# A
# Project Report
# on

# *"Smart Lab Security with Energy Conservation"*

**Submitted By**



| | |
|---|---|
| Mr. Aryan Koul | 2020BTEEN00001 |
| Mr. Sanmay Girish Kulkarni | 2020BTEEN00008 |
| Mr. Saurabh Nitin Dhande | 2020BTEEN00039 |
| Mr. Ranjit Abaji Dhaigude | 2020BTEEN00059 |
| Mr. Gaurav Shitalkumar Patil | 20202BTEIT00076 |

**Under the guidance of**

*Prof. B. G. Patil*

## Department of Electronics Engineering

## WALCHAND COLLEGE OF ENGINEERING, SANGLI

(Government-Aided Autonomous Institute)


**2023-2024**

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**WALCHAND COLLEGE OF ENGINEERING, SANGLI**

(Government-Aided Autonomous Institute)

**DEPARTMENT OF ELECTRONICS ENGINEERING**

# *CERTIFICATE*

This is to certify that the Project-I Report entitled

‘**Smart Lab Security with Energy Conservation**’

Submitted by

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| Mr. Aryan Koul | 2020BTEEN00001 |
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| Mr. Ranjit Abaji Dhaigude | 2020BTEEN00059 |
| Mr. Gaurav Shitalkumar Patil | 2020BTEIT00076 |

in partial fulfilment for the award of the Degree of

***Bachelor of Technology***

***in***

***Electronics Engineering***

is a record of students’ own work carried out by them under our supervision and guidance during the first semester of academic year 2023-2024.

Date:

Place: Sangli

**Dr. B. G. Patil**
**(Project Guide)**

**Dr. S. D. Ruikar**
**HOD**

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# ABSTRACT

The automotive industry is amidst a significant revolution, with automation being a driving force in various sectors, including modern laboratories. These cutting-edge laboratories are equipped with valuable electronic appliances, computers, and instruments, making them susceptible to security risks. Balancing safety and the comfort of laboratory personnel under these circumstances is a formidable challenge.

Our project, "**Smart Lab Security with Energy Conservation**," addresses these challenges by introducing a smart, automated, secure, and eco-friendly system for laboratory management. This comprehensive system encompasses the following features:

1. Two level authentication of a Person.
2. Controlling electric appliances based on person's detection and environmental conditions.
3. Fire alarm for safety purposes.
4. Maintaining real time attendance of attendees.

# ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who contributed to the successful completion of the "**Smart Lab Security with Energy Conservation**" project. Special thanks to our dedicated team members who invested their time and expertise. We also extend our appreciation to our project **Dr. B.G. Patil Sir** for their guidance throughout the project. We would also like to thank **Dr. S. D. Ruikar Sir** and **Prof. S.B. Dhaigude Sir** for constant support and mentorship throughout this project. We would like thank **Joshi Sir** and Electronics Department for giving us the components and all the support while doing the testing of this project. Lastly, we would like to thank in our friends and family members for constant support throughout this project.

# Chapter 1: Project Overview

## 1. Introduction

The Automotive Industry is undergoing a significant revolution. At various places, automation is playing very vital role. Modern laboratories are also one of them. Modern laboratories often include expensive electronic appliances, computers and instruments and are always open to security risks. Maintaining a positive safety culture and at the same time meeting the safety and comfort needs of laboratory personnel are challenging under these circumstances.

Our project "**Smart Lab Security with Energy Conservation**" is a smart, automatic, secure and eco-friendly system designed to automate and secure laboratories. The system includes:

- Authentication of a Person.
- Controlling Electrical Appliances Based on Person's Detection and Environmental Conditions.
- Fire Alarm for Safety Purpose.

Overall, our "**Smart Lab Security with Energy Conservation**" system is a comprehensive solution that aims to improve security, energy efficiency, and safety within modern laboratories.

By automating processes and utilizing advanced technologies such as authentication methods, environmental sensors, and solar panels, the system not only enhances the laboratory's security and safety culture but also contributes to a more sustainable and eco-friendly operation.

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## 2. Literature Survey

In today's rapidly advancing digital landscape, the fusion of security and automation has become a necessity. Upon extensive research, there is issue with the absence of comprehensive authentication and energy conservation systems in vital spaces like libraries, study rooms, and offices. This deficit results in unrestricted access to these facilities, posing security risks. Simultaneously, electricity wastage exacerbates energy scarcity, a critical issue in several regions across India. Large number of renowned and notable works have put forth this problem. But to make this a big move, it is important to start finding the solution at smaller scales first.

To address this dual challenge, we as a team decided to make this project, primarily focusing on the laboratory. Our innovative system combines the strengths of two-step verification including RFID and various Biometry Recognition system. Upon successful verification, the system promptly notifies users, ensuring smooth entry. Once inside the laboratory, the automation comes in picture along with energy conservation. It intelligently manages lighting, climate control, and other energy-consuming elements. Through this, we aim to foster a secure and eco-conscious library environment.

By integrating Authentication with Automation, we aim to create a Dynamic and sustainable solution that not only enhances user experience but also contributes to environmental responsibility.

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## 3. Extension of Previous Projects

This project marks the Extension of **Mini Projects** which the team members did in Third Year. Each project being unique and diverse. But still lacked real life expertise and faced some drawbacks. Hence, the team decided to Integrate several ideas, with the hope of creating a secure, automated system.

Following are the list of projects:

**Sanmay Kulkarni, Aryan Koul and Team:**

- Scanning Security System (TY Semester 5)

**Sanmay Kulkarni, Gaurav Patil and Team:**

- Authentication and Automation System (TY Semester 6)
- Library Check-In System (TY Semester 6)

**Aryan Koul and Team:**

- Dual Recognition Attendance System (TY Semester 6)

**Ranjit Dhaigude and Team:**

- Smart Attendance System (TY Semester 6)

**Saurabh Dhande and Team:**

- Security System Using RFID Technology (TY Semester 6)

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## 4. Objective

The Objective of the Project are as follows:

- To Develop a Reliable, Efficient and Cost Effective System for Expensive Labs.
- To Provide Real Time Attendance Reports for Better Management and Decision Making.
- To Enhance the Safety and Security of People working inside Labs.
- To Conserve Energy using Automation Techniques.
- To Control Electronic Appliances based on Environment Conditions.

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## 5. Assumed Constraints

- **Limited Budget:**
  We assume that there are financial constraints for the project, necessitating cost-effective solutions.

- **Technological Constraints:**
  The success of the project depends on the reliablity and efficiency of biometric vertification and sensor technology.

- **Administrative Constraints:**
  Effective communication with administrators is essential for handling notifications and access control.

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## 6. Methodology

The Project consists of two main components: **Authentication System and Automation System.**

- **Authentication System:**
  There are separate provisions made in for the Student and Admin for Authentication Process. The Students, the provision of Password Verification along with Face Verifcation is employed. And for the Admin, the provision for Password Verification is enabled. This ensures that proper security measures are being employed along with proper monitoring strategies implemented keeping in mind the safety of people in and around lab.

- **Automation System:**
  Once verification is completed, the door opens automatically. Electric appliances are mangaed based on user presence and enviornmental conditions. Fan Speed, lighting and solar panel orientation are dynamically controlled. A Fire Alarm System, Gas Security System and other well designed systens are integrated for safety. Manual / Automatic Control of basic electric appliances are also made available for the users.

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# Chapter 2: Hardware Components Used

## 1. Feature Diagram

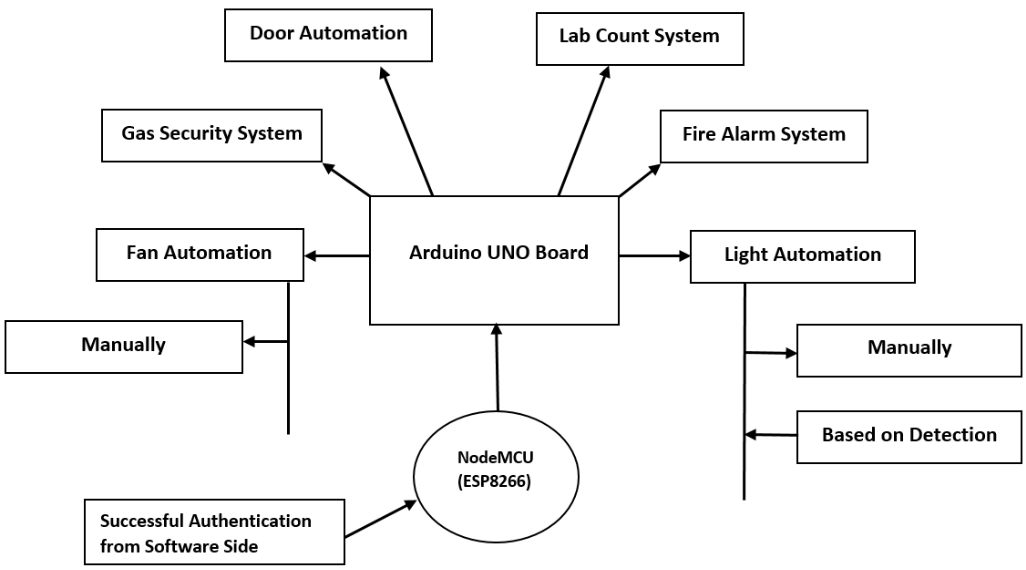


*Figure 2.1: Feature Diagram of Hardware*

Upon successful authentication, the NodeMCU relays the message to the Arduino. An IR sensor counts incoming and outgoing students for monitoring purposes. Lab security is ensured through a Gas Detection System and Fire Alarm System. Control over lab appliances is managed via manual or sensor-driven inputs, optimizing both efficiency and safety protocols.

## 2. List of Components Used: `

- Arduino UNO
- NodeMCU (ESP8266)
- IR Sensor
- Flame Sensor
- Servo Motor
- PIR Sensor
- AC Bulb
- BC547 Transistor
- Relay (5V)
- Diode (1N4007)
- MQ2 Gas Sensor

# 3. Description of Components: `

- ## Arduino UNO:

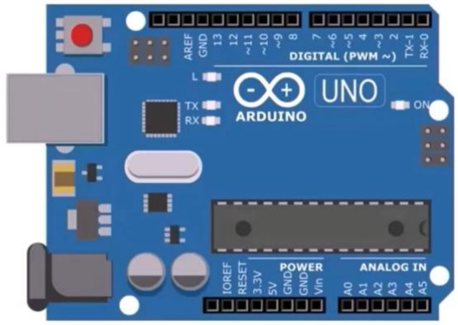


*Figure 2.2: Arduino UNO*

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board and IDE that runs on your computer, used upload computer code to the physical board.

- Processor: 16 MHz ATmega328
- Flash memory: 32 KB
- Ram: 2kb
- Operating Voltage: 5V
- Input Voltage: 7-12 V
- Number of analog inputs: 6
- Number of digital I/O: 13 (6 of them pwm)

- ## NodeMCU (ESP8266):

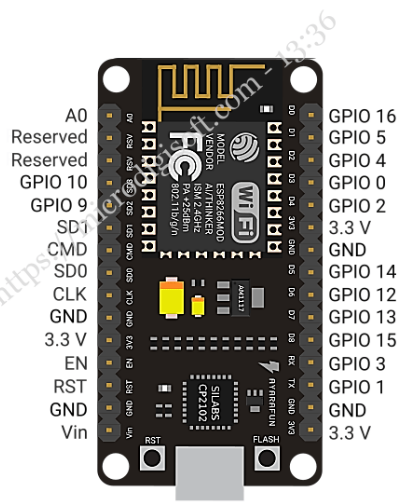


*Figure 2.3: NodeMCU*

NodeMCU is an open-source firmware and development board that is specially designed for IoT (Internet of Things) applications. It runs on the ESP8266 Wi-Fi SoC (System on Chip) from Espressif Systems, and the hardware is based on the ESP-12 module. The term "NodeMCU" combines "node" and "MCU" (micro-controller unit).

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106.
- Flash memory: 4 MB
- SRAM: 64 KB
- Operating Voltage: 3.3 V
- Input Voltage: 7-12 V
- Number of Analog Pins: 1
- Number of Digital I/O Pins: 16

- ## IR Sensor:

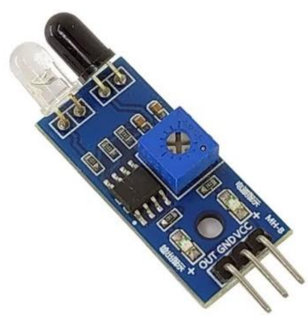

*Figure 2.4: IR Sensor*

An Infrared Sensor (IR Sensor) is a radiation sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength range of 780 nm – 50 um. In our project, IR sensor is connected to AC Bulb (Transistor and Relay present in this circuit). When the IR Sensor senses a student, it will send the high signal to base of transistor and the AC Bulb will glow.

