. The report describes the hardware and software design, development process, and practical applications of this home automation prototype.

This project contributes to the advancement of IoT-based home automation systems by effectively integrating LDR sensors, servomotors, and Arduino boards for intelligent and responsive living.

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1. Introduction

The primary objective of our project is to install advanced lighting solutions that go beyond the capabilities of traditional ambiance management. Imagine a living area where the play of light is continuously customised to the various requirements and moods of its people inside, resulting in a setting that improves general well-being in addition to responding to everyday activities. One of the most vital components of our Home Automation project is security, which is the top concern for homeowners. By combining innovative sensors and actuators, we are building an automated security system that reacts to the presence of people in a simple way. Imagine doors that shut and open smoothly, adding a little intelligence to improve convenience and security. This creative method reconsiders not only control of access but also the basic significance of feeling safe in a personal house.

Our goal is more than just convenience and safety; it also includes a dedication to environmental responsibility and sustainable living. As smart technologies become part of everyday life, energy management takes the stage, allowing homeowners to optimise and analyse their energy use. To create a more environmentally friendly and sustainable future, our concept is an exceptional instance of efficiency, controlling everything from power-hungry appliances to heating and cooling systems with intelligence.

Our effort to changing the perception of home automation is strong as we set out on this transformative path. Come with us as we imagine a day when houses become more than simply a place to stay; they are also responsive havens that adapt to the changing needs and goals of the people who live there. Greetings from our IoT Home Automation project, which redefines the fundamental meaning of home by fusing technology and people at the start of a new age in family life.

1.1 Aims and Objective

1.1.1 Aims:

1. Modify Living Spaces: To provide a dynamic and responsive environment to homes by skilfully using modern technology in order to reshape the modern living experience.

2. Improve Convenience: To make life easier by implementing a smart home automation system that changes based on the needs and preferences of its residents.

3. Ensure Security and Safety: By installing modern safety precautions, such as smart doors and sensors, automated access control will ensure residents' safety and wellbeing.

Objectives:

1. Intelligent Lighting Control: Provide intelligent lighting options with real-time changes.

2. Advanced Security Infrastructure: Install smart doors that automatically control access in accordance with user presence and authentication.

3. User-Friendly Interface and Accessibility: Provide a simple user interface through which a variety of automated functions may be managed and seen.

1.2 Current Scenario and Problem Statement

The adoption of home automation is currently limited by factors such as fragmented automation, high start-up costs, perceived complexity, privacy concerns etc. As a result, they miss an opportunity to improve energy efficiency, improve safety measures and improve everyday buildings. In addition, the slow adoption of this technology hinders innovation in the smart home industry. Addressing these barriers is essential to unlocking the full potential of home automation for a connected, efficient, and safe life.

1.3 Project as a Solution

Addressing the current barriers that prevent the broad adoption of home automation, the proposed project attempts to change the landscape by addressing key challenges. This strategy foresees the creation of an integrated ecosystem, providing customized communication protocols for seamless integration of various smart home devices, Cost-effective solutions and easy connectivity for consumption role. The aim of the project is to end barriers associated with high cost and recognize complexity. Emphasizing strong privacy and security measures, scalability and community engagement, the project aspires to drive innovation and collaboration in the smart home industry. Ultimately, this strategy seeks to provide home automation that has become more flexible, efficient, and comfortable, bringing a future of seamless integration of intelligent technology into everyday life.

2. Background

Over time, the internet of things has changed the way we interact with everything around us. This is becoming more obvious with the growing usage of IoT in products and the automated parts of our homes with improved technology. For home automation, our proposal combines a light-dependent resistor (LDR) sensor with a servo motor. The goal of this project is to improve control as well as efficiency in the use of everyday appliances.

2.1 System Overview

The home automation model is a good example of IoT's ability to transform simple homes into automated spaces. The LDR sensor, servo motor, PIR sensor, and Arduino Uno are the main parts of this prototype, which all work together to effortlessly build a scalable and useful home automation system.

The system's essential component, the LDR sensor, is designed to detect variations in the surrounding light. The LDR sensor detects changes in the surrounding light and sends the Arduino board a signal. The LED turns on if the LDR sensor senses darkness; if it does not, the LED won't turn on. In the system, the servo motor performs the role of an actuator, which is responsible for making physical changes. This model simulates door automation using a servo motor. When the PIR sensor detects motion, the door is moved to a set position which indicates the opening or closing of the door. The microprocessor prompts the servo motor to rotate at a 90-degree angle. The Arduino Uno serves as the brain of the system, processing sensor data and issuing commands to the actuator. After processing the data and reading the input from the LDR sensor, it determines whether to turn the LED on. In a similar manner, it gives the servo motor instructions to regulate the door's movement.

