Automatic Door Operating System Using PIR Sensor

A project report submitted for the End Semester Examination of 6th Semester, 3rd year, Dept. of Electrical Engineering

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CERTIFICATE

TO WHOM IT MAY CONCERN

This is to certify that the project report entitled Automatic Door Operating System Using PIR Sensor is submitted by

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Students of **INSTITUTE OF ENGINEERING & MANAGEMENT,** in partial fulfilment of requirements for the award of the degree of **Bachelor of Technology in Electrical Engineering,** is a bona fide work carried out under the supervision and guidance of Dr. **Mandakinee Bandhyopadhyay** during the pre-final year of the academic session of 2020-2024.The content of this report has not been submitted to any other University or Institute for the award of any other degree.

It is further certified that work is entirely original and its performance has been found to be quite satisfactory.

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ABSTRACT

We have designed this project entitled " Automatic Door Operating System Using PIR Sensor" with a simple design. The main motto of this project is to utilization of sensor with combination of embedded equipment for the door opening systems.

Here we describe the design and implementation of automatic controller for the door. There are various kinds of sensors are available in the market to make such types of systems such as Radar sensors, **PIR sensors**, **Infrared sensors** and **Laser sensors**, etc. This project uses a PIR sensor. The door opens when any human movement is detected near the door it detects with help of a PIR sensor detects the movement and sends a signal to the transistor, in turns gives interrupt signal to a programmable **microcontroller**, the output signal form the microcontroller is fed to the **Servo motor** which is used to open the door and close the door, which is driven by a motor driver IC. The interrupt signals can be used to stop power to the motor in the event of locked rotor condition

The automatic door opening systems are used in commercial buildings, shopping malls, theatres, etc. which senses the infrared energy produced by the human body.

Key Words: Automatic Door, PIR Sensor, Infrared Sensor, Laser Sensor, Microcontroller, Servo Motor

CONTENTS

Chapter 1

INTRODUCTION

Opening and closing of doors have been always a boring job, especially in places where a person always required to open the door for visitors such as hotels, shopping malls and theatres. Here is a solution to open and close the door i.e., movement sensed automatic door opening and dosing system. This project is based on sensing any body movement present nearby the sensor This is achieved with the help of a passive infrared sensor. Generally, a human body emits infrared energy which is detected by the PIR sensor from a particular distance. This signal which is detected by the sensor is fed to a controller to function a door motor through motor driver IC. When a body reaches the operating range of the PIR sensor, it sends a signal to the microcontroller to open and close the door.

A microprocessor controlled automatic door opener including means for detecting the velocity and direction of travel of the door. The micro-controller evaluates detected changes in either the velocity or direction of travel to determine the cause, and either reverses door travel direction or ores the detection. The settings of the door are stored in the memory of the microprocessor The microcontroller will regulate the opening and closing speed and the direction of door travel depending upon a pre-programmed sequence. The door control mechanism is able to differentiate between these internal factors and external obstructions.

Chapter 2

Overview of Project

List of components:

1. Arduino Uno R3
2. Servo motor mg996R
3. PIR sensor
4. Led
5. Jumper cable
6. Cardboard box (for display of prototype)
7. Miscellaneous (Paint, Cover paper, etc)

Circuit Diagram:

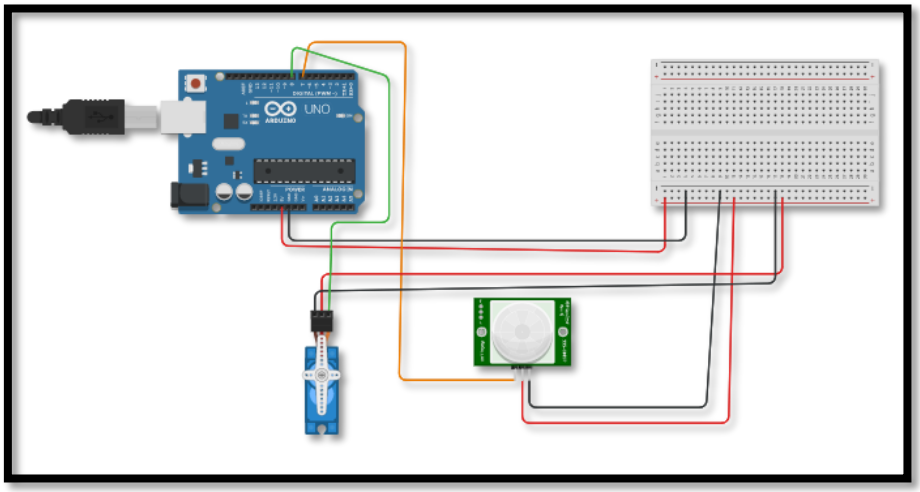

Fig.1 Circuit Diagram of Automatic Door Operating System using PIR Sensor

Block Diagram:

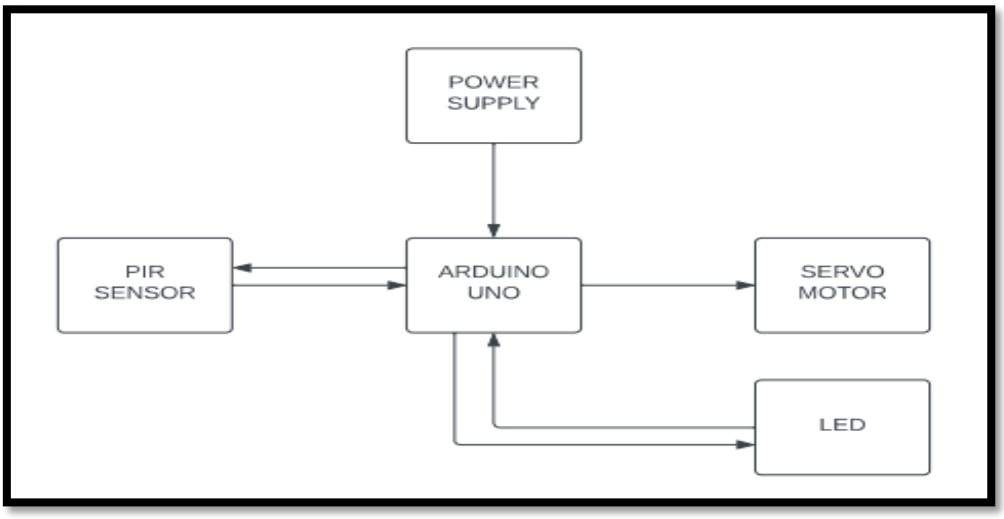

Fig.2 Block Diagram of Automatic Door Operating System using PIR Sensor

Flowchart:

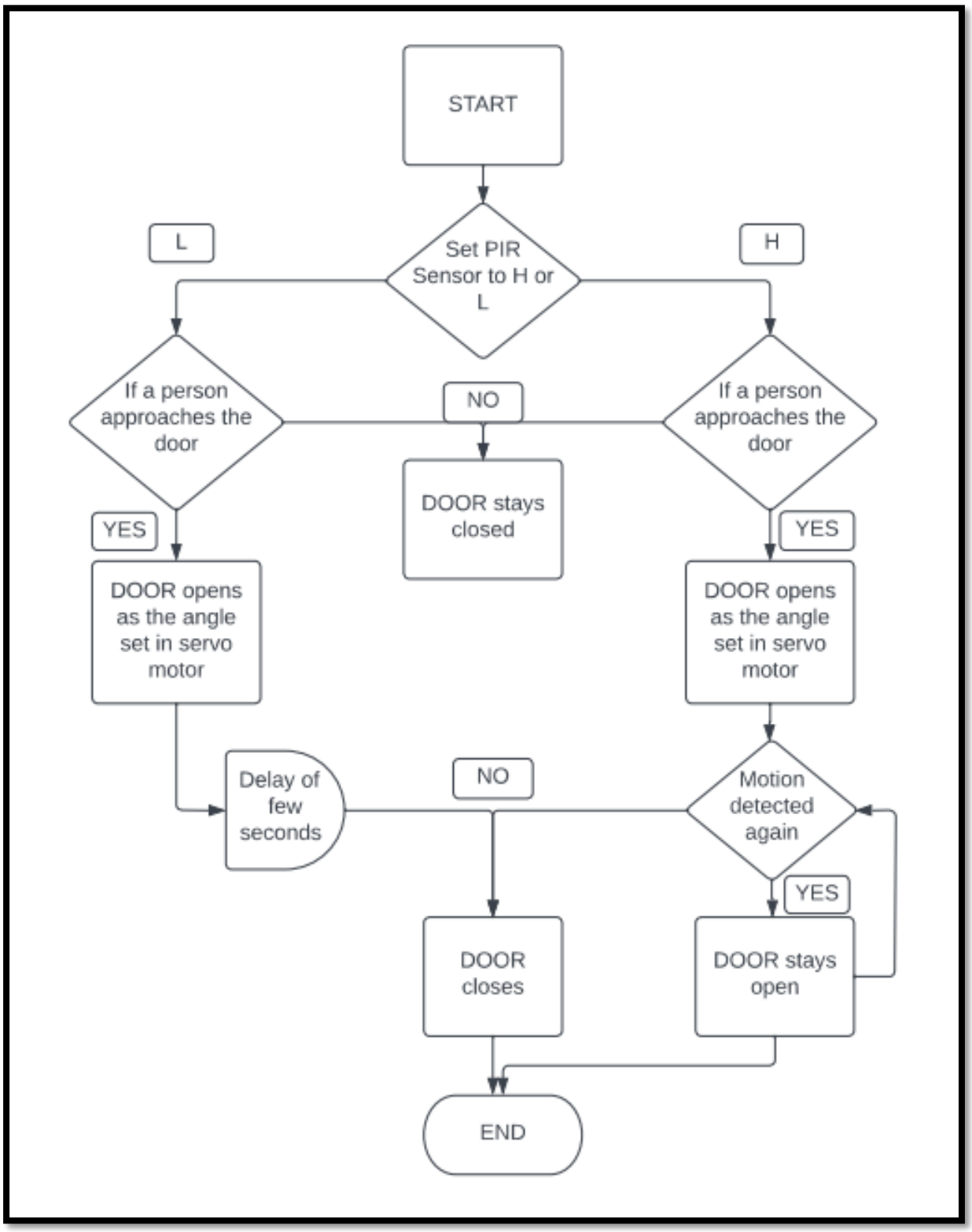

Fig.3 Flowchart of Automatic Door Operating System using PIR Sensor

Chapter 3

Details of components and software used

3.1. Arduino Uno R3

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. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

Table 1: Specifications of Arduino UNO

Board	**Name**	Arduino UNO R3
	SKU	A000066
Microcontroller	ATmega328P	
USB connector	USB-B	
Pins	**Built-in LED Pin**	13
	Digital I/O Pins	14
	Analog input pins	6
	PWM pins	6
Communication	**UART**	Yes
	I2C	Yes
	SPI	Yes
Power	**I/O Voltage**	5V

	Input voltage (nominal)	7-12V
	DC Current per I/O Pin	20 mA
	Power Supply Connector	Barrel Plug
Clock speed	**Main Processor**	ATmega328P 16 MHz
	USB-Serial Processor	ATmega16U2 16 MHz
Memory	**ATmega328P**	2KB SRAM, 32KB FLASH, 1KB EEPROM
Dimensions	**Weight**	25 g
	Width	53.4 mm
	Length	68.6 mm

