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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 are grateful because the development of the IOT group project on the topic Smart Garage is completed. Also, it would have been impossible to complete this proposal without the help of the module instructor Sujil Maharjan. And therefore, the resources provided by the resource department helped me in the overall report.

Abstract

A smart garage is an IOT device that will open and close using the sensor to detect the vehicle without the need of human intervention. The smart garage door will help to ensure security by closing the door automatically preventing robbers from entering the house. The sensors used will send signals to the Arduino board to open and close the garage according to how the board will be programmed. The micro servo motor will open and close the garage door according to the signal sent by the Arduino board to perform tasks

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1. Introduction

The internet of things, or IoT, is a network of interconnected computing devices, mechanical and digital machinery, items, animals, and people with unique identifiers and the ability to transfer data without requiring human-to-human or human-to-computer interaction (Gillis, 2022).

A person with a heart monitor implant, a farm animal with a biochip transponder, an automobile with built-in sensors to alert the driver when tire pressure is low, or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and can transfer data over a network are all examples of things in the internet of things (Gillis, 2022).

Organizations across a wide range of industries are increasingly turning to IoT to improve operational efficiency, better understand customers in order to provide better customer service, improve decision-making, and create company value (Gillis, 2022).

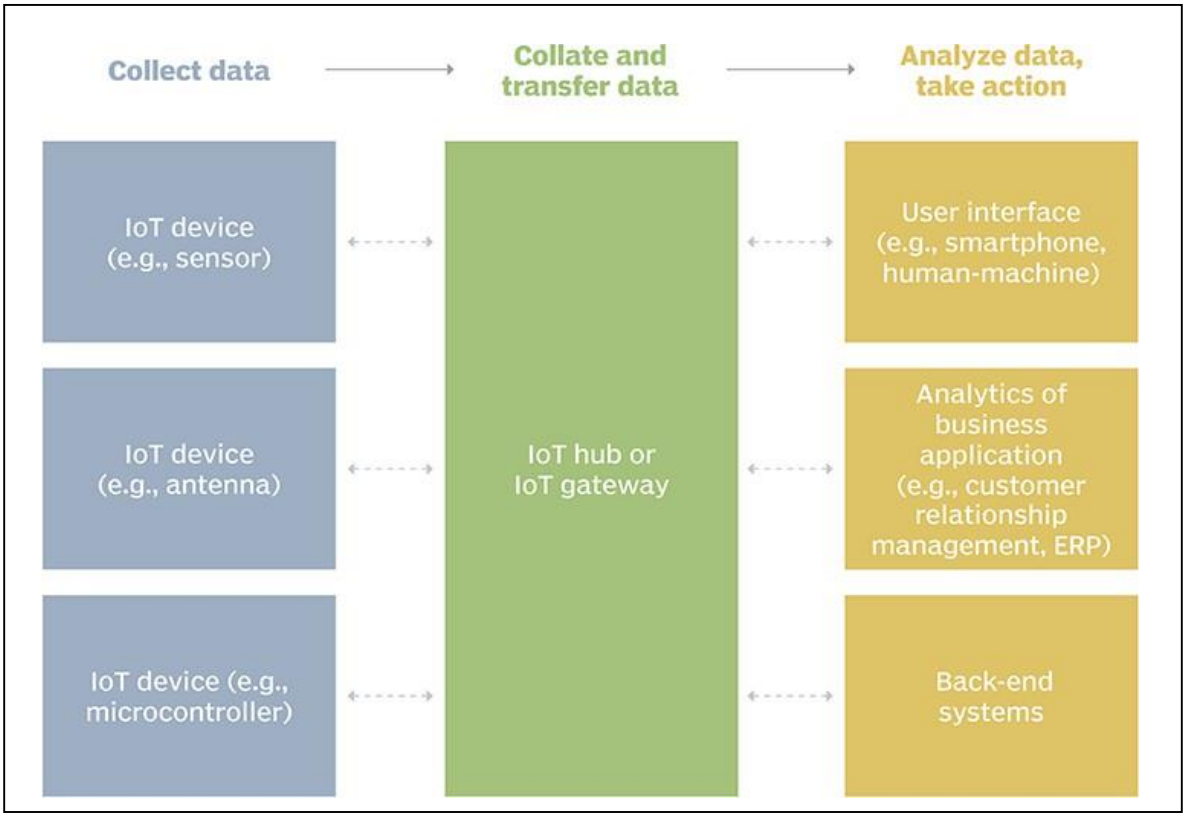

Figure 1: Example of an IoT system

1.1 Current Scenario

The Internet of Things has had significant growth during the last decade and continues to proliferate. With the rising use of smart phones and smart devices, IoT has expanded into consumers' daily lives. IoT has a wide range of uses, and smart garage is one of them. It provides simplicity and sensible security, overcoming the disadvantages and difficulties of present techniques.

1.2 Problem Statement and Project as a solution

The garage door has originated about 450 BC, when chariots were kept in gatehouses. A pulley and a lever or switch that triggers a motor are used in the manual way of accessing garage doors. Because the doors are guarded with a lock, manipulating them manually is challenging. For added security, a fingerprint recognition system has been implemented to prevent unauthorized people from gaining access. People may have difficulties opening their front door because it is difficult for them to turn a key or because they are unable to manoeuvre their wheelchair into a position to open the door, grab the doorknob, or scan their finger.

The rising use of sensors matched with the evolution of garages. The newest technologies use sensors to detect a vehicle and pneumatically open or close the door. However, the security of the vehicle is jeopardized if it is accessed by unauthorized people or if it is misplaced.

Project as a solution

Smart garage mitigates the process where the owner can open the garage by not getting out of the vehicle and save time in the process. This also helps to overcome the manual labor of the owner to access the door. The sensor detects the owner’s vehicle and opens the gate. When a person is inside the garage, another sensor is activated until the person leaves the room.

Aim and Objectives

The aim of this project is to use sensors to open and close the garage door automatically. The objectives of this project are:

- To open the door using an ultrasonic sensor to open the gate for the vehicle outside the garage.
- To open the door using the micro servo motor by pressing a button.
- Properly code to execute commands for opening and closing the garage door.
- Allow the PIR sensor to detect motion inside the garage and switch on the light.

2. Background

2.1 System Overview

The smart garage is developed using an ultrasonic sensor and a PIR (passive infrared) sensor, a servo motor as an actuator and an Arduino UNO as a microcontroller. We use the Arduino to program how the sensors work and work the servo motor according to the code. The sensors and actuator are connected to the Arduino using a breadboard. When the vehicle gets close to the door from outside, the ultrasonic sensor detects the vehicle and opens the door for the owner. When the owner is inside the garage the PIR sensor detects the owner and turns on the light for 2 minutes until the owner leaves the garage.