- Pin 1: VCC
- Pin 2: GND
- Pin 3: DOUT

- **Flame Sensor:**

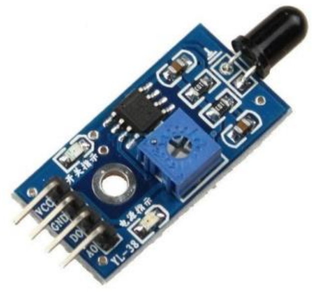

*Figure 2.5: Flame Sensor*

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting.

- Pin 1: VCC
- Pin 2: GND
- Pin 3: DOUT
- Pin 4: AOUT

- **Servo Motor:**


*Figure 2.6: Servo Motor*

A servo motor is a type of motor that can rotate with great precision. Servo motor is used when there is need to rotate an object at specific angle or distances. In our project, servo motor is used to open and close the door.

- Pin 1: GND (Brown)
- Pin 2: VCC (Red)
- Pin 3: PWM Signal (Orange)

- ## PIR Sensor:

*Figure 2.7: PIR Sensor*

PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m. PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation.

- Pin 1: VCC
- Pin 2: DOUT
- Pin 3: GND

- ## AC Bulb:

*Figure 2.8: AC Bulb*

A light-bulb produces light from electricity. In addition, they can be used to show an electronic device is on, to direct traffic, for heat, and for many other purposes. AC bulb is used because, alternating current is the form in which residences receive their supply of electricity. In our project, when an IR sensor senses a student then the respective bulb will glow.

- **Transistor (BC547):**


*Figure 2.9: Transistor (BC547)*

The BC547 transistor is an NPN transistor. A transistor is nothing but the transfer of resistance which is used for amplifying the current. A small current of the base terminal of this transistor will control the large current of emitter and base terminals. The main function of this transistor is to amplify as well as switching purposes.

- Pin 1: Collector
- Pin 2: Base
- Pin 3: Emitter

- **Relay (5V):**

*Figure 2.10: Relay (5V)*

A Relay is one kind of electro-mechanical component that functions as a switch. The relay coil is energized by DC so that contact switches can be opened or closed. A single channel 5V relay module generally includes a coil, and two contacts like normally open (NO) and normally closed (NC).

- Pin 1: Coil End 1
- Pin 2: Coil End 2
- Pin 3: COM
- Pin 4: NC (Normally Closed)
- Pin 5: NO (Normally Opened)

- **Diode:**

*Figure 2.11: Diode (1N4007)*

1N4007 belongs to the silicon family of1N400X series. It is a general-purpose rectifying diode that serves its purpose of converting alternating current signals (AC) to direct current signals (DC) in electronic products.

- Pin_1: Anode (+ve)
- Pin_2: Cathode (-ve)

- **MQ2 Gas Sensor:**

*Figure 2.12: MQ2 Gas Sensor*

A Gas Sensor is a device which detects the presence or concentration of gases in the atmosphere. It works by changing the resistance of the material inside the sensor based on the gas concentration, which can be measured as output voltage.

- Pin 1: VCC (+ve)
- Pin 2: Ground (-ve)
- Pin 3: Dout

# Chapter 3: Hardware Proteus Simulations

## 1. Integrated Circuits:

- **Light Automation using Switch (Manual):**

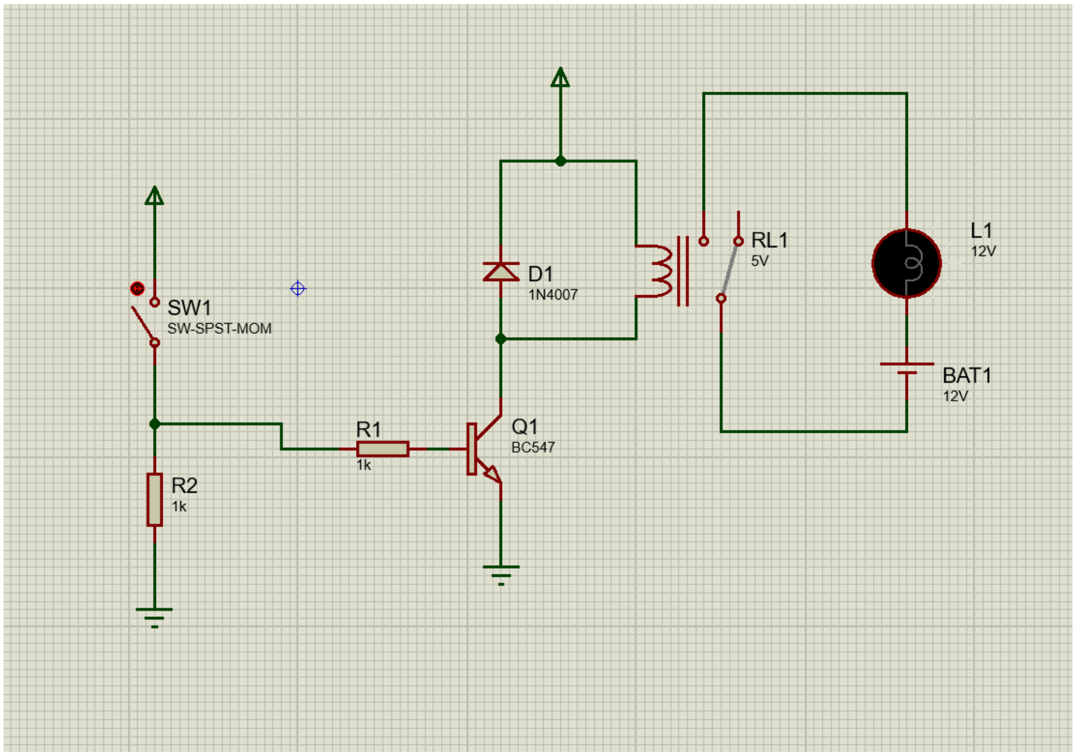


*Figure 3.1: Light Automation using Switch (Manual) Circuit Diagram*

**Components Used:**
Arduino UNO, Switch (SPST), Resistor, Diode, Transistor, Relay, Bulb.

**Working:**
This provides Manual Automation of Light. Based on user requirement, he/she can switch ON/OFF the bulb anytime.

| Sr No. | Switch Status | Result |
|---|---|---|
| **1.** | Pressed | Bulb Glows. |
| **2.** | Released | Bulb doesn’t Glow. |

- **Light Automation using IR Sensor (Automatic):**

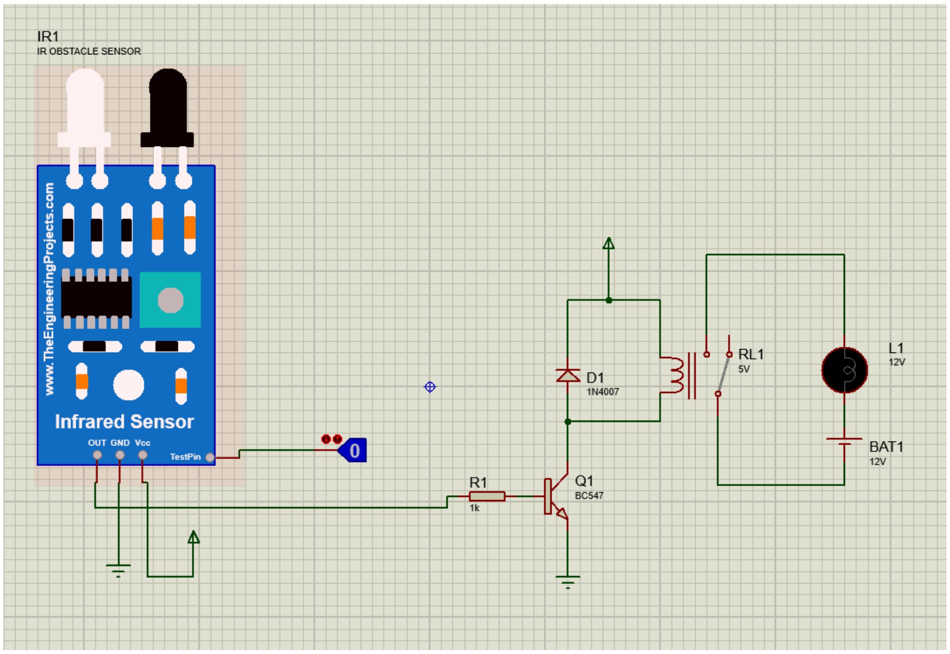


*Figure 3.2: Light Automation using IR Sensor (Automatic) Circuit Diagram*

**Components Used:**
Arduino UNO, Logic State, IR Sensor, Resistor, Diode, Transistor, Relay, Bulb.

**Working:**
IR Sensor is used for detection of Motion present, if the motion is detected, then automatically the bulb available in the room should be turned ON, and if no motion is detected, then the bulb should be turned OFF as such

| Sr No. | IR Logic State | Result |
|---|---|---|
| **1.** | HIGH | Motion Detected and hence Bulb Glows. |
| **2.** | LOW | No Motion Detected and hence Bulb doesn't glow. |

- ## Fire Alarm System:

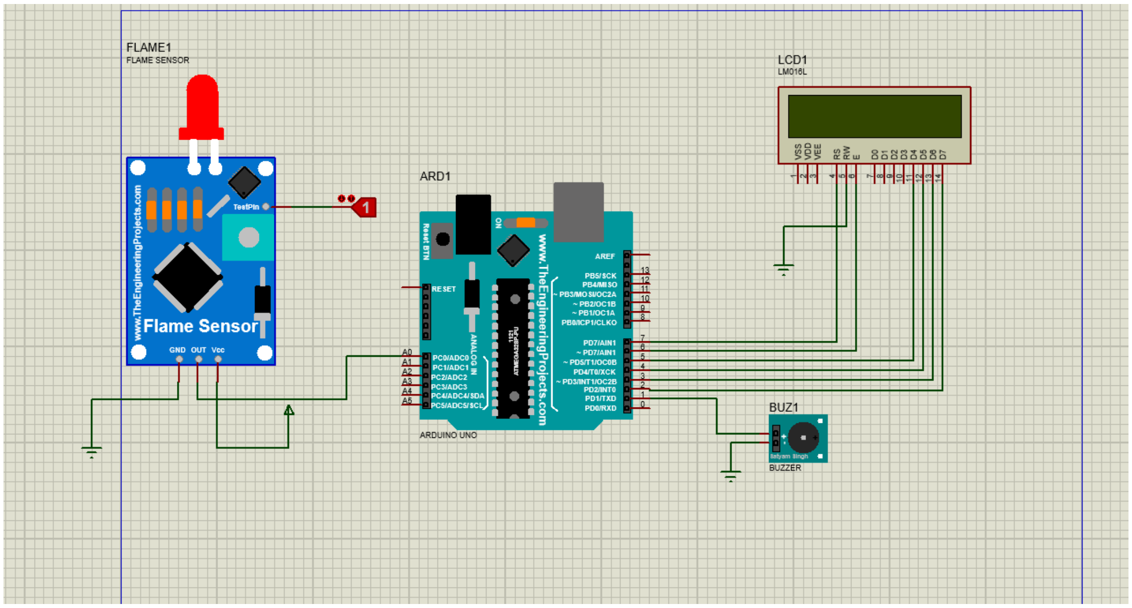


*Figure 3.3: Fire Alarm System Circuit Diagram*

**Components Used:**
Arduino UNO, Buzzer Module, LCD Module, Flame Sensor, Logic State.

**Working:**
LCD is used to display the message of Fire Detected/Not Detected. Flame Sensor is used to detect the presence of Fire. Buzzer is used as an indicating purpose and beeps, if fire is detected, else it is not providing a beep sound as such.

| Sr No. | Logic State | Result |
|---|---|---|
| **1.** | HIGH | Fire Detected Message displayed on LCD and Buzzer beeps. |
| **2.** | LOW | No Fire Detected Message displayed on LCD and Buzzer doesn't beeps. |

- ## Gas Security System:

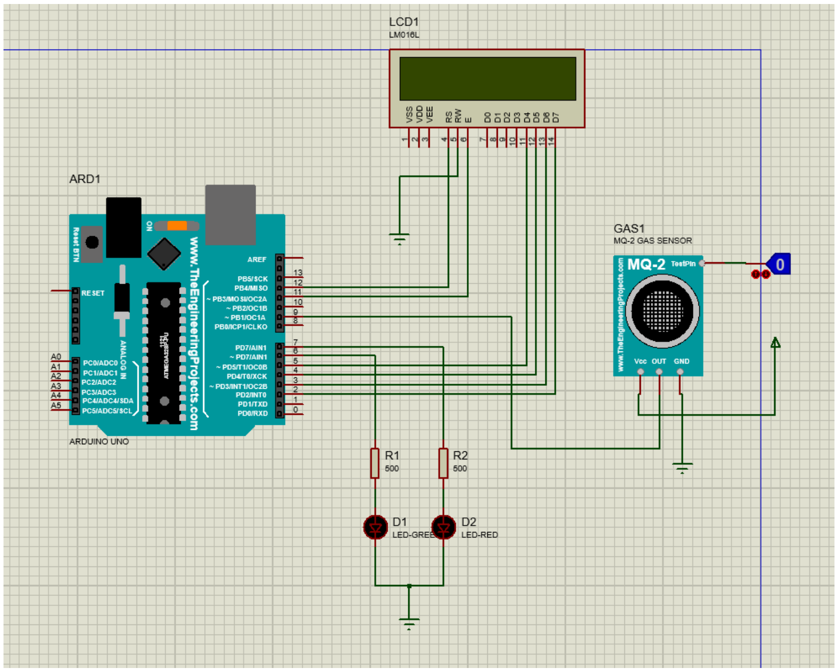

*Figure 3.4: Gas Security System Circuit Diagram*

**Components Used:**
Arduino UNO, LCD Module, MQ2 Gas Sensor, Logic State, Resistors, LEDs.

**Working:**
LCD is used to display the message of Gas Detected/Not Detected. Gas Sensor is used to detect the presence of Gas. LEDs are used for indication purpose. Based on Gas Detected/Not Detected, respective LEDs will glow.

| Sr No. | Gas in Lab | LED Status |
|---|---|---|
| **1.** | Present | Red LED glows, indicating presence of Gas in the room. |
| **2.** | Absent | Green LED glows, indicating absence of Gas in the room. |

- **Fan Automation using Switch (Manual):**

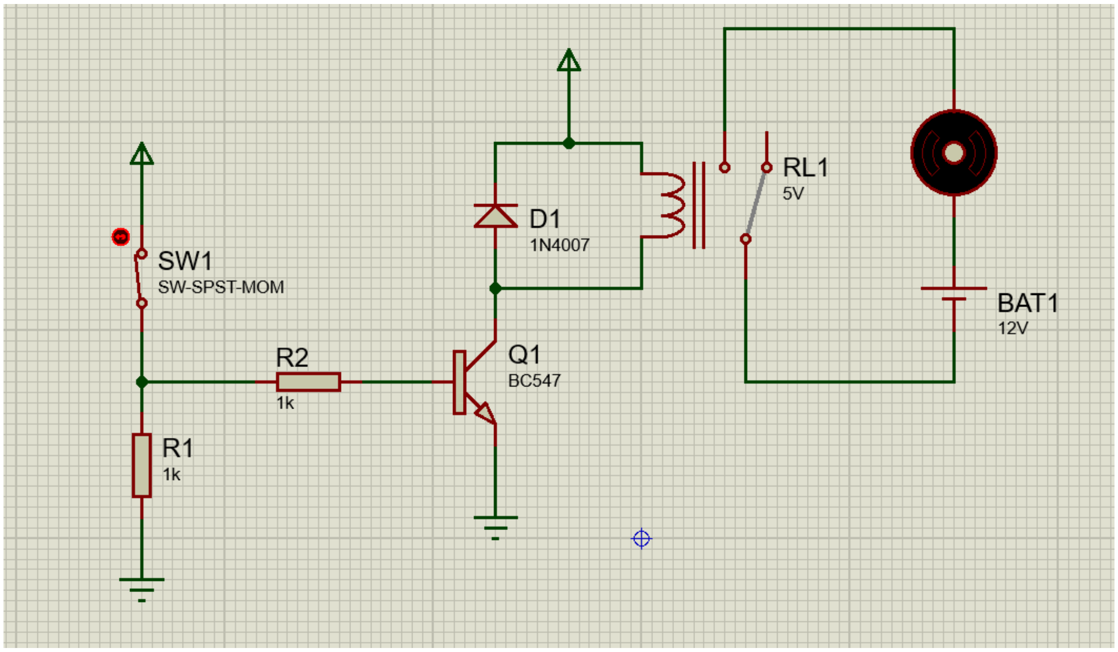


*Figure 3.5: Fan Automation using Switch (Manual) Circuit Diagram*

**Components Used:**
Switch (SPST), Resistor, BC547 Transistor, Diode (1N4007), Relay Module, Cell.

**Working:**
This provides Manual Automation of Fan. Based on user requirement, he/she can switch ON/OFF the fan anytime.

| Sr No. | Switch Status | Result |
|---|---|---|
| 1. | Pressed | Fan Starts |
| 2. | Released | Fan Stops |

- **Lab Count Display System:**

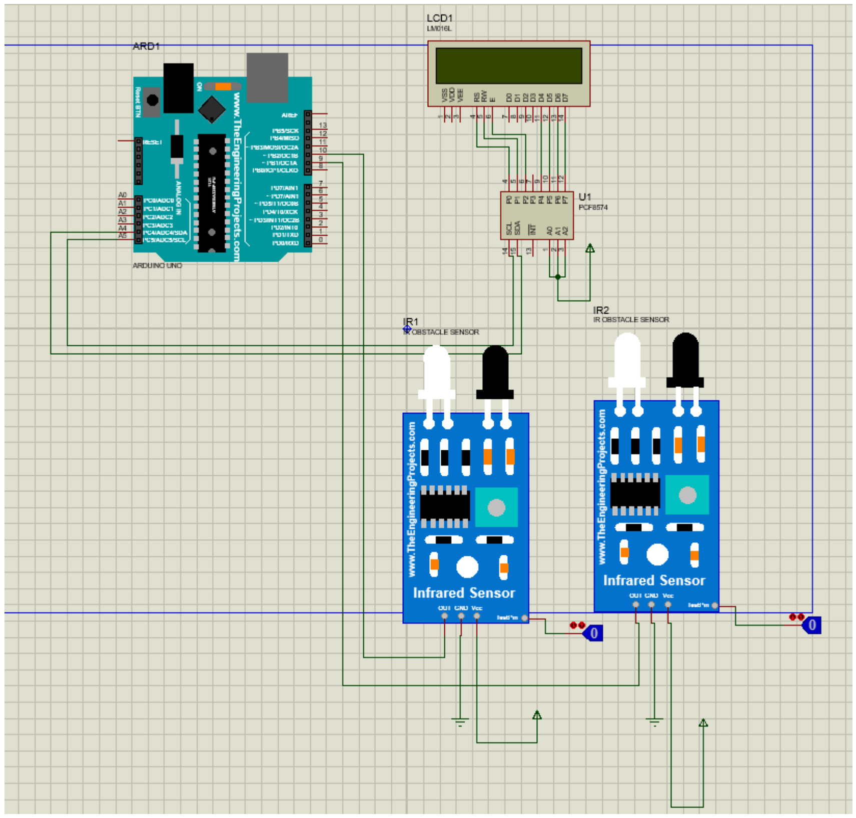


*Figure 3.6: Lab Count Display System Circuit Diagram*

**Components Used:**
Arduino UNO, I2C Module, LCD Module, IR Sensor, Logic States.

**Working:**
Provides the count of students available in the Lab. SN1 is used to detect **Entry of Student** while SN2 is used to detect **Exit of Student.**

| Sr No. | SN1 Status | SN2 Status | Result |
|---|---|---|---|
| 1. | Not Detects Person | Not Detects Person | No Movement Recorded |
| 2. | Not Detects Person | Detects Person | Student Exiting |
| 3. | Detects Person | Not Detects Person | Student Entering |
| 4. | Detects Person | Detects Person | Student Entering and Exiting Simultaneously |

- **NodeMCU-Arduino-Server Integration:**

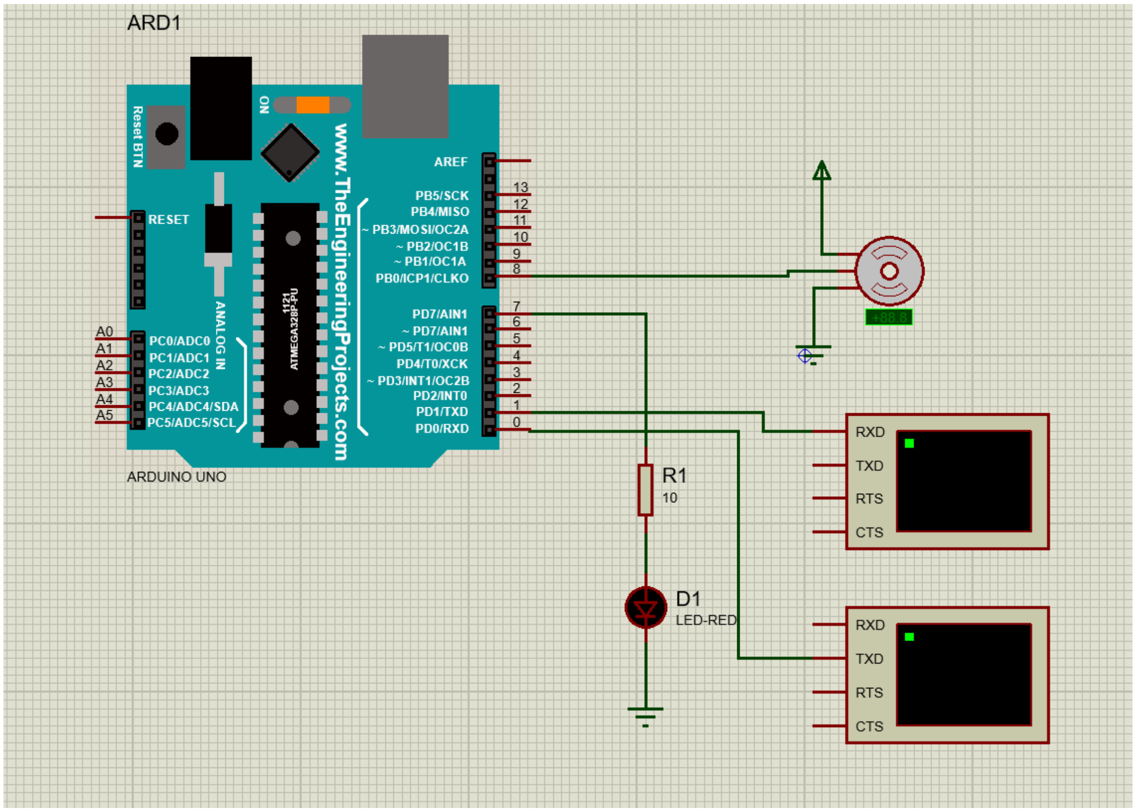


*Figure 3.7: NodeMCU-Arduino Server Circuit Diagram*

**Components Used:**
Arduino UNO, Virtual Terminal, LED, Resistors, Servo Motor.

**Working:**
UART Protocol is used to establish connectivity in between NodeMCU and Arduino UNO Board. Here, the Virtual Terminals are used for display purpose and represent NodeMCU for sending data. Based on the data received, student authentication will take place and action to be implemented upon the Servo Motor.

| Sr No. | User Validity | Servo Motor Status |
|---|---|---|
| **1.** | Unauthenticated User | Servo Motor Don’t Rotate. |
| **2.** | Authenticated User | Servo Motor Rotates. |

## 2. Final Proteus Circuit:

- **With Controller Proteus Diagram:**

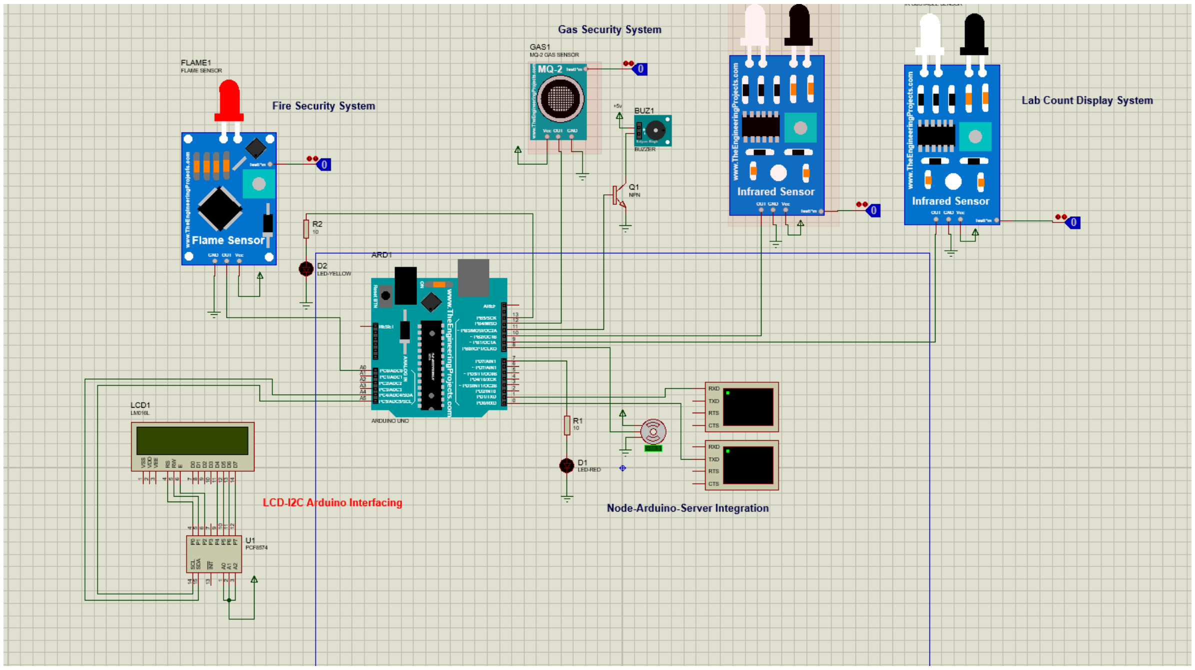


*Figure 3.8: Final Proteus Schematic Diagram with Controller*

**Components Used:**
Arduino UNO, Flame Sensor, MQ2 Gas Sensor, IR Sensors (Entry and Exit Detection), NodeMCU (ESP80266 Module), LCD Module, I2C Module, LEDs, Buzzer, Resistors.