2.2 Design Diagram

The diagram visually represents the flow of information and actions among the LDR sensor, PIR sensor, Arduino Uno, LED, and servo motor, showing the prototype's functionality.

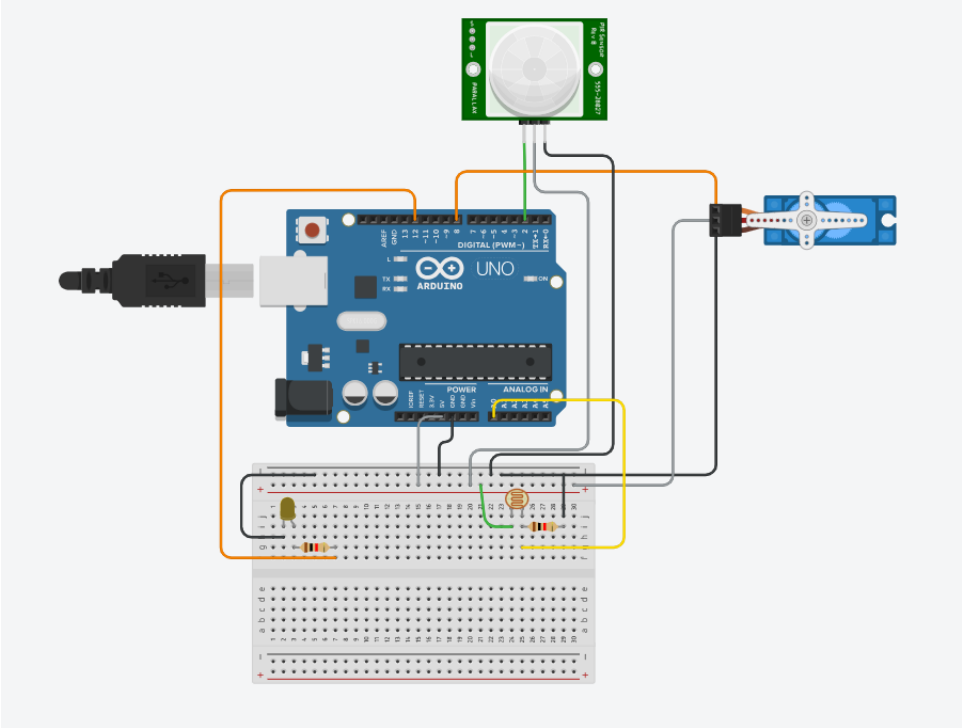

Figure 1: Circuit Diagram.

2.2.1 Hardware Architecture

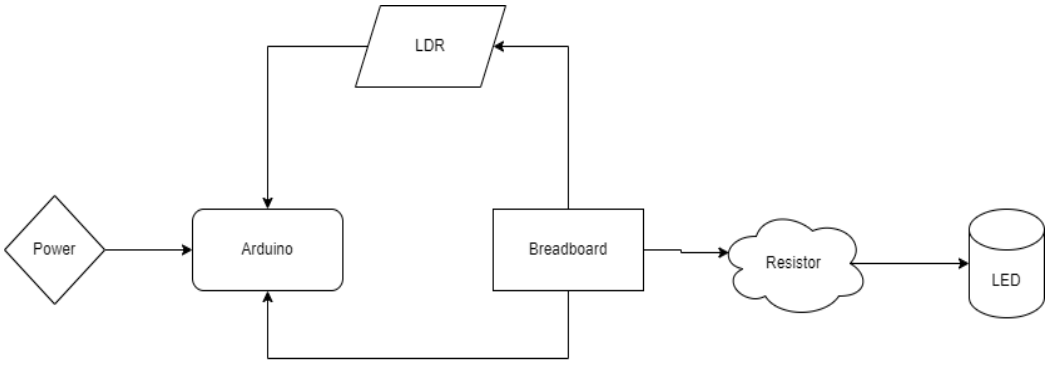

Figure 2: Block Diagram for LDR.