2.2 Design Diagrams

2.2.1Flowchart

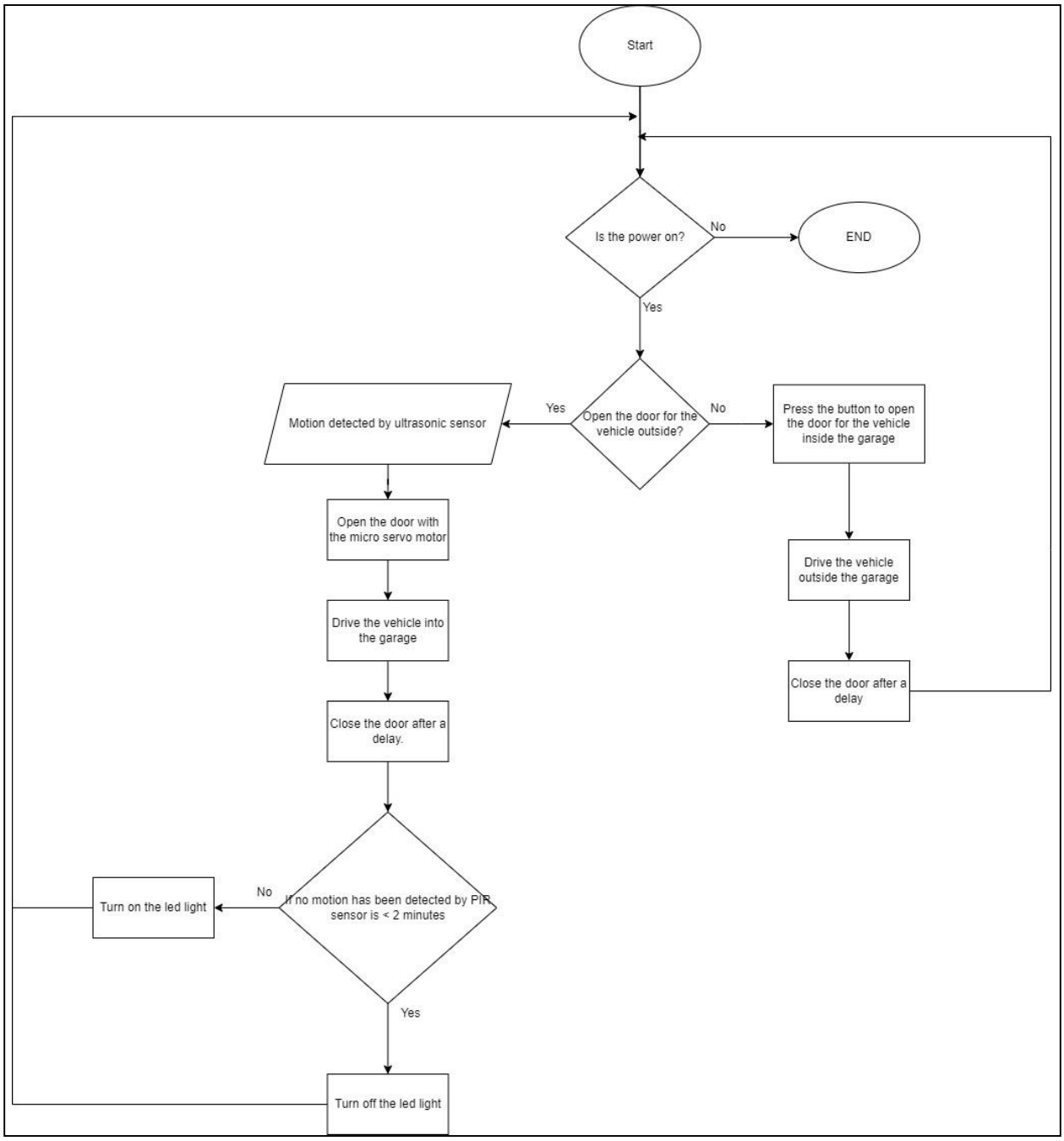

Figure 2: System Flowchart

2.2.2 Hardware architecture

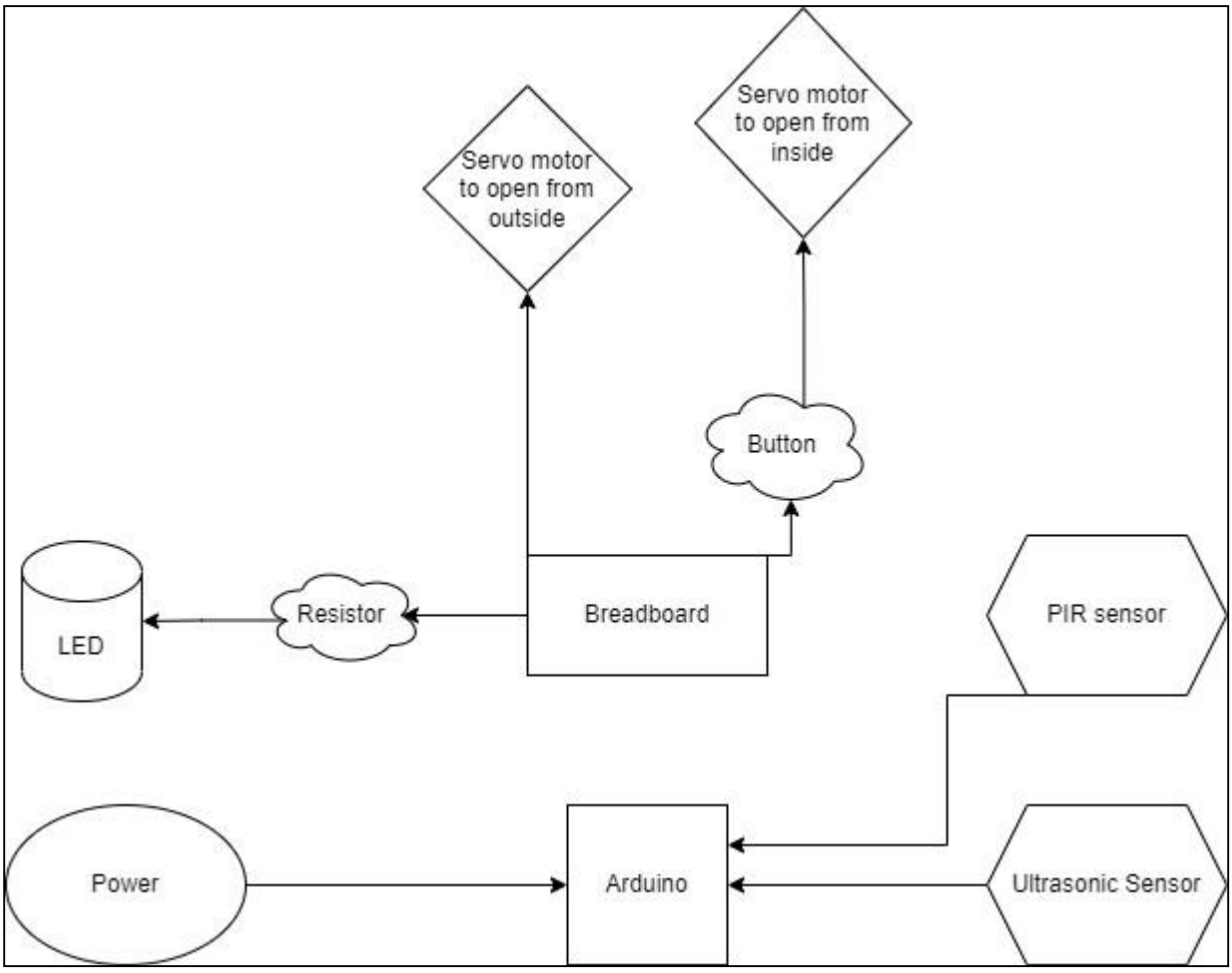

Figure 3: Hardware Architecture

2.2.3 Circuit Garage

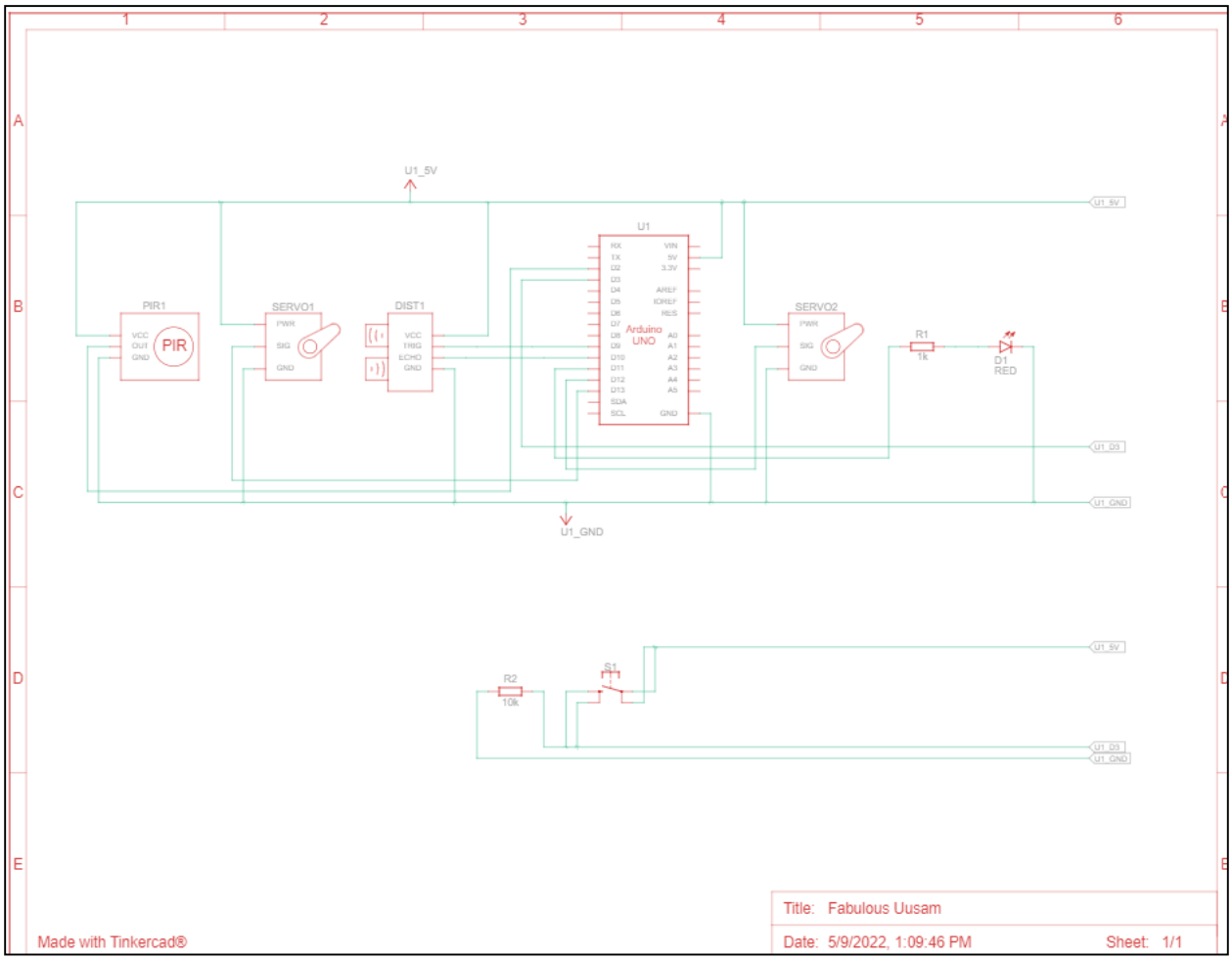

Figure 4: Circuit Diagram

2.3 Requirement Analysis

The required resources for this system are:

i. Breadboard: Electronic circuits are built on breadboards, which are temporary work boards. The general design of a breadboard is compatible with most breadboards, and circuits are connected with 24-gauge wire that is solid, not stranded (Bates, 2011).

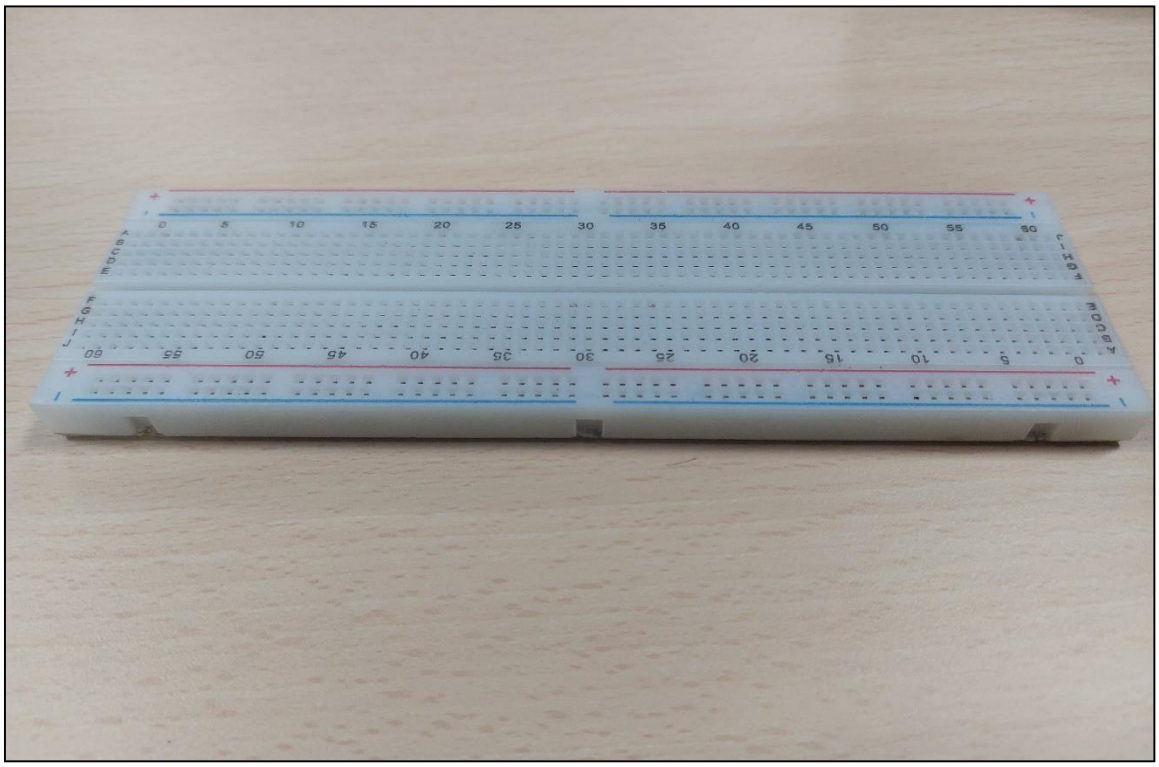

Figure 5: Breadboard

In this project breadboard is used to connect to connect the sensors, servo motors and the led to the Arduino.