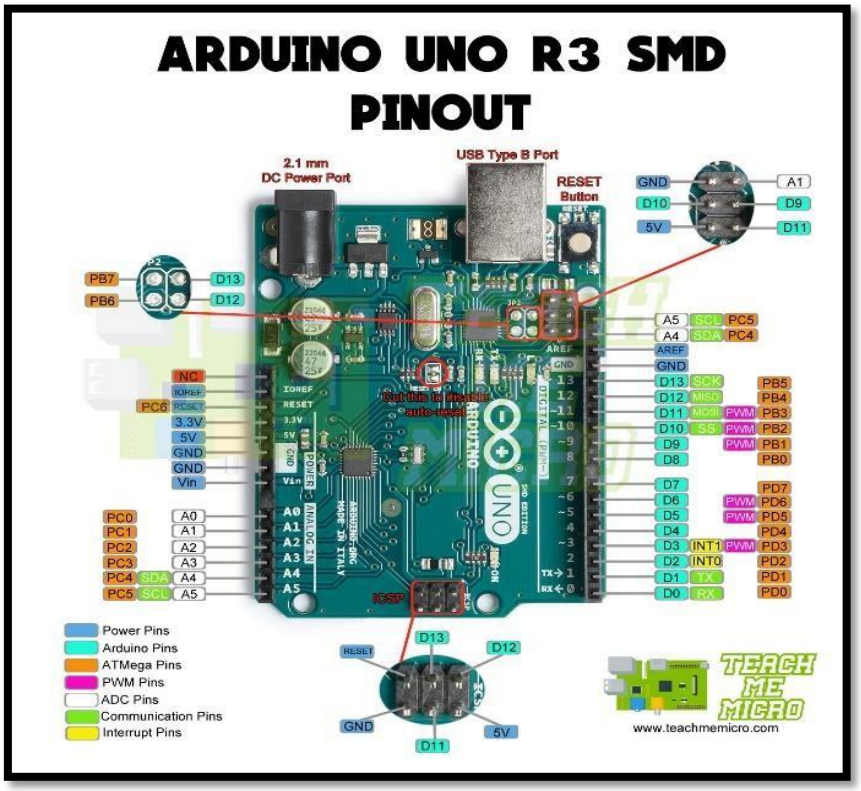

Fig. 4 Pin diagram of Arduino Uno

3.2. Servo motor mg996R

A servo motor is a closed-loop system that uses position feedback to control its motion and final position. There are many types of servo motors and their main feature is the ability to precisely control the position of their shaft. In industrial type servo motors the position feedback sensor is usually a high precision encoder, while in the smaller RC or hobby servos the position sensor is usually a simple potentiometer. The actual position captured by these devices is fed back to the error detector where it is compared to the target position. Then according to the error, the controller corrects the actual position of the motor to match with the target position.

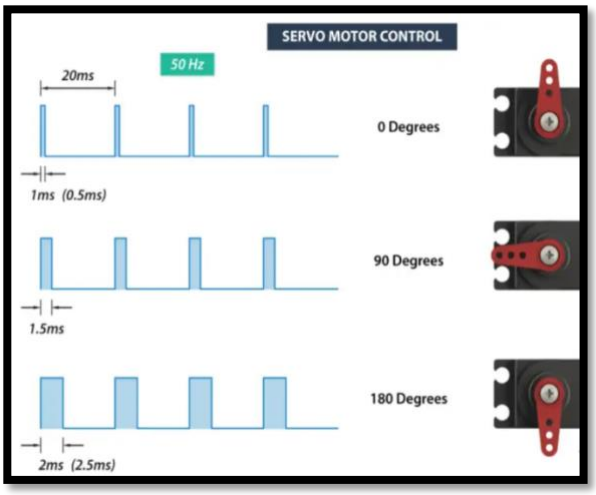

Fig.5 Working of Servo Motor

There are four main components inside of a hobby servo, a DC motor, a gearbox, a potentiometer and a control circuit. The DC motor is high speed and low torque but the gearbox reduces the speed to around 60 RPM and at the same time increases the torque. The potentiometer is attached on the final gear or the output shaft, so as the motor rotates the potentiometer rotates as well, thus producing a voltage that is related to the absolute angle of the output shaft. In the control circuit, this potentiometer voltage is compared to the voltage coming from the signal line. If needed, the controller activates an integrated H-Bridge which enables the motor to rotate in either direction until the two signals reach a difference of zero.