**Systems Configured and Used:**

| Sr No. | Systems Used |
|---|---|
| **1.** | Fire Alarm System |
| **2.** | Gas Security System |
| **3.** | Node-MCU Arduino Server Integration |
| **4.** | Lab Count Display System |

- **Without Controller Proteus Diagram:**

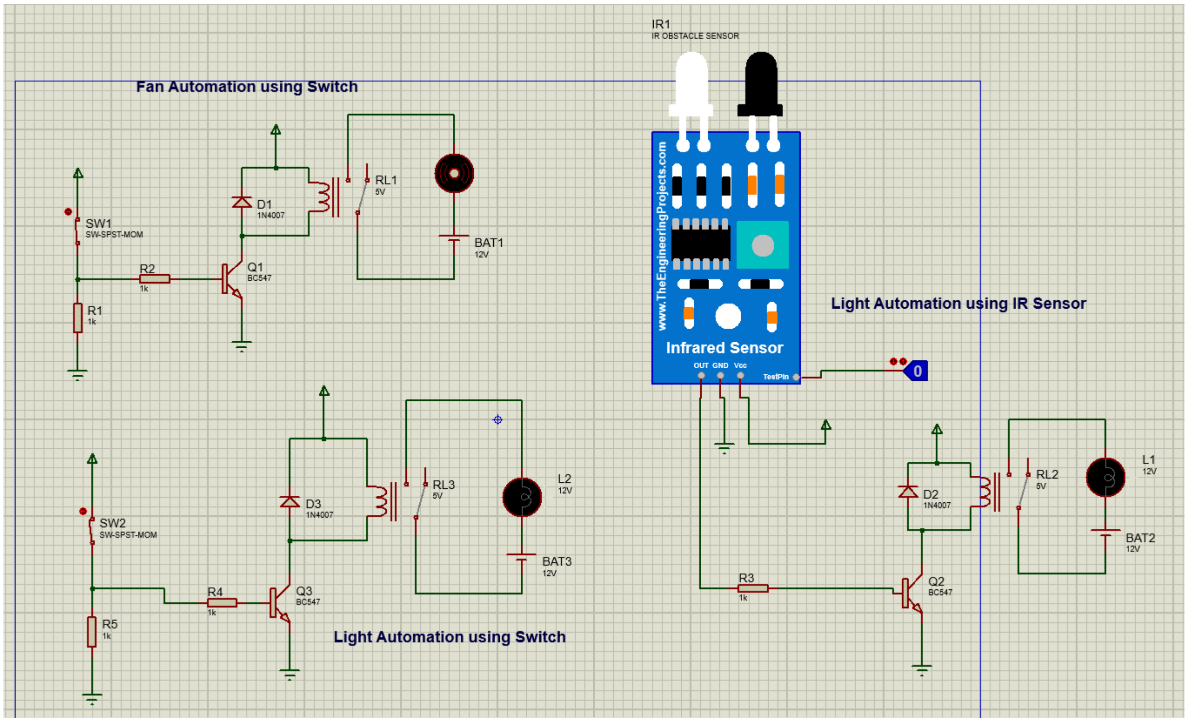


*Figure 3.9: Final Proteus Schematic Diagram without Controller*

**Components Used:**
Switch, Push Button, Resistors, BC547 Transistor, Relay Module, 1N4007 Diode, Fan Module, AC Bulb, IR Sensor, 9V Battery.

**Systems Configured and Used:**

| Sr No. | Systems Used |
|---|---|
| **1.** | Fan Automation using Switch |
| **2.** | Light Automation using Switch |
| **3.** | Light Automation using IR Sensor |

# Chapter 4: Software Part of the Project

## 1. Overview

The Software Part of the project involves the Authentication of students and admins so as to provide entry to them in the laboratories. For the students, there is a Two Step Verification Procedure, including the Student Authentication followed by Face Recognition. Once both these are validated, student will be provided entry into the laboratory, while his/her entry getting recorded in the database.

Admin is also validated and based on that, entry is given to him. Also, admin has the facility to add any new student or modify/delete existing student from the database. Also, he gets an idea of the exact number of entries of students those who have entered into the laboratory.

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## 2. Technology Stack

- **Frontend Technologies:** HTML, CSS, Javascript
- **Backend Technologies:** Django, Python 3
- **Libraries Used:** face_recognition, open-cv
- **Database Used:** dbsqlite3

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## 3. Database Schematic Diagram

| **Sr No.** | **Database Attributed** | **Datatype** |
|---|---|---|
| **1.** | Student_ID | Varchar |
| **2.** | Student_Username | Varchar |
| **3.** | Password | Varchar |

*Figure 4.1: Software Database Schematic*

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# 4. Block Diagram:

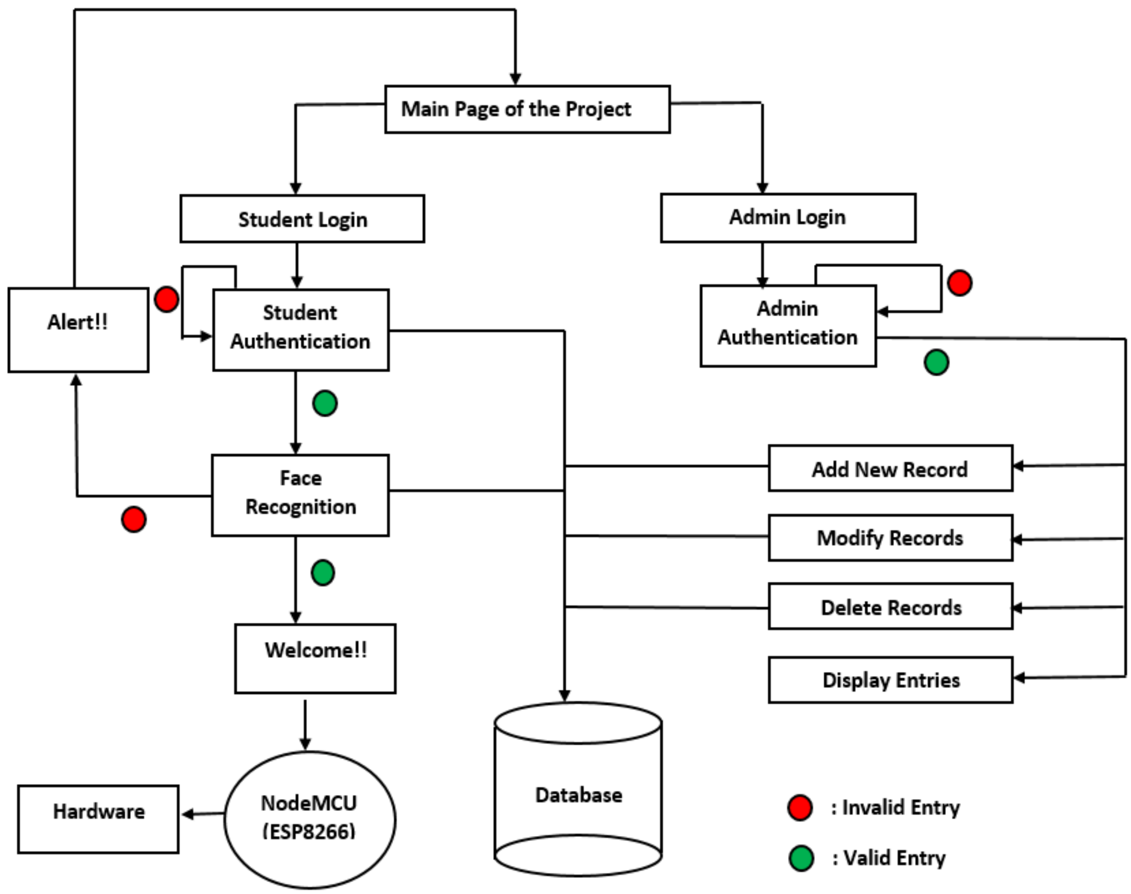


*Figure 4.2: Software Block Diagram*

- ## Main Page of the System:

The Project's Main Page comprises two distinct login interfaces: one for students and another for admin. These interfaces are developed using frontend technologies, including HTML, CSS, and JavaScript, ensuring user-friendly and intuitive access points.

- ## Student Login Process:

Upon entering their credentials, students' data, including Username and Password, undergoes initial verification against the meticulously maintained database curated by the admin. If successful, a second-level verification utilizing a machine learning-based facial recognition algorithm is initiated. In the event of a mismatch, an alert is promptly generated, flagging the entry as invalid. Upon successful authentication, students gain access to the laboratory, streamlining the entry process and bolstering security measures.

- **Admin Login Process:**

  The Admin panel is a designated interface accessible exclusively to course instructors or administrators. Within this panel, instructors wield a range of powerful tools to manage student records. They have the capability to add new entries, modify existing records, and even remove outdated or inaccurate information. This level of control empowers instructors to maintain an accurate and up-to-date database, ensuring that only authorized individuals have access to the laboratory.

  Furthermore, the admin panel offers a comprehensive overview of all student entries via seamless integration with the database. This provides instructors with a detailed and organized view of all individuals with access privileges, facilitating effective oversight and management.

- **Software to Hardware Integration (Using NodeMCU) Process:**

  Upon successful student authentication, the webpage redirects to the NodeMCU-hosted platform. From there, a signal is dispatched to the Arduino, enabling the door automation system through collaboration with the IR sensor data. Subsequently, upon clicking the "complete" button on the NodeMCU interface, the webpage transitions back to the main application's homepage, ensuring a seamless user experience and effective integration between systems.

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# 5. Various Views Explanation:

- **Main Page View:**
  - Users start at Home Page, where he will get two options: **Student Login & Admin Login.**
  - Student will choose **Student Login Option** while Admin will choose **Admin Login Option.** Once done, they will be directed to the respective Login Pages.

- **Student View:**
  - Students have to enter their **login credentials (Student ID and Password),** for **Student Authentication.**
  - If Authentication found to be **invalid**, then they will be redirected onto the same page.
  - If Authentication found to be **valid**, they will be redirected to the **Face Recognition Page,**
    - The Face Image will be captured, and it will be compared the images stored in database.
    - If matched, then **Authentication is Successful** and message will be sent to Hardware.
    - If not matched, then **Authentication is Failed,** and the student will be redirected Home Page.
  - By default, in the project, **some entries** have been already added, the credentials of the same have been listed in **Chapter 5.**

- **Admin View:**
  - Admin have to enter the **login credentials** on the admin login page. If the username and password matches and correct then the admin can see the details of the students and have access of the data of the students
  - By Default, there is only **1 Admin** for this project, having credentials:
    - **UserID: admin@123**
    - **Password: admin@123**
  - When admin login, then the admin can see the list of the students along with credentials like **student_id, username, password.**
  - Admin have access to **edit the details** of the particular student if he wants.
  - If a student **data need to be added**, then the admin has access to do it.
  - Admin has the access to **delete the data** of the particular student.

- **NodeMCU Software-Hardware Integration View:**
  - Upon Successful **Student Authentication,** the webpage redirects to the **NodeMCU Hosted Platform.**
  - From there, a signal is **dispatched** to the **Arduino,** enabling the Door Automation System through collaboration with the IR Sensor Data.
  - Subsequently, upon clicking the **complete button** on the NodeMCU Interface, the webpage transitions back to the main application's homepage, ensuring a seamless user experience and effective integration between systems.