Arduino UNO: The Arduino/Genuino Uno microcontroller board is based on the ATmega328P microcontroller (datasheet). There are 14 digital input/output pins (six of which can be used as PWM outputs), six analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button on the board (Arduino, 2022).

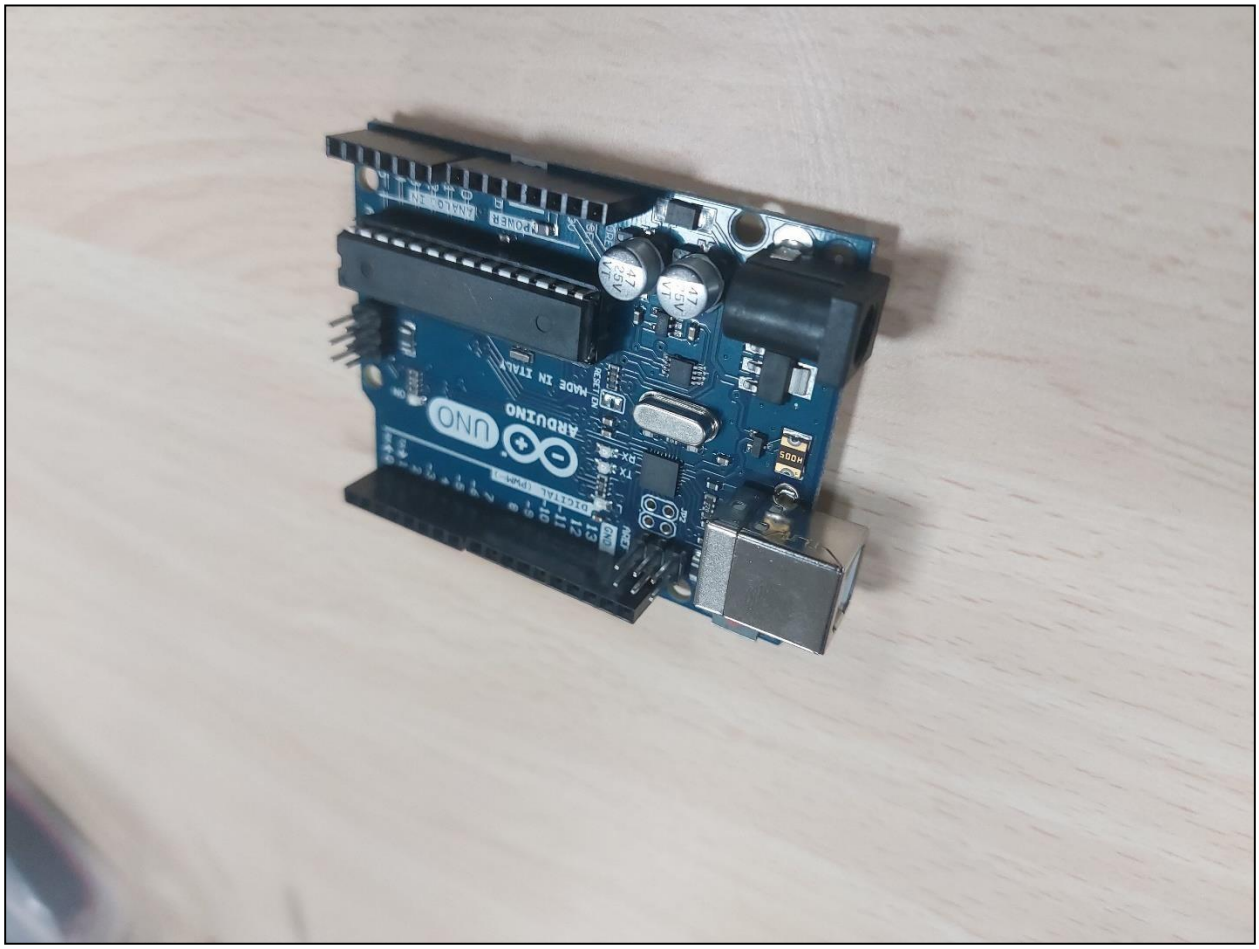

Figure 6: Arduino UNO

In this project, Arduino UNO is used connect devices in a fast, simple, and secure manner.

ii. PIR sensor: A passive infrared (PIR) sensor is an electrical sensor that detects IR light emitted by objects in its range of vision. PIR-based motion detectors are the most common application for them (Abraham, et al., 2021).