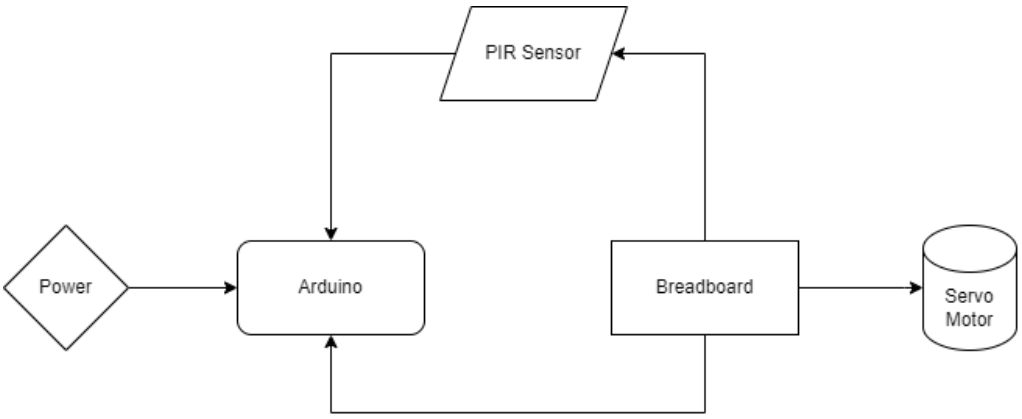

Figure 3: Block Diagram for Servo Motor.

2.2.2 Schematic Diagram

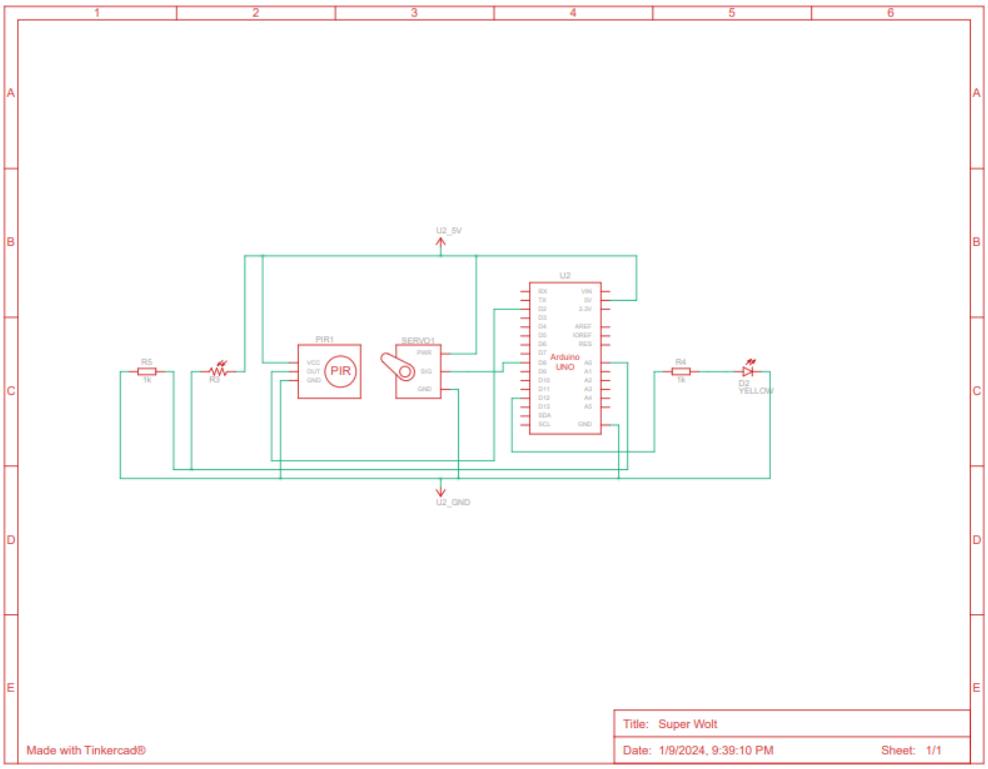

Figure 4: Schematic.

2.2.3 Flow Chart

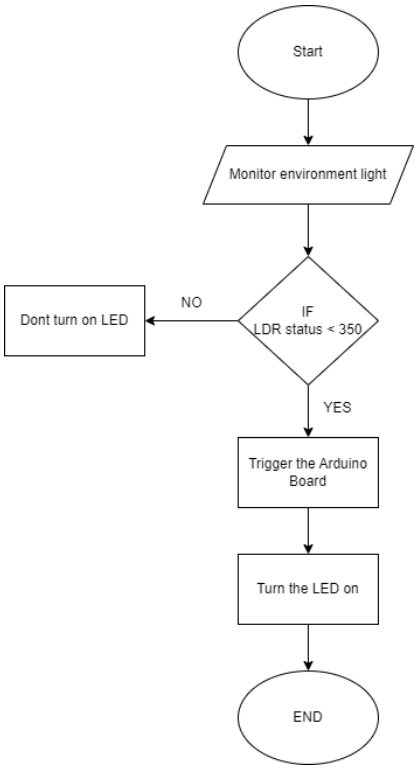

Figure 5: Flowchart for automatic light.