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# Chapter 5: Software Views Demonstration

## 1) Main Page View:

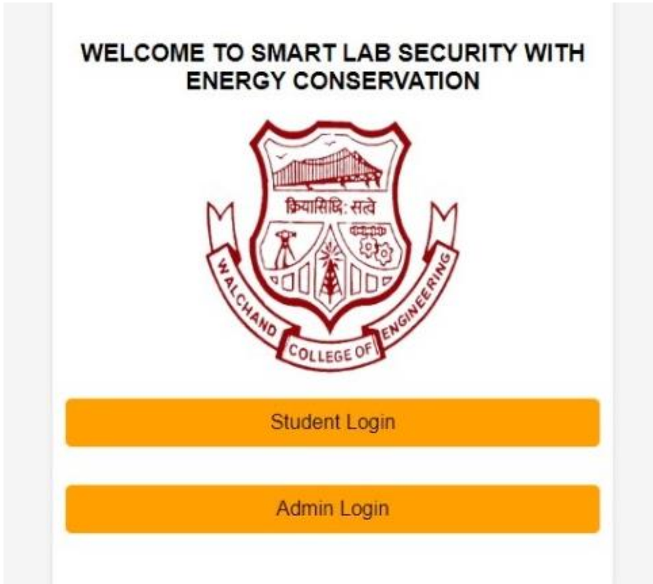


*Figure 5.1: Main Page of the Project*

## 2) Student Authentication Page:

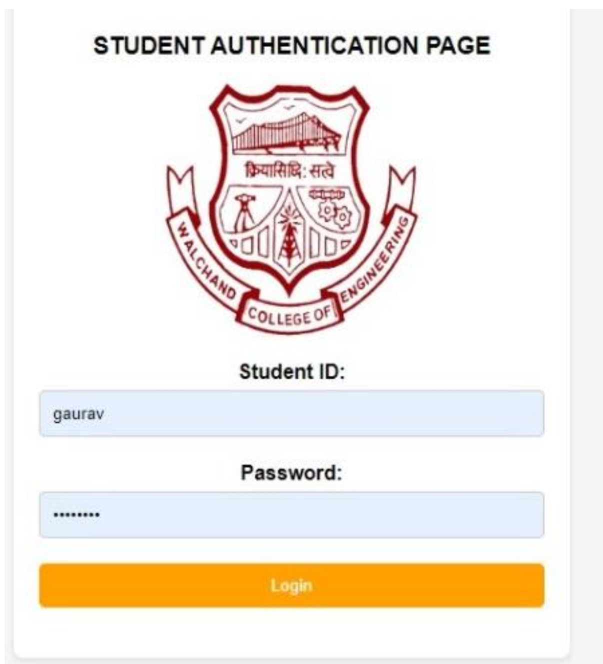


*Figure 5.2: Student Authentication Page*

## 4) Face Recognition System:

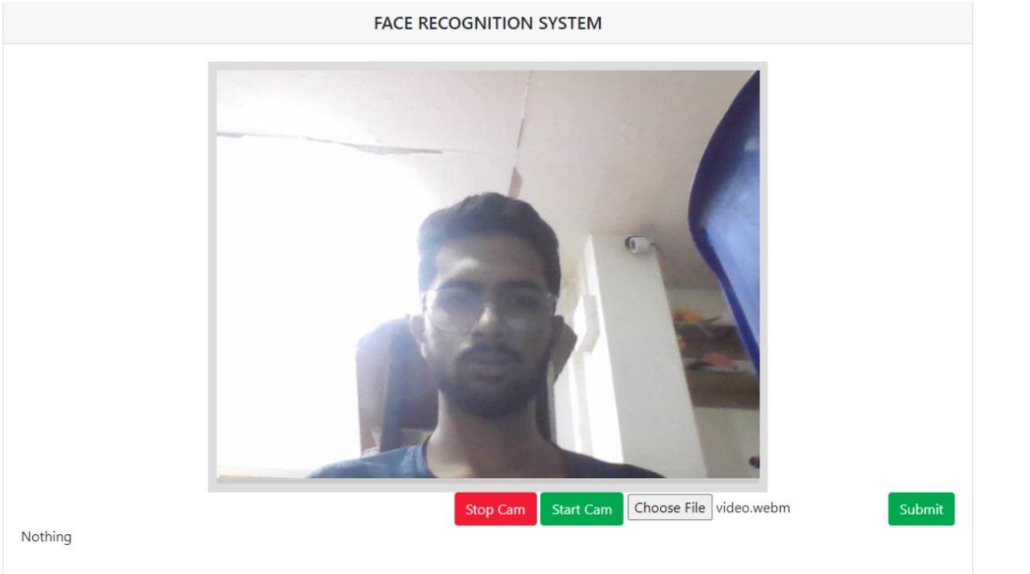


*Figure 5.3: Face Recognition System Page*

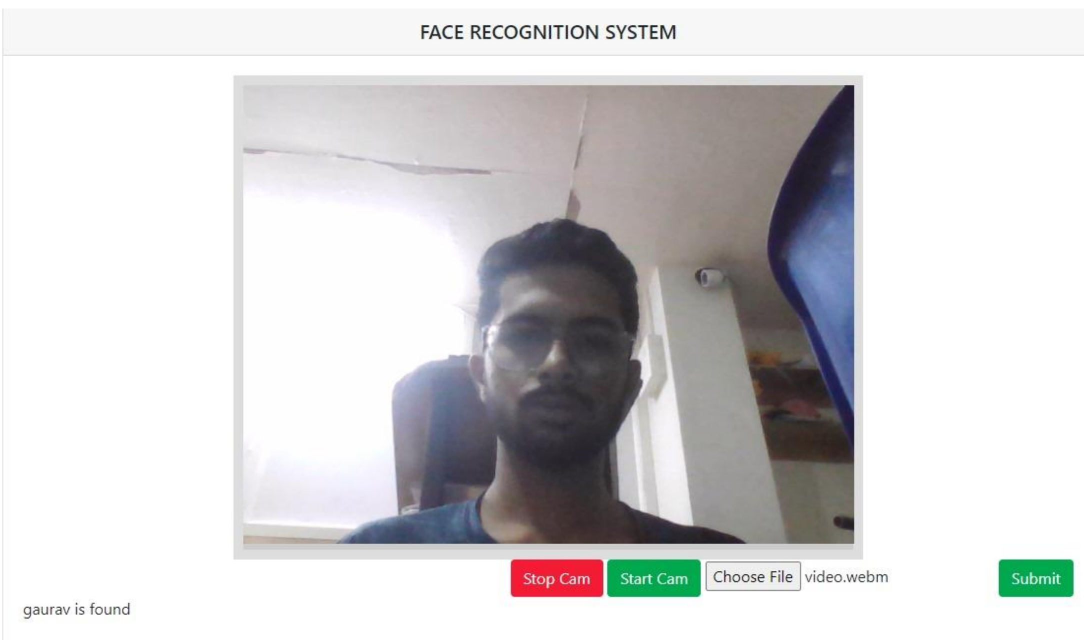


*Figure 5.4: Face Authentication Successful*

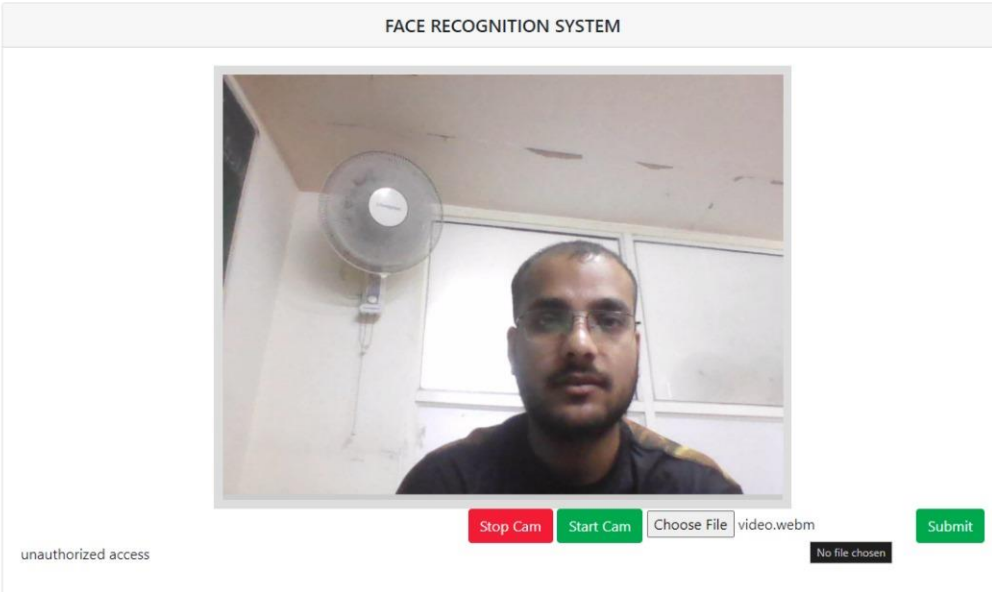


*Figure 5.5: Face Authentication Unsuccessful*

## 5) Admin Authentication Page :

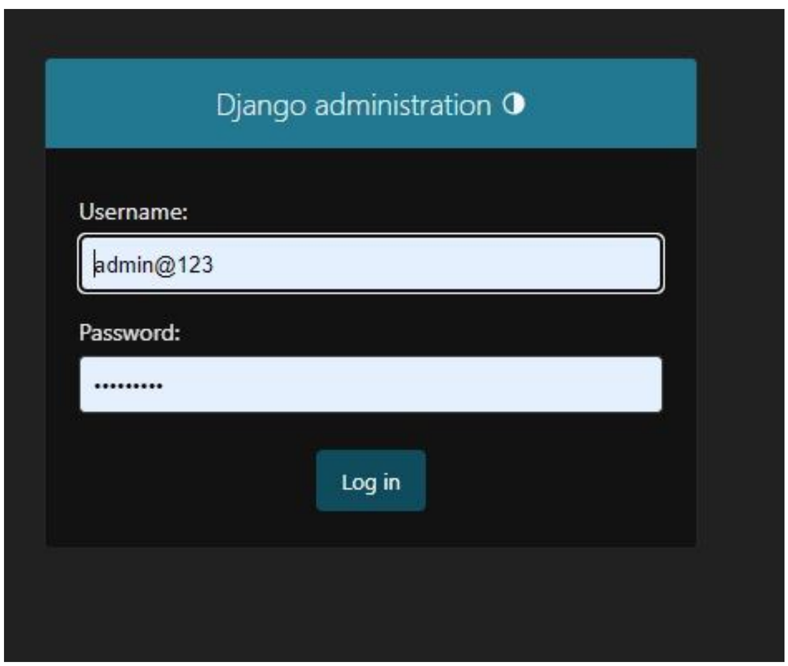


*Figure 5.6: Admin Authentication*

## 6) Admin Database Schematics:

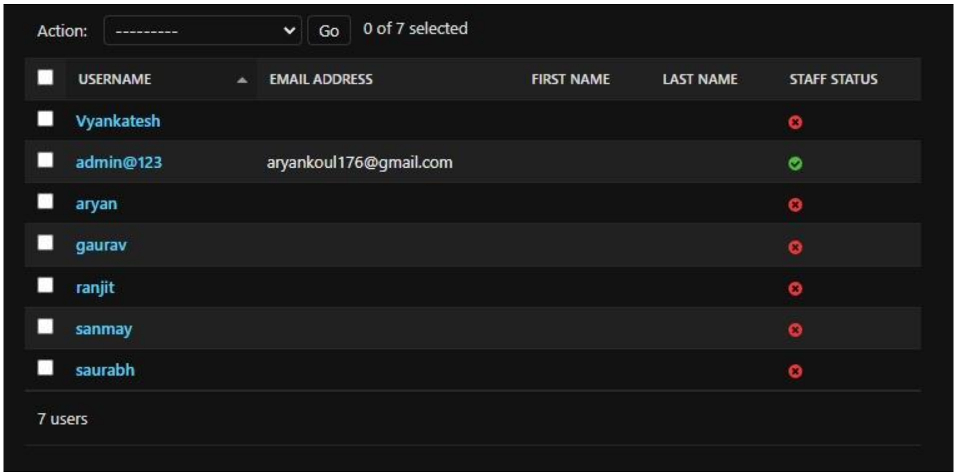


*Figure 5.7: Initial Entries in the Database*

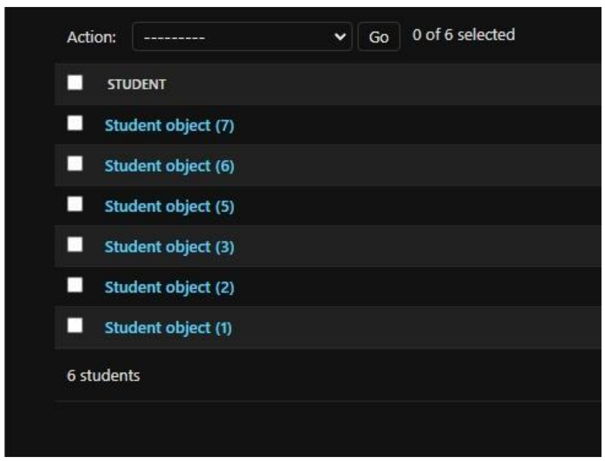