A servo motor is controlled by sending a series of pulses through the signal line. The frequency of the control signal should be 50Hz or a pulse should occur every 20ms. The width of pulse determines angular position of the servo and these types of servos can usually rotate 180 degrees (they have a physical limits of travel).

Generally, pulses with 1ms duration correspond to 0 degrees position, 1.5ms duration to 90 degrees and 2ms to 180 degrees. Though the minimum and maximum duration of the pulses can sometimes vary with different brands and they can be 0.5ms for 0 degrees and 2.5ms for 180 degrees position.

Table 2: Specifications of Servo Motor

Stall Torque	11kg.cm @4.8v, 13kg.cm @6V
Operating Voltage	4.8 – 7.2V
No Load Current	220mA @4.8V, 250mA @6V
Stall Current	650mA
Max Speed	60 degrees in 0.20s
Weight	55g

3.3. PIR sensor

HC-SR501 PIR sensors allow you to sense motion. They are used to detect whether a human has moved in or out of the sensor's range. They are commonly found in appliances and gadgets used at home or for businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. the term "passive" means that sensor is not using any energy for detecting purposes, it just works by detecting the energy given off by the other objects.

Following are the advantages of PIR Sensors −

- Small in size
- Wide lens range
- Easy to interface
- Inexpensive
- Low-power
- Easy to use
- Do not wear out

Fig.6 PIR sensor

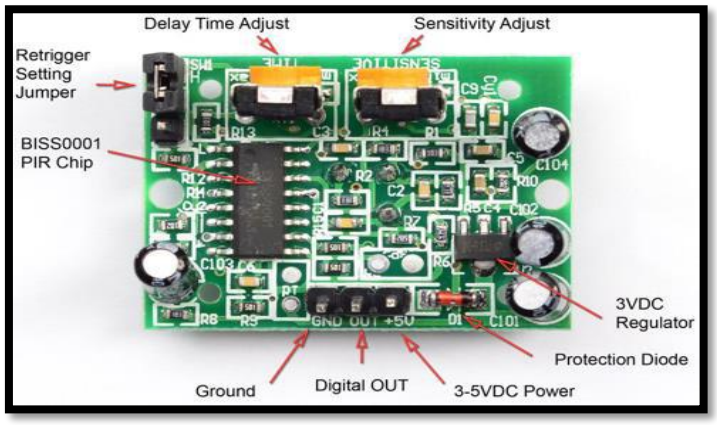

Fig.7 PIR sensor components

PIRs are made of pyroelectric sensors, a round metal can with a rectangular crystal in the center, which can detect levels of infrared radiation. A special lens called a fresnel lens which Focuses the infrared signals on the pyroelectric sensor.

Everything emits low-level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is split in two halves. This is to detect motion (change) and not average IR levels. The two halves are connected so that they cancel out each other. If one-half sees more or less IR radiation than the other, the output will swing high or low.

PIRs have adjustable settings and have a header installed in the 3-pin ground/out/power pads.

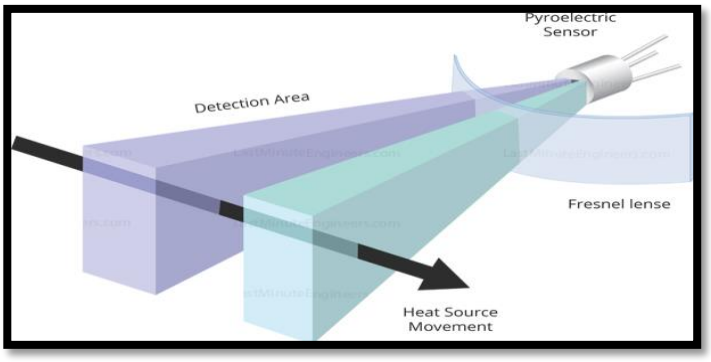

Fig.8 Operation of PIR Sensor

For many basic projects or products that need to detect when a person has left or entered the area, PIR sensors are great.