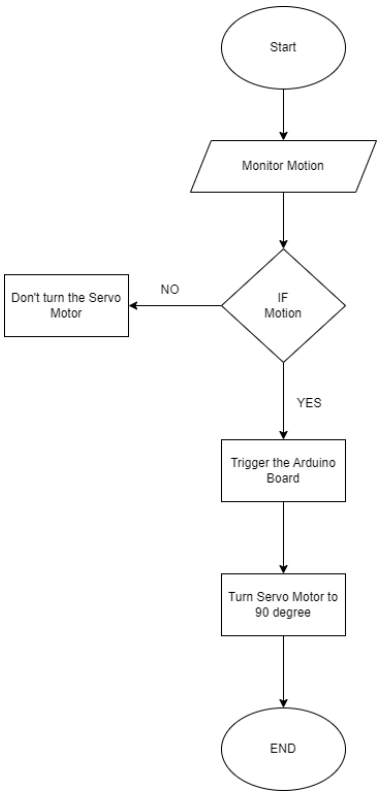

Figure 6: Flowchart for automatic servo motor.

2.3 Requirement Analysis

2.3.1 Hardware Requirements

- **Arduino Uno**

  Arduino Uno is a microcontroller which consists of digital and analogue input/output pins (I/O) and other circuits, a USB power connector, an ICSP header and a reset button. It has its own IDE which allows users to reprogram the board (Arduino.cc, 2024). The Arduino is used to upload code to the system and control the entire system.

- **Breadboard**

  Breadboard is an electronic circuit board which can be used to connect wires. It is used for creating temporary circuits because the wires and components can be easily replaced which makes it so that it is easy to practically demonstrate the circuit (ScienceDirect, 2019). Arduino is connected to breadboard where all the components are connected.

- **Jumper Wires**

  Jumper wires are electrical wires that can be used to connect different components without having to solder them together. They are used in prototyping and creating test circuits. There are 3 types of jumper wires: male-to-male, male-to-female, and female-to-female. The difference between them is only the end point. (Hemmings, 2016).

- **LED**

  LED (Light Emitting Diode) turns electrical energy into light energy. The electrons in the semiconductor combine with the electron holes which releases energy. LED allows current flowing forward and block the current backwards. The LED light is covered with a transparent capsule, so the light is visible when emitted (Byjus, 2017).

- **Resistor**

  Resistor is an electrical component that is used to limit the flow of electrical current. They are used to provide specific voltage to electrical devices. The resistance is measured in Ohm (Keim, 2024).

Servo Motor

Servo Motors have the ability to perform precise movement. It is made up of a motor that runs through a servo mechanism which uses feedback to control the speed and position of the motor shaft. The control wires provide the motor with PWM (Pulse with Modulation) which controls the servo motor. The servo motor uses pulse to determine how much the motor moves from its initial position (Circuit Digest, 2023). The servo motor works as an actuator to open the door.

- **LDR**

  Light Dependent Resistor (LDR) is a type of optoelectronic sensor that works on the principle of photoconductivity which means that the resistance changes based on the intensity of light. The resistance of the LDR increases in the dark and the resistance decreases when the light increases (robocraze, 2022). The LDR sensor is used to detect darkness which turns the LED on.

- **PIR sensor**

  PIR sensors are used to detect motion. They are small, consume low power and easy to use. They are usually referred to as “Passive Infrared”, “IR motion” or “pyroelectric” sensor. PIR sensors are made up of pyroelectric sensor that detect levels of infrared radiation. The sensor inside the PIR is split in two halves. The output will shift to high or low state if either side of the sensor detects variation in infrared radiation (lady ada, 2023)**.** The PIR sensor is used to detect motion which provides feedback to servo motor to open the door.

2.3.2 Software Requirements

- **Arduino IDE**

  The Arduino IDE is an open-source software which allows the users to write and upload code to any Arduino Board.

3. Development

The project's development is covered in detail in this report's section, from the beginning of planning to project completion. It presents an overview of the project's progress from beginning to end.

3.1 Planning and Design

Our group joined within the project's guidelines and discussed and selected the correct focus topic. When deciding to focus our research on home automation, we believed it would be amazing and maybe beneficial in daily life. We thought about house automation a lot. The next stage of our project development is doing an extensive analysis to identify and gather information on the components required to build this Internet of Things project, which we have named "Home Automation." Automated door and lighting controls in a home environment is the objective of our project. This calculated move promotes our primary objective of using IoT to enhance convenience and efficiency in home spaces.