*Figure 5.8: Entries represented as objects*

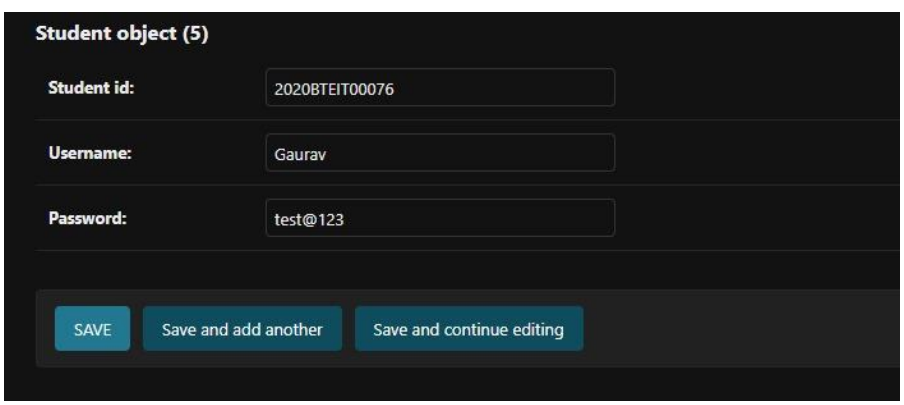


*Figure 5.9: Object Representations*

## 7) Admin Adding a student:

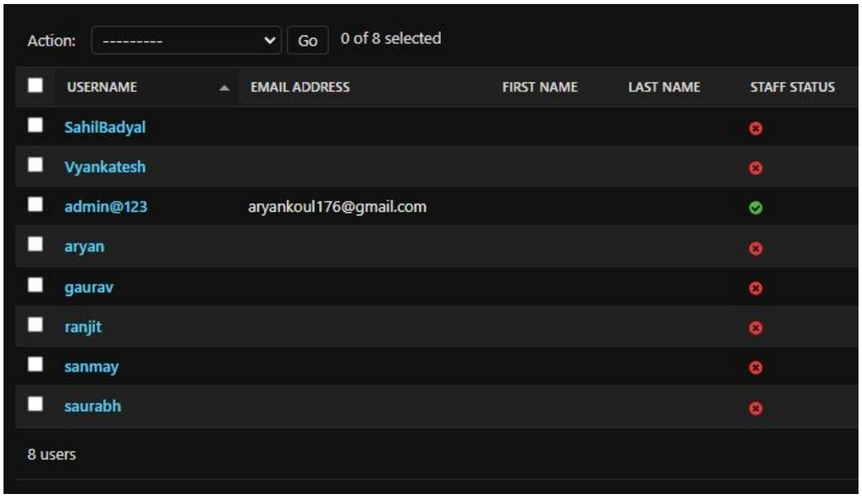


*Figure 5.10: Student Added in the Database*

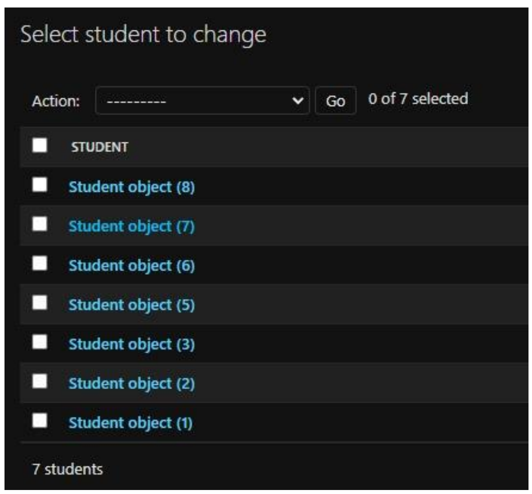


*Figure 5.11: New Object Created*

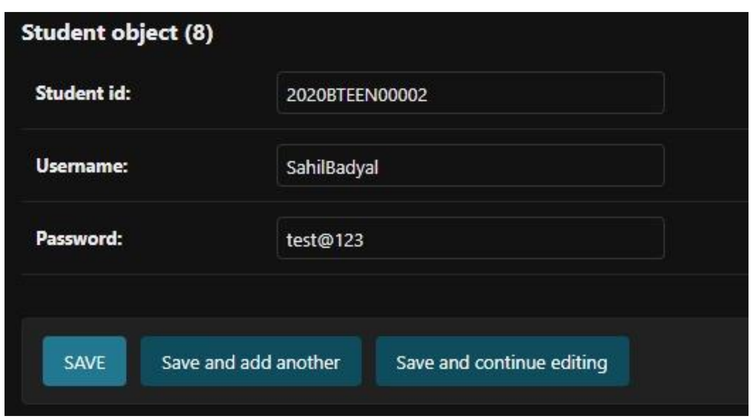


*Figure 5.12: New Student Details*

## 8) Admin Modifying Student Details:

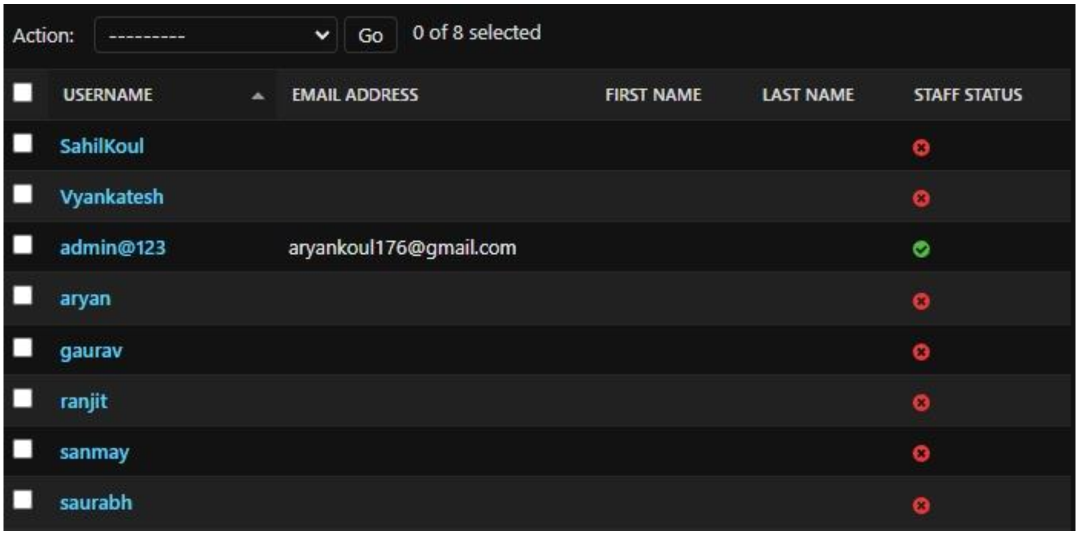


*Figure 5.13: Admin Modifying Student*

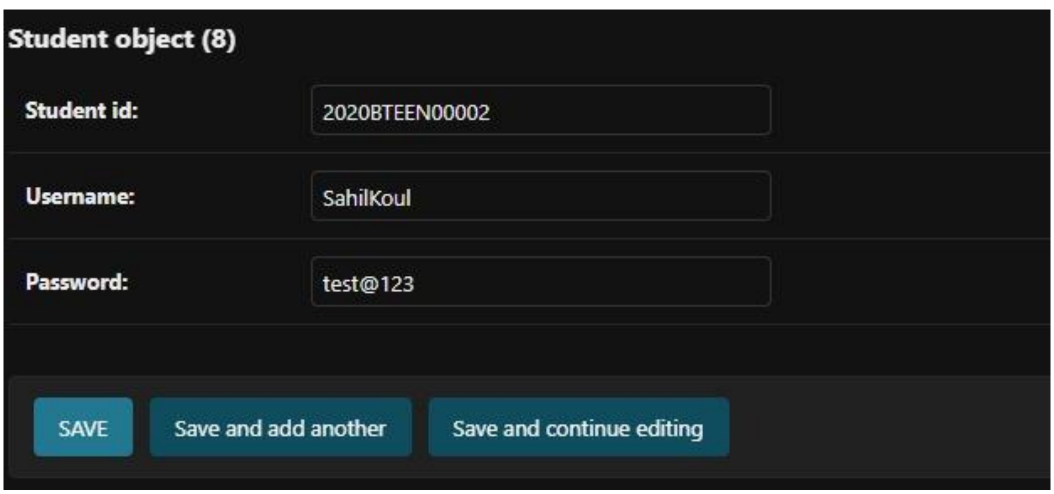


*Figure 5.14: Modified Student Details*

## 9) Admin Deleting Student:

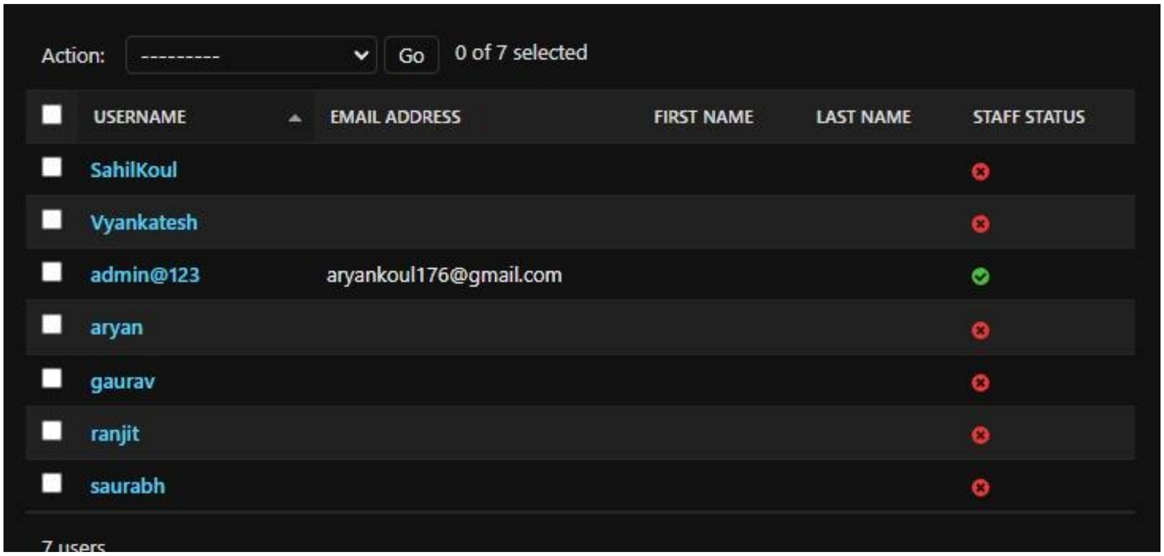


*Figure 5.15: Admin Deleting Student*

## 10) NodeMCU Software Integration Page:

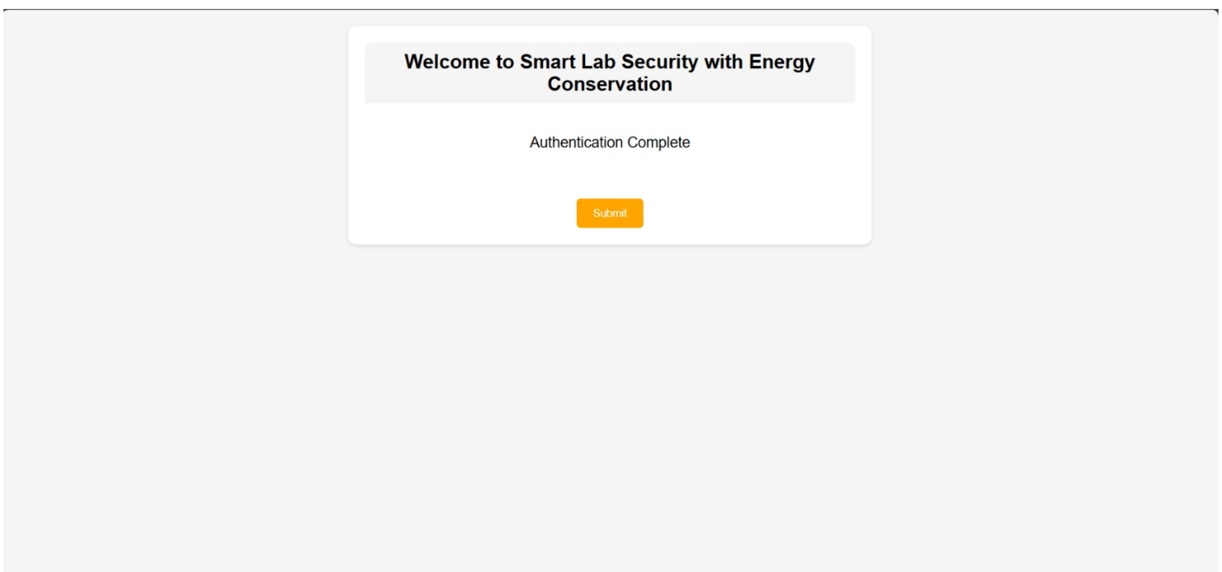


*Figure 5.16: Integration Page which arrives upon after successful completion of Authentication*