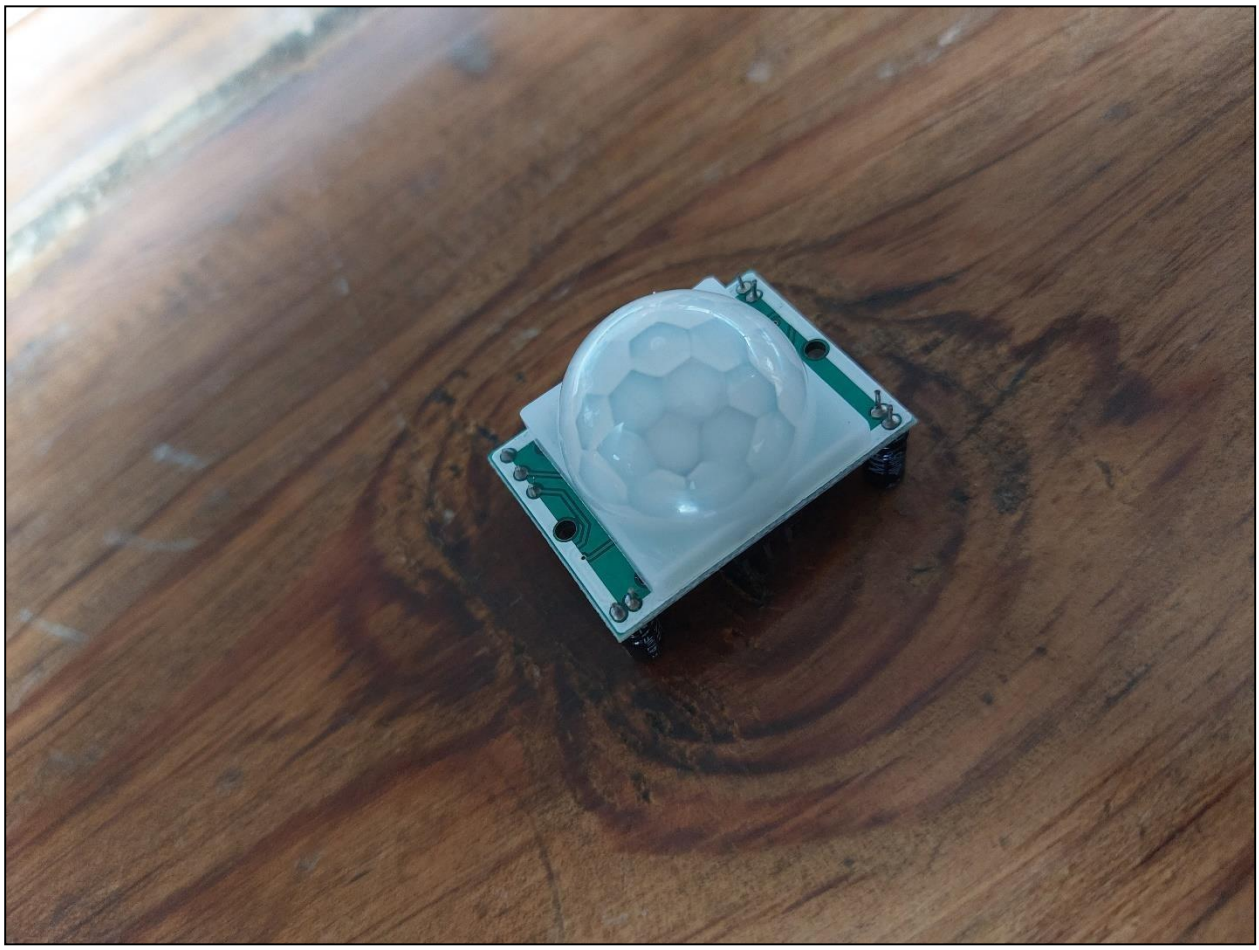

Figure 7: PIR sensor

In this project, PIR sensor is used to detect any one who is inside the garage and turn on the LED until the person leaves the garage.

Ultrasonic sensor: An ultrasonic sensor is an electronic device that uses ultrasonic sound waves to d etect the distance between a targeted items and converts the reflected sound into an electrical signal. Ultrasonic waves travel quicker than audible sound waves (i.e. the sound that humans can hear). The transmitter (which generates sound using piezoelectric crystals) and the receiver are the two primary components of ultrasonic sensors (which encounters the sound after it has travelled to and from the target).

Figure 8: Ultrasonic sensor

In this project ultrasonic sensor was used to detect vehicle coming from outside.

Micro servo motor: The SG90 Micro Servo Motor is a small and light server motor with a high output power. The servo can spin 180 degrees (90 degrees in each direction) and functions in the same way as the regular types but is smaller. To control these servos, you can use any servo code, hardware, or library. It's ideal for beginners who wish to move things without having to create a motor controller with feedback and gearbox, especially because it fits in small spaces. It includes three horns (arms) as well as hardware.

Figure 9: Micro servo motor (tertiaryrobotics, 2022)

In this project micro servo motor was used to open gate when a sensor detects a vehicle and from the inside a button is pressed to open the gate (tertiaryrobotics, 2022).

3. Development

3.1 Planning and designing

The planning was done by all of us group members in this IOT project. The plan for the IOT project was to create a smart garage with the help of sensors to open and close the door. The basic planning of the smart garage was done in the proposal for the IOT project. The devices needed, the aims and objectives of the IOT project itself were all planned in the proposal of this IOT project.

Ultrasonic sensor was to be used to detect any vehicle that had approached the garage door. When the ultrasonic sensor detects a vehicle by coding, the micro servo would open the door and would automatically close after a few second of interval. When a vehicle inside the garage wants to exit the garage, a button inside the garage would have to be pressed and the garage door will open and the vehicle can exit. After exiting the garage door can be closed using the button outside the garage door.

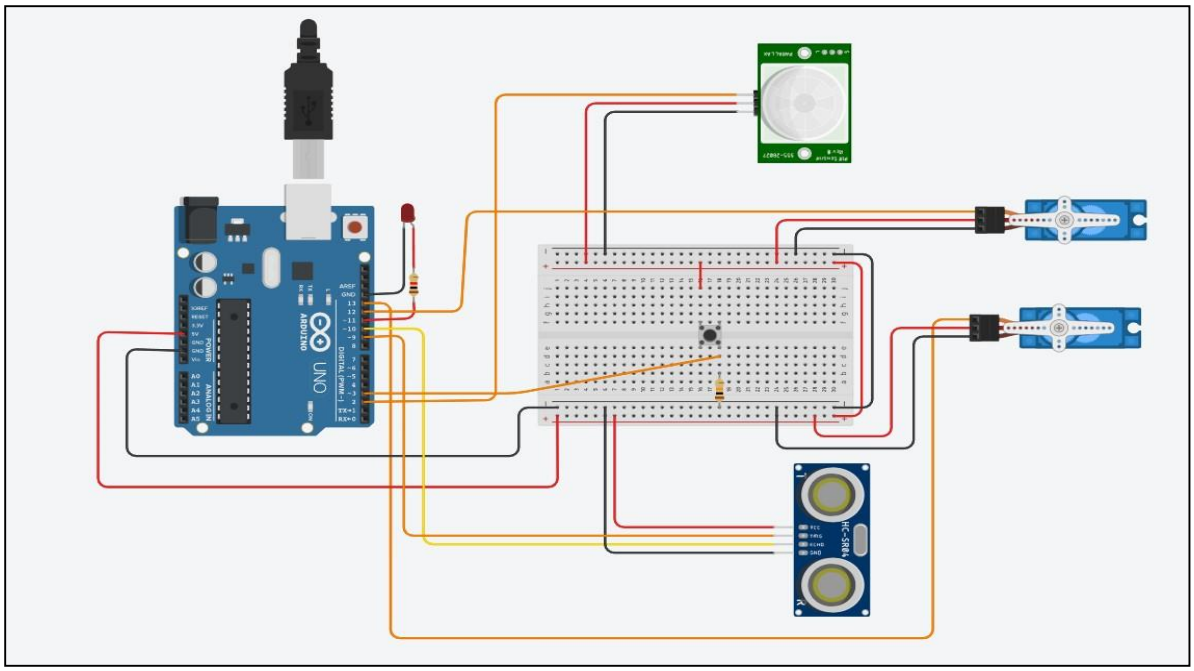

Figure 10: Tinkercad design:

3.2 Resource collection

The resources required for the project were acquired from the college's resource department. Arduino UNO, ultrasonic sensor, breadboard, PIR sensor were borrowed from the resource department. The wires and LED lights were bought from the Himalayan Solutions. The micro servo was also bought from a local store.