3.2 Resource Collection

We required a variety of tools and equipment, each having a separate command source, for showing the progress of our project. The resource department at Islington College sourced and managed around half of these items. Each team member made an essential contribution to our team's efforts to get the resources necessary for the completion of the project. More specifically, most important items in our project inventory are the equipment we purchased and things that were provided from Islington College's resource department. The components we received from resource department and bought are-

- Arduino Uno
- PIR Sensor
- Servo Motor
- Resistor 1k OHM
- LDR
- Bread Board
- Jumper Wires
- LED Bulb

3.3 System Development

Phase 1: In the first phase, the circuit diagram for this project was created in tinkercad. Through Arduino uno, the ground pin and the 5V pin was connected with the breadboard which can later be useful as multiple hardware can be connected to the breadboard.

Phase 2: In this phase, the connection between the PIR sensor and the servo motor is made. For the PIR sensor, the signal pin is connected to the digital pin 2, the power is connected to the 5V in the breadboard to provide power to the PIR sensor. For the servo motor, the signal pin is connected to digital pin 8 and the power pin is connected to 5V which provides power to the motor.

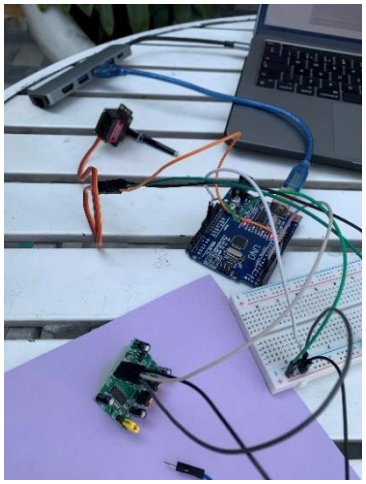

Figure 7: Making a connection between PIR sensor and Servo Motor.

Phase 3: In the third phase, the connection between LDR and LED is made. The LDR is connected to the analogue A0 pin, a resistor is placed to limit the flow of current. The LED is connected to the digital 12 pin and a resistor is placed in between to limit the flow of current.

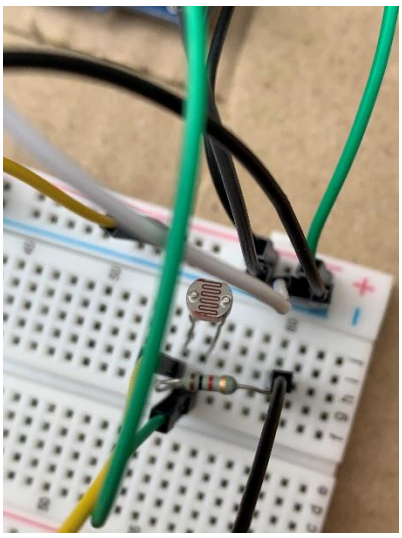

Figure 8: Making the connection of LDR.

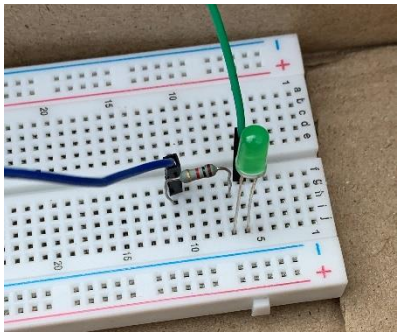

Figure 9: Making the connection of the LED.

Phase 4: Writing and uploading the code to Arduino uno**.**

```
Servo myservo;
const int led = 12;  // Set digital pin 12 for LED
const int ldr = A0;  // Set Analog pin A0 for LDR
int PIR = 2;         // Set digital pin 2 for PIR motion sensor
int servo = 8;       // Set digital pin 8 for servo motor

void setup() {
  Serial.begin(9600);    // Set up the serial communication
  pinMode(led, OUTPUT); // Set LED pin as output
  pinMode(ldr, INPUT); // Set LDR pin as input
  myservo.attach(servo);
}

void loop() {
  int ldr1 = analogRead(ldr); // Read LDR value status
  int motion1 = digitalRead(PIR); // Read motion status

  Serial.print("LDR: ");
  Serial.print(ldr1);
  Serial.print("  Motion: ");
  Serial.println(motion1);

  //If the LDR status is <= 350, Turn on the LED
  if (ldr1 < 350) {
    digitalWrite(led, HIGH); // Turn on the LED
  } else {
    digitalWrite(led, LOW); // Turn off the LED
  }

  // If motion is detected, rotate the servo to 90 degree
  if (motion1 == HIGH) {
    myservo.write(90); // Set servo to 90 degrees when motion is detected
    delay(3000);
  } else {
    myservo.write(0); // Set servo to 0 degrees when no motion is detected
```

Figure 10: Code for the project.