Table 3: Specification of PIR Sensors

Operating Voltage	4.5 – 20V (typically 5V)
Maximum Current Draw	< 2mA
Time Delay	~ 1 sec to 3 min
Detection Distance	3 – 7 meters (9 – 21 feet)
Detection Angle	120 degrees (typically)

3.4. LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as in Light-emitting diodes are used in applications as diverse as aviation lighting, digital microscopes, automotive lighting, advertising, general lighting, and traffic signals. LEDs have allowed new text, video displays, and sensors to be developed, while their high switching rates are also useful in advanced communications technology. Infrared LEDs are also used in the remote-control units of many commercial products including televisions, DVD players and other domestic appliances LEDS are also used in seven-segment display detector lamps in many devices and are increasingly used for other lighting.

3.5. Jumper Cable

A wire is a single, usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads and to carry electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Standard sizes are determined by various wire gauges. The term wire is also used more loosely to refer to a bundle of such strands, as in 'multi stranded wire", which is more correctly termed a wire rope in mechanics, or a cable in electricity

Although usually circular in cross-section, wire can be made in square, hexagonal, flattened rectangular or other cross sections, either for decorative purposes, or for technical purposes such as high efficiency voice coils in loudspeakers. Edge wound coil springs, such as the slinky toy, are made of special flattened wire.

3.6. Software

Arduino 1.8.1 windows: we used this software for Arduino programming

Chapter 4

Hardware Implementation and Result

The components used in this circuit are PIR sensor, LED and Servo Motor. Vcc pin of PIR sensor and servo is connected to the positive terminal of the power supply with 3.3V and 5V respectively, ground pins are connected to the ground of Arduino, the output pin of PIR sensor is connected to digital port 2 and output pin of Servo is connected to digital pin 9 of Arduino. So, when there is any motion in the range of PIR, LED will start to glow.