3.3 System Development

In IOT project, when the ultrasonic sensor detects a vehicle inside its range, the mini servo opens the garage door and closes automatically after a delay. When a vehicle needs to leave the garage, a button inside the garage can be pressed to open the garage door and to close the garage door another button is outside the garage door, pressing it will close the door.

In the system development phase, a cardboard was cut to create a shape of a garage for the IOT device. The ultrasonic sensor and the PIR sensor are connected to a micro breadboard. The Arduino UNO circuit board is connected to a mini breadboard and the connection in the micro breadboard was connected to the mini breadboard to connect to the Arduino circuit board. A mini and micro breadboard, Arduino UNO circuit board, male to female wire, ultrasonic sensor, PIR sensor and buttons were used to create the smart garage.

A force sensor was used in the original design in the proposal of this IOT project, but a force sensor was not a viable option to detect any vehicles in the driveway. So, an ultrasonic sensor was used to detect any vehicles. Instead of the DC motor, the micro servo was used to open and close the garage door as the servo motor was simpler to use in the project.

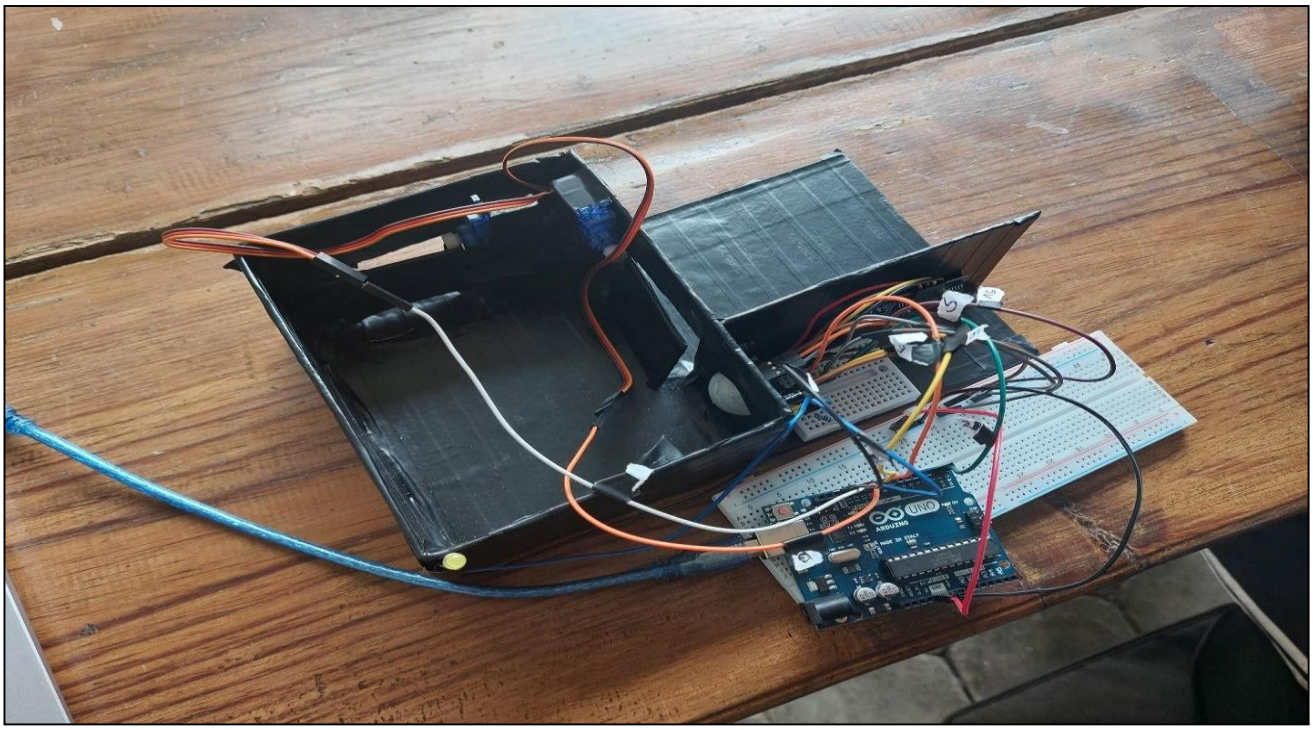

Figure 11: Developed project

3.4 Coding

The coding was done in C++ and was first tested in Tinkercad by wiring the devices. We verified if the code was correct by entering the code in the tinkercad and starting simulation in it. After many changes in the code, the code was correct. Then we moved to test the code in the real project.

3.5 Testing

For the testing phase, a small toy car was taken to test out the smart garage. The toy car was taken near the garage door where the ultrasonic sensor detected the toy car. After detecting the toy car, the ultrasonic sensor sends a signal to the Arduino board and the Arduino board send a signal to the micro servo to open the garage door. The garage door opens and after a short delay of opening the door, the door automatically closes.

When inside the garage, the PIR sensor is used to detect any motion. If motion has been detected the LED light is turned on. If no motion has been detected for more than 2 minutes by the PIR sensor then the LED light is turned off. When the vehicle wants to leave the garage, there is a button inside the garage. The button is pressed and the garage door opens automatically. The vehicle then exits the garage from the opened door and there is another door button that is used to close the garage door.

4. Results and Findings

4.1 Results

The IOT device created was a smart garage that would open and close when vehicles need to enter or leave the garage. The smart garage develop would use ultrasonic sensor, servo motors and buttons to open and close the garage doors. The PIR sensor is used to detect motion inside the garage and would turn the LED light on and off according to whether motion has been detected or not.

4.2 Findings

4.2.1 Test 1

Test case Number	1
Objective	To open the door using ultrasonic sensor for the owner.
Action	When a vehicle comes close to the sensor within the range, the sensor detects the vehicle and opens the door.
Expected Result	The door should open.
Actual Result	The door was opened.
Test Result	The test was successful.