4. Results and Findings

During the testing and development of our prototype, we have gathered valuable insight on the core functionality of this system. The created system is able to perform certain features like opening and closing the door and switching the lights on and off on its own. The LDR sensor is used to detect the light intensity of the environment. If the light intensity of the environment is less than a certain threshold, the LED light glows. Similarly, for the automatic door, a servo motor is paired with a PIR sensor. If the PIR sensor detects movement, the servo motor activates, and the door is opened. The door remains open for a short period of time and automatically closes.

4.1 Key Findings:

- **Functionality Validation**

The circuit diagram was first created in tinkercad to see if the circuit works so that there was no risk of damaging the Arduino board. The primary features and functions are successfully validated. It demonstrates the ability to open and close door when motion is detected, and turning on the LED when there isn't sufficient light in the environment.

- **Error Identification and Resolution**

There were some errors that occurred while creating the prototype. It includes placing the wires in the wrong pins or the code not working as intended. Those errors were then quickly identified and resolved.

4.2 Testing

Test 1: Testing if the PIR sensor works.

Test	1
Objective	To test if the PIR sensor works.
Activity	A movement is provided, and the PIR output is monitored.
Expected result	The PIR output should detect motion.
Actual result	The PIR sensor detects motion.
Conclusion	The test was successful.

Table 1: Testing PIR sensor.

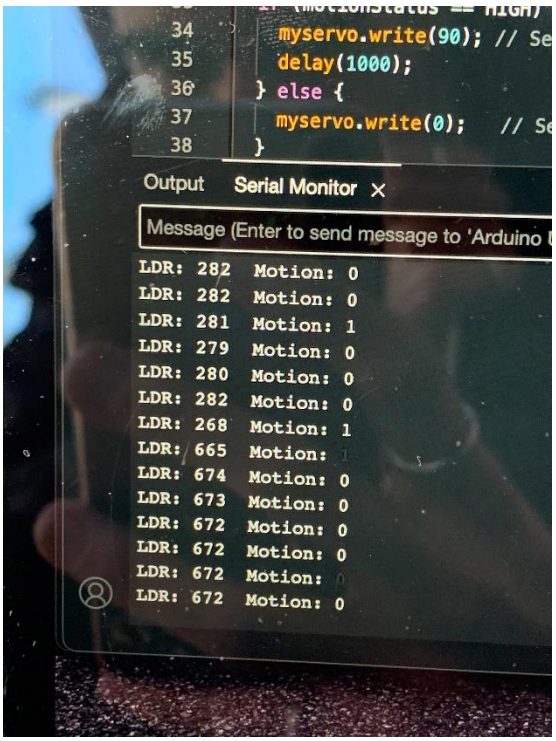

Figure 11: Monitoring the PIR sensor's output.

Test 2: Testing if the servo motor works when motion is detected.

Test	2
Objective	To test the servo motor works when motion is detected.
Activity	Activating the PIR sensor.
Expected Result	The motor should rotate 90 degrees.
Actual Result	The motor rotates 90 degrees.
Conclusion	The test was successful.

Table 2: Testing the servo motor.

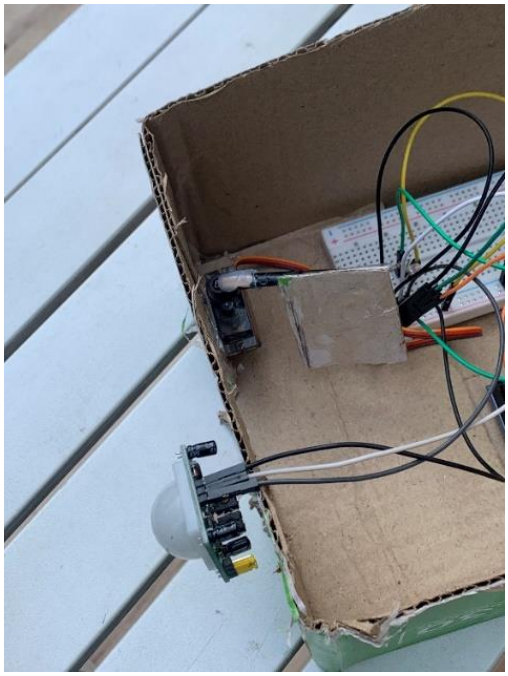

Figure 12: The servo motor is functional.

Test 3: Testing if the LDR sensor works.