# Chapter 6: Hardware Kit Demonstration

## 1) Fire Alarm System:

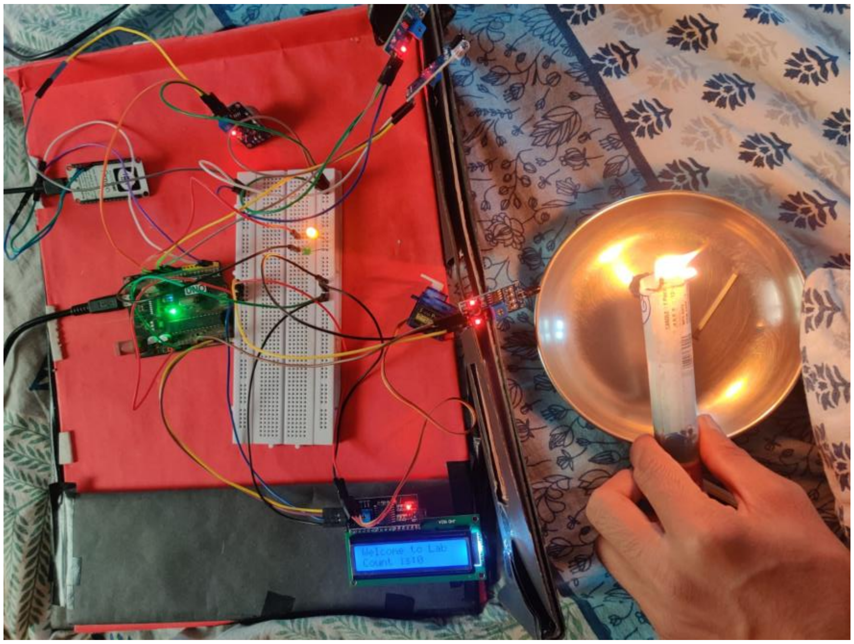

*Figure 6.1: LED Glowing when Fire Sensed*

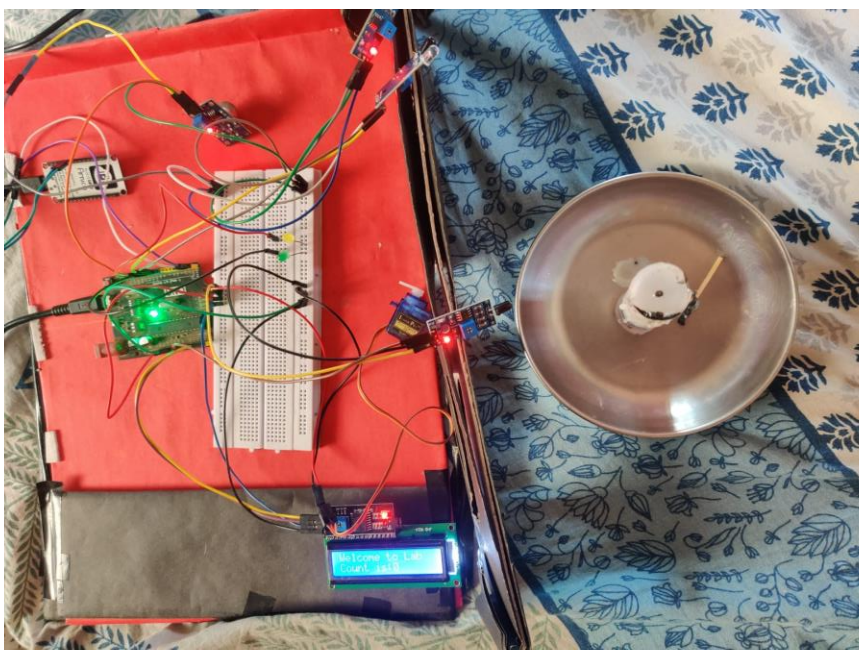

*Figure 6.2: LED stops Glowing when Fire Not Sensed*

## 2) Gas Security System:

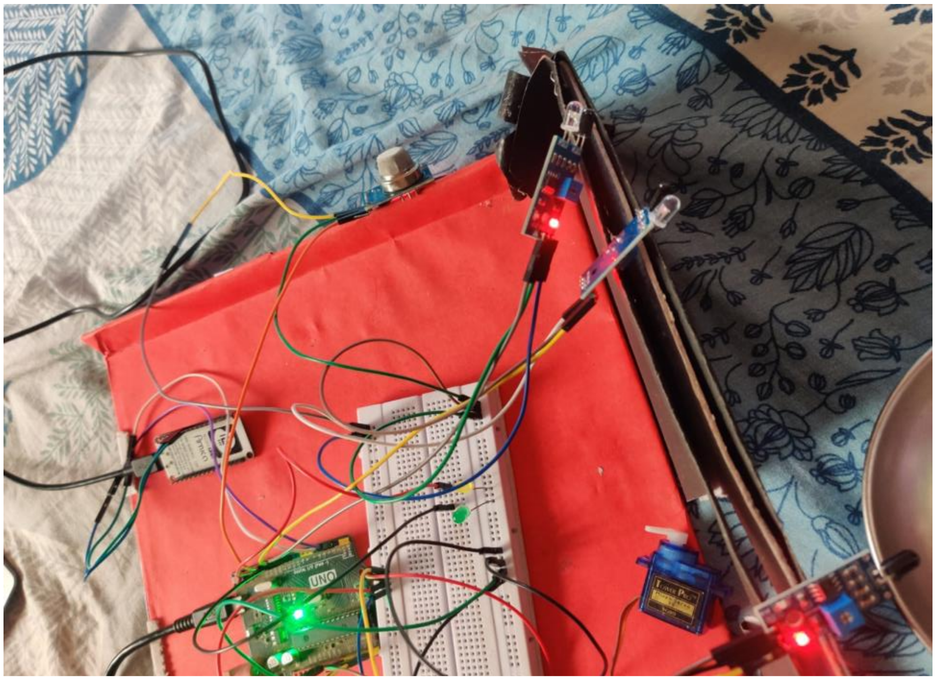


*Figure 6.3: Green LED Not Glowing when Gas Not Sensed*

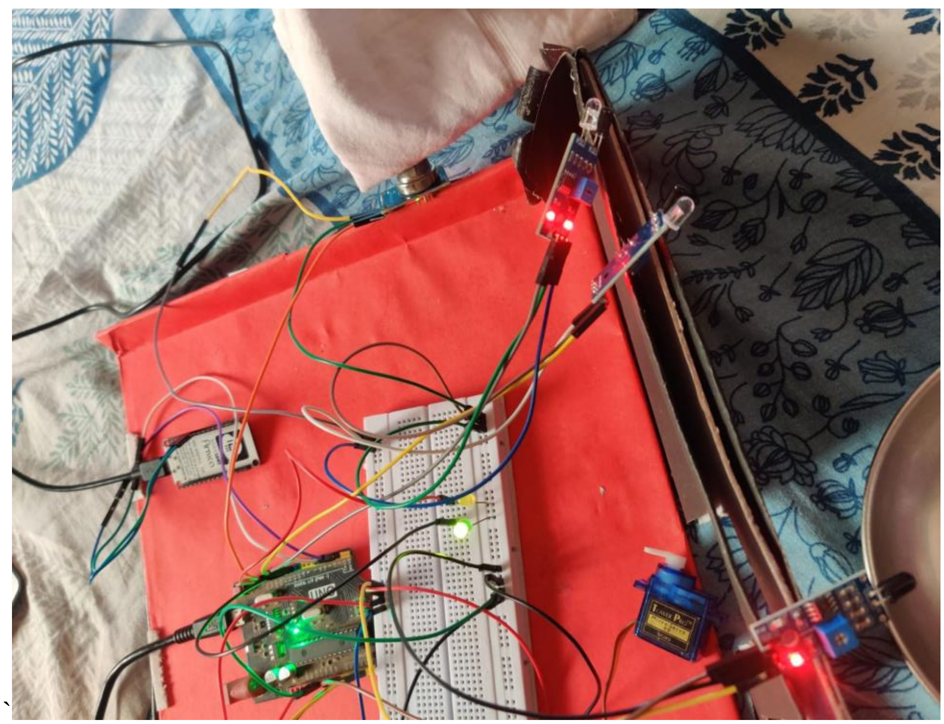


*Figure 6.4: Green LED Glows when Gas Sensed*

## 3) Lab Count Display System:

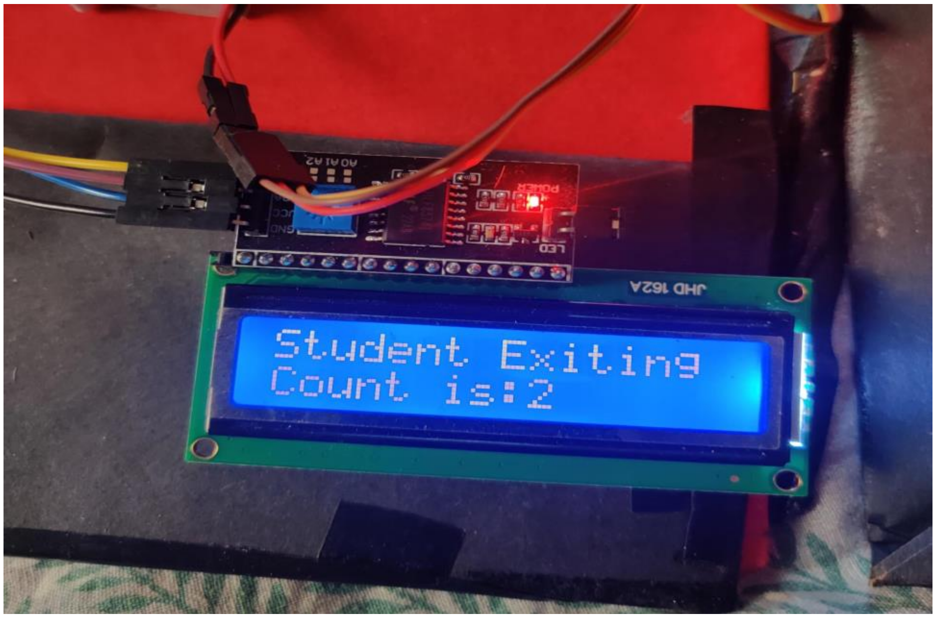


*Figure 6.5: Message of Student Exiting displayed whenever students leaves the laboratory after successfully getting sensed by Exit IR Sensor*

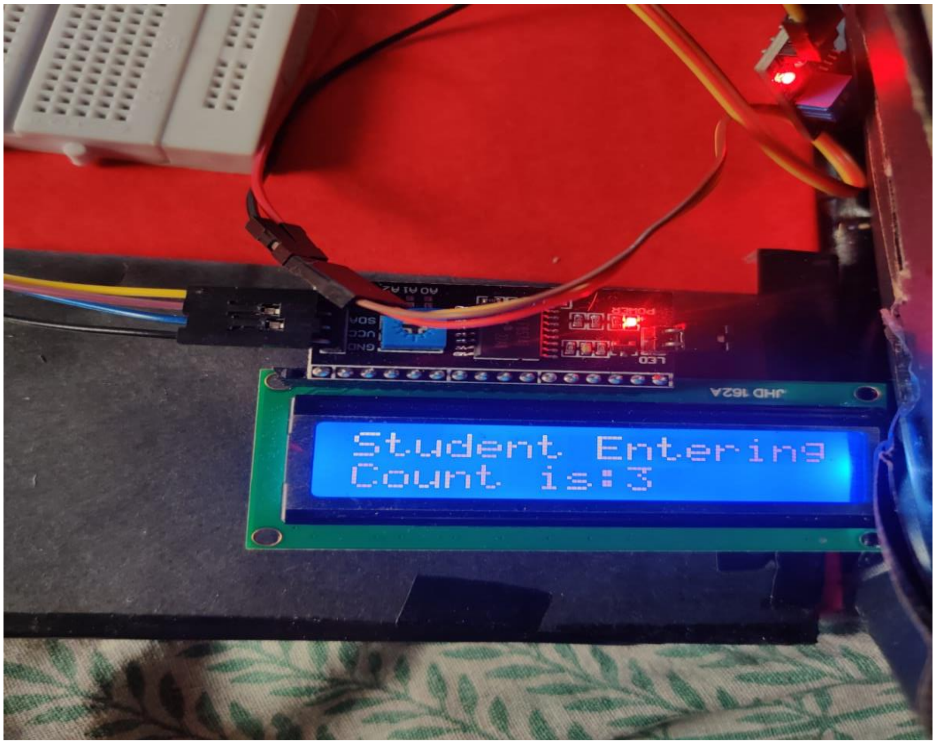


*Figure 6.6: Message of Student Entering displayed whenever student enters the laboratory after successful getting sensed by Entry IR Sensor*