Table 1: Table for test 1

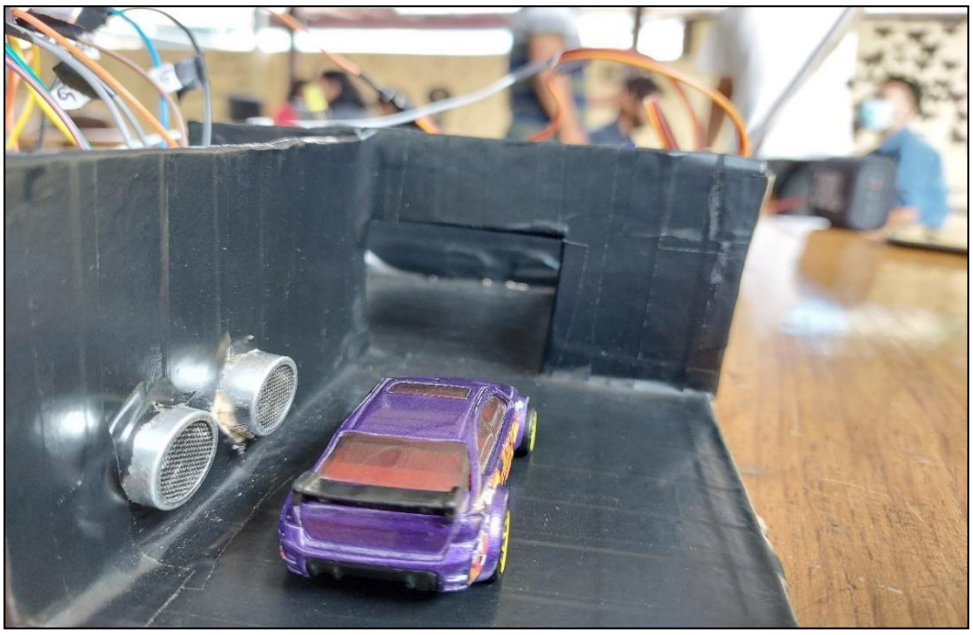

Table 2: Test to open door using ultrasonic sensor

4.2.2 Test 2

Test case Number	2
Objective	To detect the motion inside the garage and turn on the LED.
Action	When there is any motion inside the garage the PIR sensor senses the motion and LED light is switched on for 2 minutes and if no motion is detected, the light is switched off.
Expected Result	The light should be switched on when motion was detected inside the garage.
Actual Result	The light was switched on when motion was detected inside the garage.
Test Result	The test was successful.

Table 3: Table for test 2

Table 4: LED light switched on when the vehicle is inside the garage

4.2.3 Test 3

Test case Number	3
Objective	To open the gate by pressing the button and the servo motor opens the gate for a few minutes and the door closes automatically after some delay.
Action	The button was pressed which opens the gate and the vehicle is taken outside. After the set delay time, the gate is closed
Expected Result	The gate should open when button is pressed and close after interval of some time.
Actual Result	The gate was opened when button is pressed and close after interval of some time.
Test Result	The test was successful.