Test	3
Objective	To see if the LDR sensor works.
Activity	Making a low light environment.
Expected Result	The LDR output should show change in light intensity.
Actual Result	The LDR output shows change in light intensity.
Conclusion	The test was successful.

Table 3: Testing the LDR sensor.

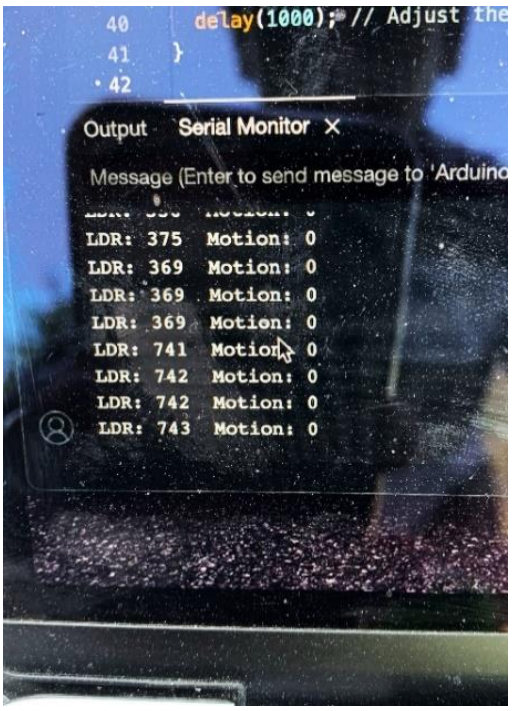

Figure 13: Monitoring the LDR sensor's output.

Test 4: Testing if the LED works.

Test	4
Objective	To test if the LED works.
Activity	Activating the LDR sensor so that the LED lights up.
Expected Result	The LED should light up.
Actual Result	The LED lights up, but the LED inside burns out because a resistor wasn't placed to limit the current flowing.
Conclusion	The test is unsuccessful.

Table 4: Testing the LED before placing a resistor.

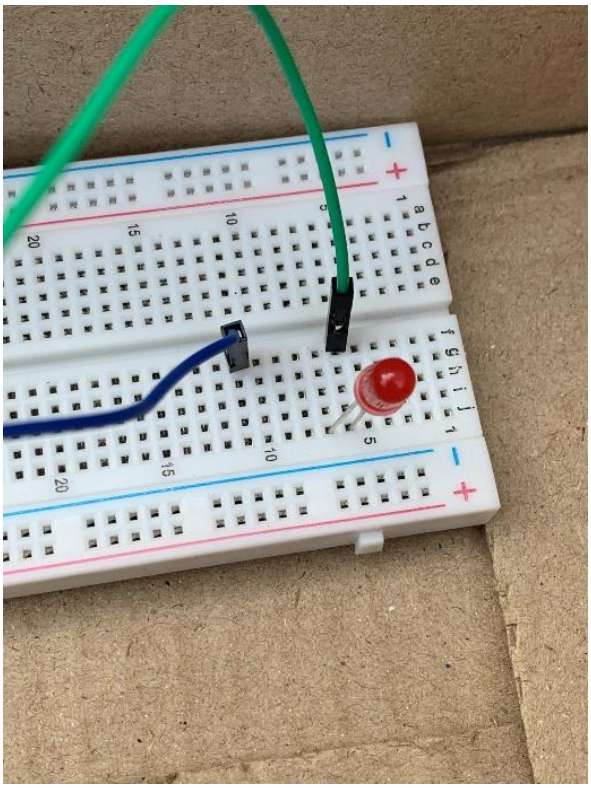

Figure 14: Burnt out LED.

Test 5: Testing if the LED works as expected after a resistor is placed.

Test	5
Objective	To test if the LED works.
Activity	Activating the LDR sensor so that the LED lights up.
Expected Result	The LED should light up as a resistor has been placed to limit the flow of current.
Actual Result	The LED lights up.
Conclusion	The test is successful.

Table 5: Testing the LED after a resistor is placed.