**4) With Controller Entire Circuit Configurations:**

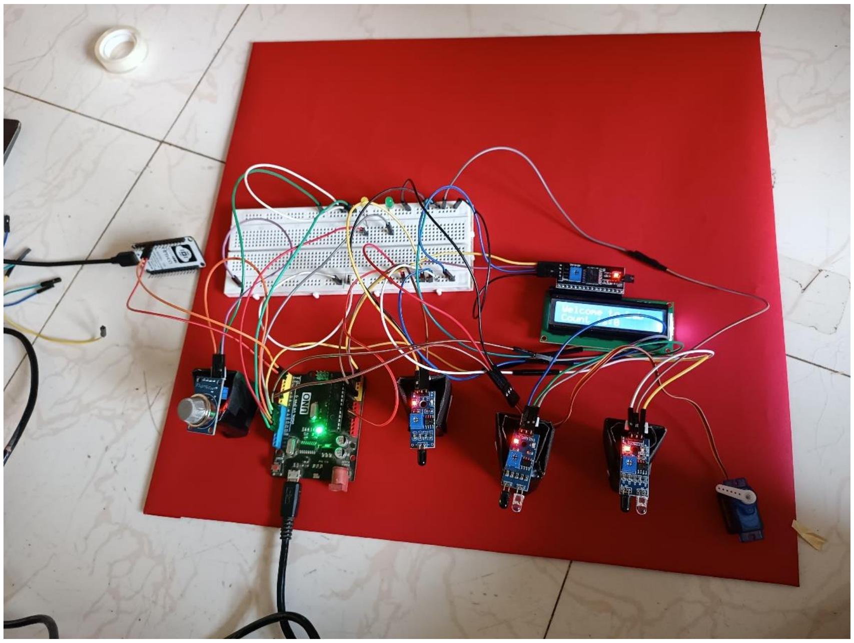

*Figure 6.7: Circuit Configurations with Controller*

**5) Without Controller Entire Circuit Configurations:**

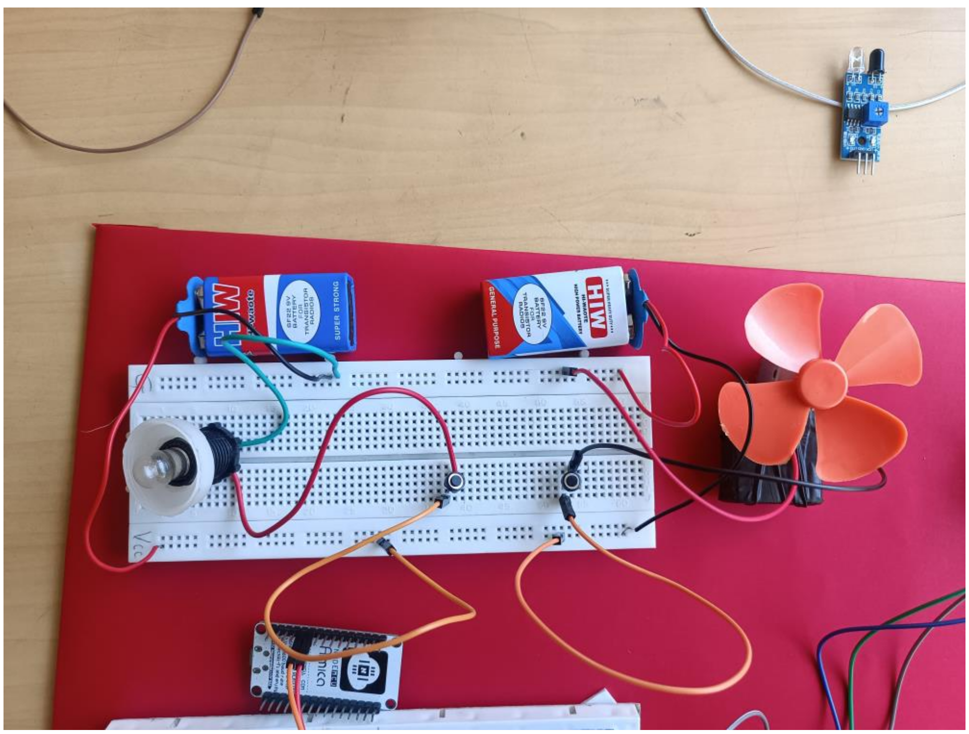

*Figure 6.8: Circuit Configuration without Controller*

## 6) Entire Project Schematics:

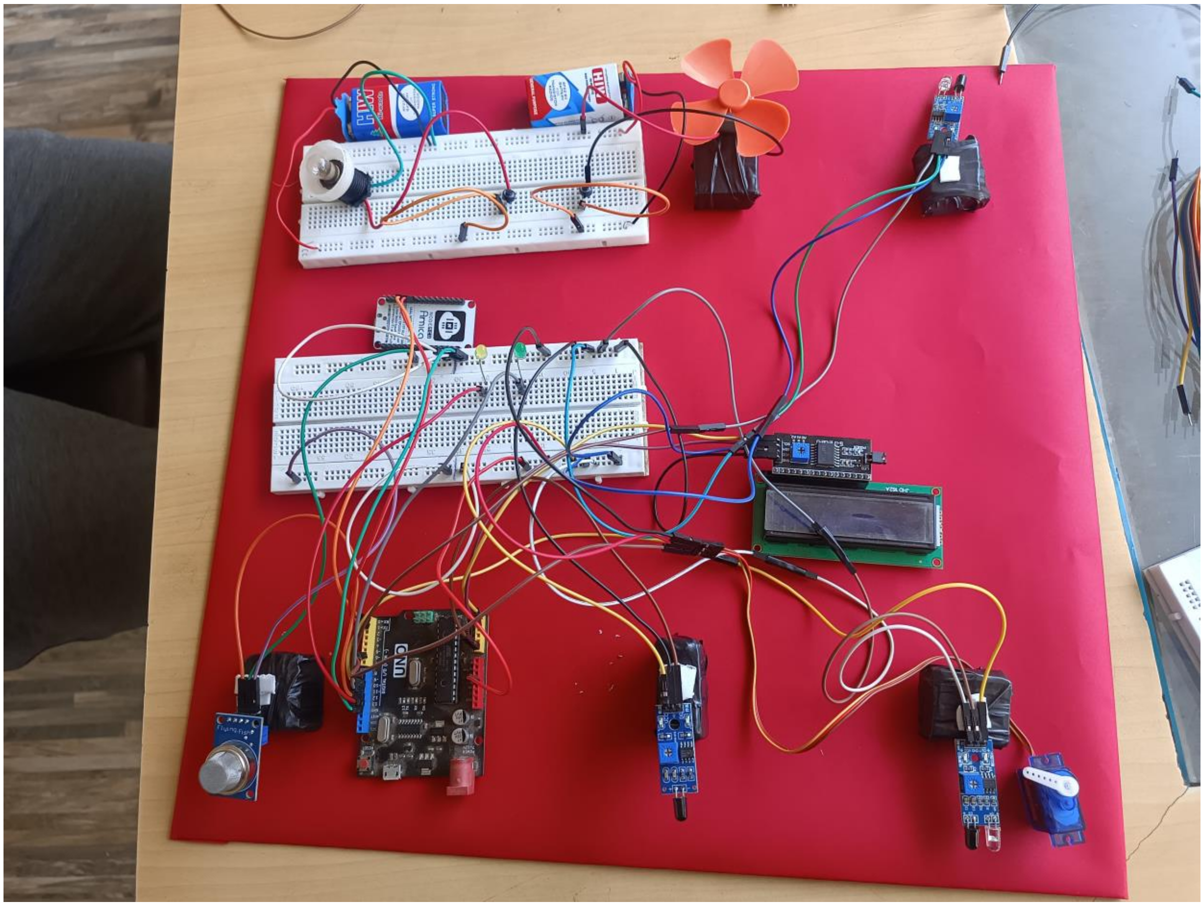

*Figure 6.9: Entire Circuit Schematics*

# Chapter 7: Conclusion and Future Scope of the Project

## 1. Conclusion

The **'Smart Lab Security with Energy Conservation**' project presents a smart solution to the challenges faced by modern lab in the colleges. By integrating advanced technologies such as authentication systems, sensors, and energy-efficient appliances, our system not only enhances security and safety but also promotes sustainability. The inclusion of features like face verification for student access and an admin panel for teacher control adds a layer of convenience and efficiency to lab management. Overall, our project embodies the fusion of innovation, security, and environmental responsibility, paving the way for smarter and greener lab operations. Overall project is to be made with the help of the software as well as the hardware components which make the project more efficient providing safety and security to the lab.

## 2. Limitations of the Project

- **Complexity for Users:**
Using the system might be a bit tricky for some people, especially if they're not familiar with technology.
- **Maintenance Needs:**
Like any system, ours will need regular updates and maintenance, which could cost time and money.
- **Dependence on Technology:**
If there's a power outage or a tech glitch, our system might not work until the issue is fixed. Familiar with technology.
- **Complexity Limited Functionalities:**
While our system does a lot, there might be other things labs need that it doesn't cover yet, like handling certain types of emergencies or specific lab setups.

## 3. Future Scope

In the future, we can improve our project by using smarter technology. For example, we could make our system better at recognizing people and understanding their behavior to enhance security. We might also add features that predict when lab equipment needs maintenance, which can save time and money. Exploring new ways to save energy, like using wind or motion power, could make our system even more eco-friendly. Improving the admin panel with helpful tools for teachers could also make managing the lab easier. Overall, there are many exciting possibilities to make our project even better in the future.

# Chapter 8: Time Plan Followed

| Sr No. | Work/Activity | Month |
|---|---|---|
| Semester 7th (August 2023 to December 2023) | | |
| **1.** | Selection of Project | August 2023 |
| **2.** | Submission of Synopsis | August 2023 |
| **3.** | Division of Members among Hardware and Software Leads. | September 2023 |
| **4.** | Submission of Component List | October 2023 |
| **5.** | LA2 Presentation | November 2023 |
| **6.** | Final ESE Presentation and Submission of Report | December 2023 |
| Semester 8th (January 2024 to May 2024) | | |
| **7.** | LA1 Presentation | February 2024 |
| **8.** | LA2 Presentation | April 2024 |
| **9.** | Hardware – Software Integration<br>(Proteus Simulation, Actual Kit Testing, Authentication System Testing, Face Verification Portal Designing) | October 2023<br>-<br>May 2024 |
| **10.** | Final ESE Presentation and Submission of Final Report | May 2024 |

# Chapter 9: Cost Estimation of the Project

| Sr. No. | Name of Component | Quantity | Price |
|---|---|---|---|
| **1.** | Arduino UNO | **1** | ₹440.00 |
| **2.** | IR Sensor | **4** | ₹680.00 |
| **3.** | LCD (16 x 2) | **1** | ₹200.00 |
| **4.** | LED | **16** | ₹80.00 |
| **5.** | Resistors | **10** | ₹10.00 |
| **6.** | Transistors (BC547) | **10** | ₹10.00 |
| **7.** | Diode (1N4007) | **10** | ₹10.00 |
| **8.** | Relay (5V) | **4** | ₹80.00 |
| **9.** | Bulb Holder | **4** | ₹60.00 |
| **10.** | AC Bulb | **4** | ₹60.00 |
| **11.** | Servo Motor | **1** | ₹150.00 |
| **12.** | Jumper Wires | **70** | ₹210.00 |
| **13.** | Breadboard | **1** | ₹240.00 |
| **14.** | NodeMCU | **1** | ₹400.00 |
| **15.** | Flame Sensor | **1** | ₹100.00 |
| **16.** | PIR Sensor | **1** | ₹120.00 |
| **17.** | MQ2 Gas Sensor | **1** | ₹150.00 |
| **18.** | DC Motor Fan | **1** | ₹25.00 |
| **19.** | LCD Solder Kit | **1** | ₹10.00 |
| **20.** | I2C Module | **1** | ₹130.00 |
| | | Total | ₹3165.00 |

# Chapter 10: References and Website Links

## References


[1] *Ethan Thorpe, "Arduino: Advanced Methods and Strategies of using Arduino"*, 2020 February 13th.

[2] *Jameson Wetmore, "Technology & Society"*, 2021 August 24th.

[3] *Marco Schwartz, "Arduino: Automate your Home using Open Source"*, 2013 July 13th.

[4] *Kreslmir Delac and Mislav Grgic, "Face Recognition", 2007 June 16th.*

[5] *Zhen Wen, Yonghong Tian and Guodong Guo, "Face Recognition: From Theory to Application"*, 2019 August 19th


## Website Links


1. https://www.theengineeringprojects.com/2018/07/infrared-sensor-library-for-proteus.html/
2. https://www.youtube.com/watch?v=FWvEEtrTGRQ/
3. https://www.youtube.com/watch?v=lK0oIyC76M4/
4. https://www.youtube.com/watch?v=KBnENMTY_C0/
5. https://docs.djangoproject.com/en/4.2/contents/
6. https://docs.python.org/3/library/tkinter.html/
7. https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html/