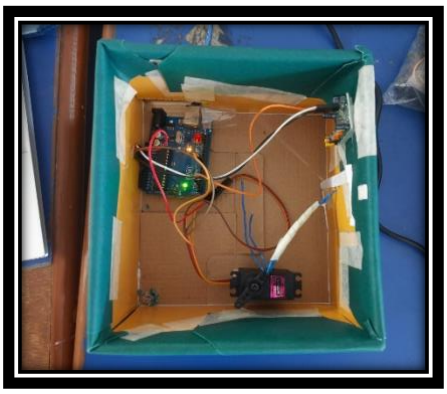

Fig.9.1

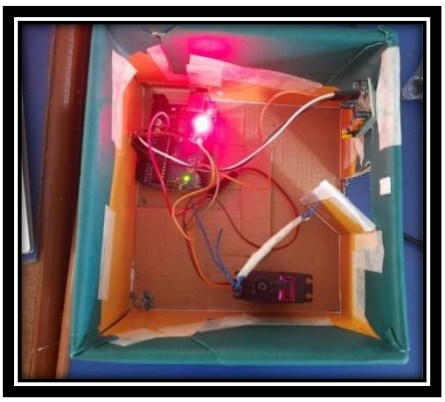

Fig. 9.2

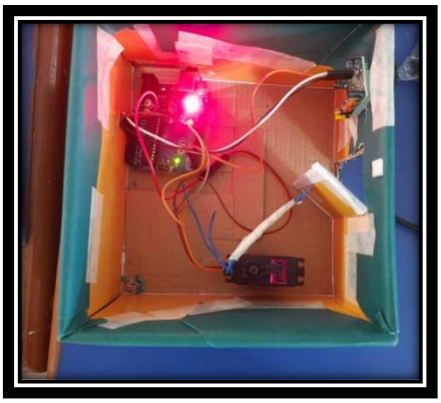

Fig. 9.3

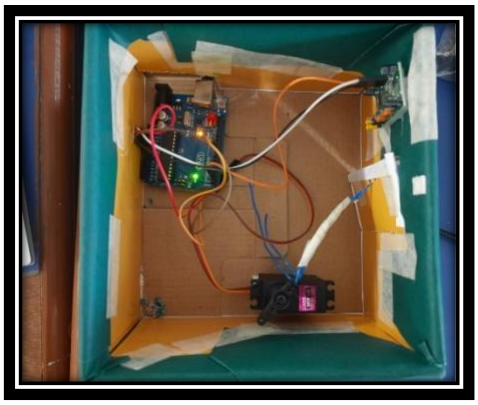

Fig. 9.4

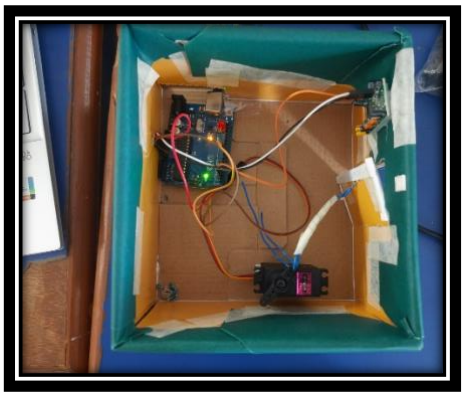

Fig. 9.5

Fig 1-5: (1) When no operation is taking place, i.e. no motion is detected, door is closed.

(2) When motion is detected, led lights up and the door opens

(3) Door opens to the maximum angle set

(4) When no further motion is detected, door closes

(5) Door closes completely

Figure 1-5, depicts the operation of Automatic Door, where when the PIR sensor detects heat radiation in its proximity it sends signal to the microcontroller. The microcontroller operates the servo motor to open the door. During this operation the led stays switched on. If further motion is not detected then the door is closed

Code

```
#include<Servo.h>
Servo Door;
int pirPin = 2;
int val = 0;
int servoPin = 9;
int ledPin = 13;                // choose the pin for the LED
void setup()
{pinMode(ledPin, OUTPUT);      // declare LED as output
  pinMode(pirPin, INPUT);
  Serial.begin(9600);
  Door.attach(servoPin);}
void loop(){
  val = digitalRead(pirPin);
  if(val== HIGH)
 {
  Door.write(180);
  digitalWrite(ledPin, HIGH);  // turn LED ON
  Serial.println("Motion detected!");
  delay(4000);
 }
// else
// { Door.write(0);
// }
Door.write(30);
//delay(400);
digitalWrite(ledPin, LOW); // turn LED OFF
Serial.println("Motion ended!");
 }
```

CHAPTER-5

APPLICATIONS:

- This architecture can be implemented in various places like shopping malls, toilets and theatres where a person is always required to open the door for visitors.
- It is also helpful for the disability person so that he could easily come in and out without opening the door.
- It can be used in hospitals for the patients.

CHAPTER-6

DISCUSSION

The automatic gates do not need any physical effort to open or close. They durable, strong and can be available in customized sizes. It is very convenient to enter and leave through the automatic gates. They are economical and easy to use consumes less power but power failure causes inconvenience and thus cannot used for security purposes.

CHAPTER-7

FUTURE DEVELOPMENT:

- There can be a display unit for showing number of persons entered in a particular room. A better sensor is recommended to achieve new functionality, for instance, a suitable
- Sensor as radar sensor that could detect contraband good any vehicle.
- Can be further used in security systems by implementing finger print on it.
- Fans air conditioner, curtains, control can be added along with automatic door.

CHAPTER-8

CONCLUSION:

This project is a simple design of automatic door opening system where PIR sensor serves the main input function and here Arduino uno is a microcontroller board based on the ATmega328p.

We have considered two feedbacks to this architecture that when we implement an effective system then there can be a display unit for showing number of persons entered in a particular room along with this system we can use face-detection through camera for automated attendance system.

Thus, we can conclude that this is a simple and low-cost architecture of automatic door opening system but having lots of benefits such as we can conserve energy, reduces human efforts, saves time etc.

Chapter 9

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