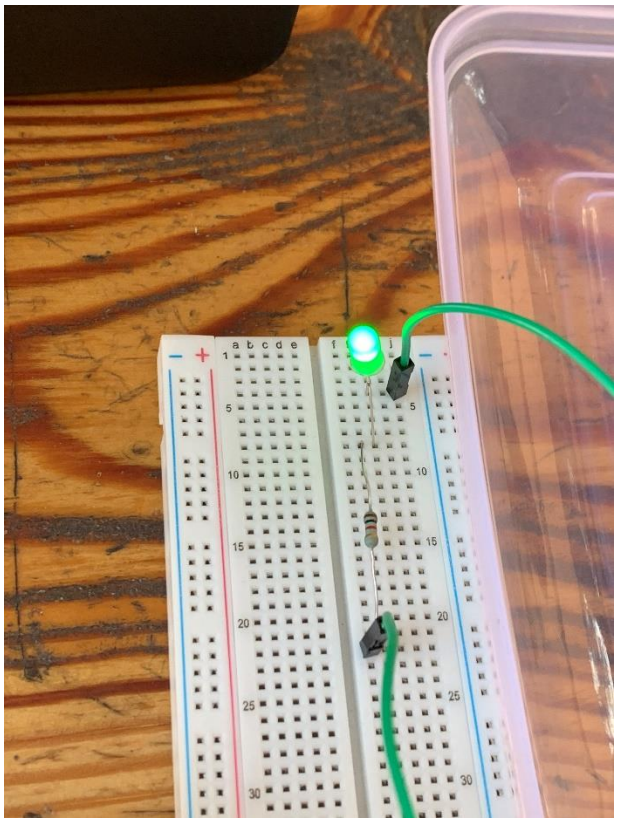

Figure 15: The LED turns on.

5. Future Works

The next phase of a smart home automation prototype is to refine its capabilities and expand its functionality. Embedding advanced machine learning into the PIR sensor will improve the accuracy of motion detection. Voice recognition technology will be integrated for hands-free communication, and environmental sensors will enhance comfort. Security will be strengthened through strong encryption, and a dedicated mobile app will simplify user control. The demand for renewable energy, such as solar panels, is consistent with sustainability goals. These developments aim to provide a smart home experience with flexibility, convenience and a flexible environment that matches the changing needs of users.

6. Conclusion

In summary, the conclusion of this work marks a breakthrough in home automation, demonstrating the seamless integration of advanced technologies for safety and energy efficiency, LDR sensor for reactive lighting control and servomotor for automatic door operation allowing not only effective automation but also user-defined customization.

Furthermore, the ability of the model to intelligently respond to ambient lighting conditions via an LDR sensor and automatically operate the door via servomotor reflects a systematic approach to smart living. This meets the needs of today's domestic environment, where user convenience and efficiency are crucial. The project’s success helps generate valuable insights into the broader landscape of IoT-based home automation systems and provides a foundation for future innovations in the field of dynamic smart home technologies.

Moving forward, the lessons learned from this coursework highlights the potential for building sophisticated and user-friendly systems. The combination of LDR sensors, servomotors and Arduino boards not only meets current requirements for high levels of energy efficiency but also sets the stage for continuous insight and improvement.

7. References

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8. Appendix

8.1 Source code

```
#include <Servo.h>


Servo myservo;
const int led = 12;  // Set digital pin 12 for LED
const int ldr = A0;  // Set Analog pin A0 for LDR
int PIR = 2;         // Set digital pin 2 for PIR motion sensor
int servo = 8;       // Set digital pin 8 for servo motor


void setup() {
  Serial.begin(9600);    // Set up the serial communication
  pinMode(led, OUTPUT); // Set LED pin as output
  pinMode(ldr, INPUT); // Set LDR pin as input
  myservo.attach(servo);
}


void loop() {
  int ldr1 = analogRead(ldr); // Read LDR value status
  int motion1 = digitalRead(PIR); // Read motion status


  Serial.print("LDR: ");
  Serial.print(ldr1);
  Serial.print("  Motion: ");
  Serial.println(motion1);
```

```
  //If the LDR status is <= 350, Turn on the LED
  if (ldr1 < 350) {
    digitalWrite(led, HIGH); // Turn on the LED
  } else {
    digitalWrite(led, LOW); // Turn off the LED
  }

  // If motion is detected, rotate the servo to 90 degree
  if (motion1 == HIGH) {
    myservo.write(90); // Set servo to 90 degrees when motion is detected
    delay(3000);
  } else {
    myservo.write(0); // Set servo to 0 degrees when no motion is detected
  }

  delay(150);
}
```

8.2 Work Breakdown Structure

Name	Task
Krish Bhattarai	• Research • Creating Automatic Door using PIR sensor. • Coding • Testing • Hardware Architecture, Schematic, System Design, Results and Finding, Appendix.
Nikhil Raj Singh	• Research • Coding • Creating Automatic LED using LDR. • Testing and Debugging • Introduction, Aims and Objective, Development, Planning and Design, Resource Collection.
Krisha Bhasink Shrestha	• Research • Circuit Diagram • Coding and reviewing • Testing and Debugging • Current Scenario and Problem Statement, Project as a solution, Background, System Overview, Flowchart, Future Works, Conclusion.

Table 6: Work Breakdown Structure.