Table 5: Table for test 3

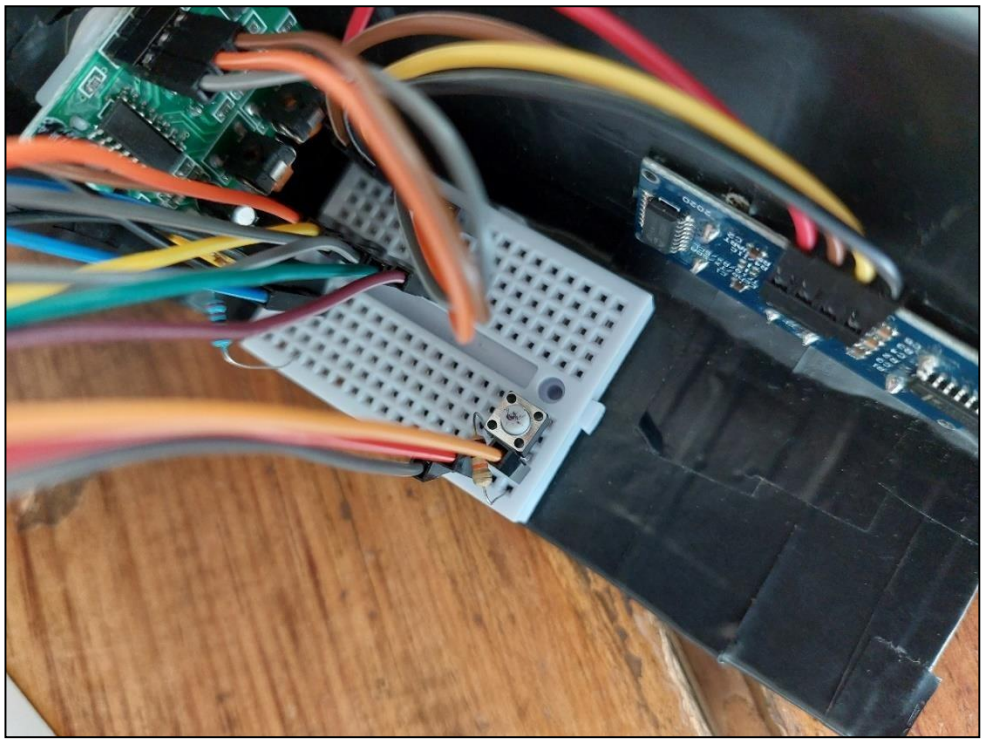

Table 6: Pressing the button

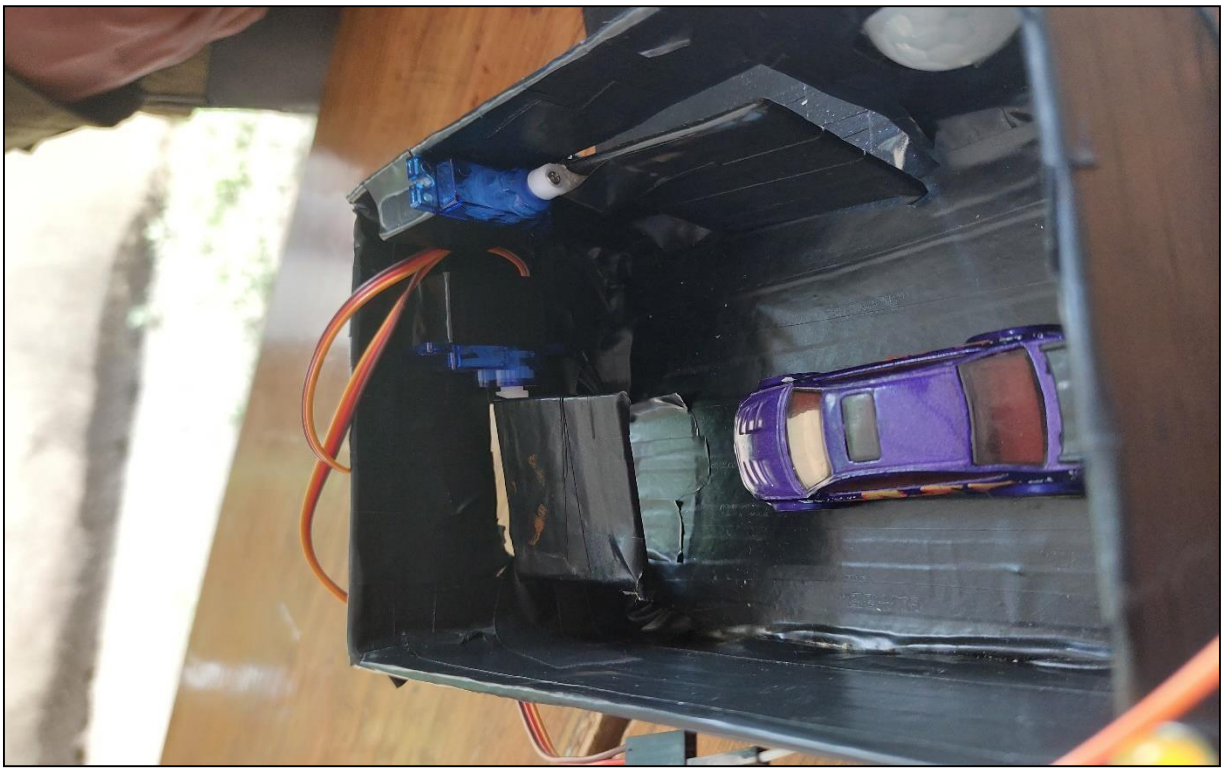

Table 7: The gate opened when button pressed

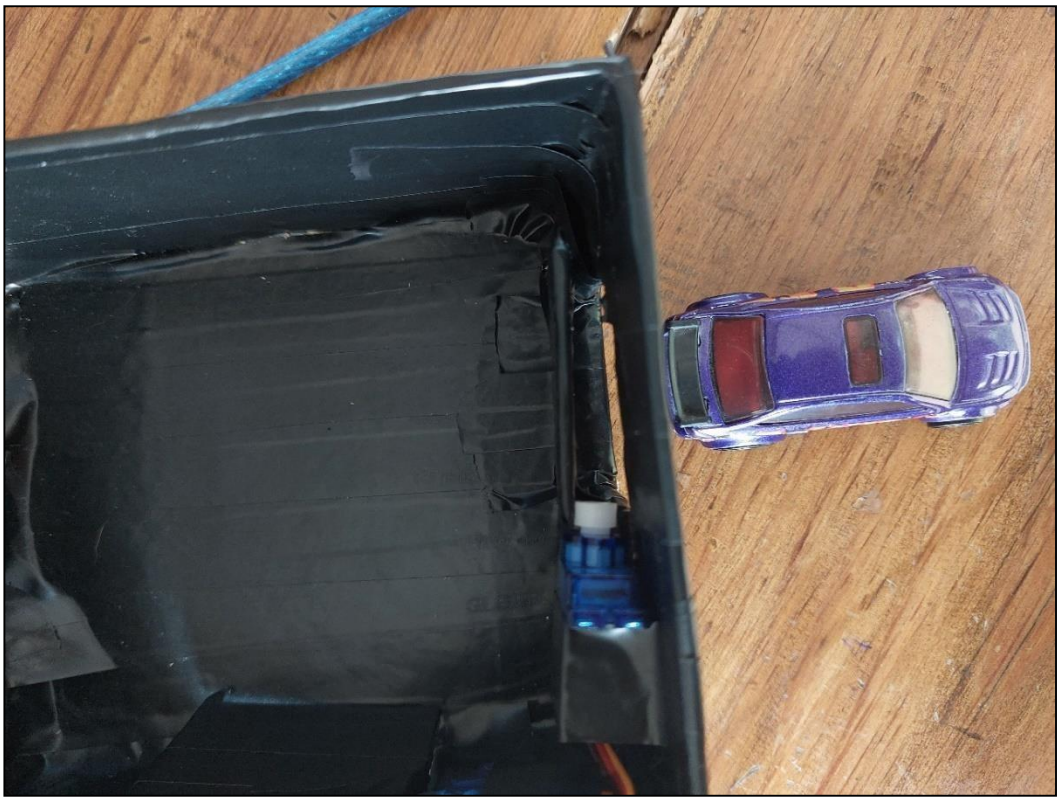

Table 8: Gate closed after delay

5. Future Works

Many modifications can be done in the future. We can develop an application which needs a PIN code to access the application. We can create buttons inside the application to open or close the gate. We can also use license detection system using camera system. The camera can be linked with the application to whitelist the license plate and only open the door for that particular vehicle. We can fit battery backup to the camera to make sure that the camera runs 24hours a day. We can also store the log of gate opened or closed to cloud and check for security concerns. Also, without using battery, we can use solar panel to generate energy to open the door.

6. Conclusion

Finally, the IoT project resulted in a smart garage that automatically opened and closed the garage door. The smart garage detects the vehicle with an ultrasonic sensor and opens the garage door with a button and the ultrasonic sensor. After a brief delay, the garage door would close automatically. The PIR sensor is located within the garage door and detects motion. If motion is detected, the LED light turns on; if no motion is detected, the LED light turns off. This IoT project has given us a better grasp of how to design and use IoT devices in our daily lives.

7. References

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[Accessed 9 May 2022].

8. Appendix

8.1 Source code

```
#include <Servo.h>

Servo myServo1;// Servo for entry

Servo myServo2;//Servo for exit

int servoPin1 = 12;//Pin for servo 1

int servoPin2 = 13;// Pin for servo 1

int ledPin = 11;// Pin for Led

int echoPin=10;//Echo Pin of Ultrasonic sensor

long duration;//Variable to store the time duration of ultrasonic wave to transmit and receive

int distance;//Variable to store the distance after calculation

int pirPin = 2;//Pin for PIR sensor

int buttonPin = 3;// Pin for Btn

int buttonState = 0;// initalising buttonState



void setup() {

pinMode(trigPin, OUTPUT);//Set trigPin as output pin

pinMode(echoPin, INPUT);//Set echoPin as input pin

pinMode(servoPin1, OUTPUT);//Set servoPin1 as output pin
```

```
pinMode(servoPin2, OUTPUT);//Set servoPin2 as output pin
pinMode(pirPin,INPUT);//Set pirPin as input pin
pinMode(buttonPin, INPUT);//Set buttonPin as input pin
```

```
myServo1.attach(servoPin1);//Assigning ServoPin1 to myservo1
myServo2.attach(servoPin2);//Assigning ServoPin2 to myservo2
Serial.begin(9600);//starts serial communication
}


void loop() {
//for PIR
int val = digitalRead(pirPin);// to store input from PIR sensor
if (val == HIGH)//Condition for motion ditection
 {
   digitalWrite(ledPin,HIGH);// Turning LED on
 }
else
 {
   digitalWrite(ledPin,LOW);// Turning LED off
 }
//for Ultrasonic
//Imitting Ultrasonic rays from trigPin
```

```
digitalWrite(trigPin,                LOW);
delayMicroseconds(2);
digitalWrite(trigPin,                HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
```

```
duration=pulseIn(echoPin, HIGH); //Reciving Ultrasonic rays by echopin
distance=duration*0.034/2;//Formula to convert the ultrasonic time into centimeters
if(distance<=5)// Condition for distance being less than or equals to 5 cm
 {
   myServoIN.write(90);//Rotate servo 90 degree or open the door
   delay(10000);// Leave the door open for 10 seconds
 }
 else
 {
   myServoIN.write(0);//Close the door
 }


//For PushButton
buttonState = digitalRead(buttonIN);
  if (buttonState == HIGH)//Condition for button being pressed
 {
   myServoOUT.write(90);//Rotate servo 90 degree or open the door
 }
```

```
  else
  {
    myServoOUT.write(0);//Close the door
  }
}
```