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Design of A Smart and Secure Home

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Abstract

In this project, we designed a home appliance security and automation system. It offers several possibilities for securing sensitive access points in the home. It also offers different tools for the control and management of energy and household appliances.

Keywords: Smart Home, IOT, Automation, Security, Safety, Energy, Microcontroller.

Résumé

Dans ce projet, nous avons conçu un système de sécurité et d'automatisation d'appareils domestiques. Il offre plusieurs possibilités pour la sécurisation des points d'accès sensibles de la maison. Il offre également différents outils pour le contrôle et la gestion de l'énergie et des équipements électroménagers.

ملخص

في هذا المشروع، قمنا بتصميم نظام أمان وأتمتة للأجهزة المنزلية. يوفر العديد من الاحتمالات لتأمين نقاط الوصول الحساسة في المنزل. كما يقدم أدوات مختلفة للتحكم في الطاقة والأجهزة المنزلية وإدارتها.

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Table of abbreviations:

Wi-Fi	Wireless Fidelity.
IOT	Internet of Things.
PCB	Printed Circuit Board
NRF	Nordic Radio Frequency
MQ-2	the "M" stands for MOS (Metal-Oxide Semiconductor) gas sensor, and the "Q" represents the quick response of the MQ-2 smoke sensor.
DIY	Do It Yourself
LDR	Light Dependent Resistor
CO	Carbon Monoxide
LPG	Liquefied Petroleum
CH4	Methane
uC	Micro-Controller
SNO2	Tin Dioxide
TV	Television
UART	Universal Asynchronous Receiver Transmitter

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Introduction

A smart house is a practical house design where electronics and appliances may be remotely controlled via the internet from any location using a smartphone or other networked device. The internet connects the devices in a smart house, enabling users to remotely control features like temperature, lighting, security access, and house entertainment systems. [Yagami 23]

Futuristic residences are extremely advantageous to people, particularly those with long-term disabilities, inpatients, and the elderly, who must be cared for by others. Because they just require one device to function, smart systems provide a great deal of utility and convenience. In addition to the comfort they offer, smart houses are an effective method to reduce utility expenditures like those for energy, water, and fuel. People living in these homes feel safer thanks to the usage of sensors that are better at spotting the presence of fire and/or hazardous gas leaks.

IoT-enabled houses are an efficient way to lower utility costs like energy, water, and fuel in addition to the comfort they provide. Additionally, the use of sensors that are more effective in detecting the presence of fire and/or dangerous gas leaks gives people in these homes a greater sense of safety.

The primary objective of this project is to create a comprehensive smart home system that combines automation systems and security systems into a unified solution. The system encompasses various components, including a secure door system, a gas detection system, and a windows security system for enhanced home security. In the automation aspect, the system includes a lighting system for customized and efficient illumination, as well as a relays control system to manage and control various appliances and devices within the home. By integrating these automation and security systems, the project aims to provide users with a seamless and integrated smart home experience that enhances convenience, safety, and efficiency.

Our team has created a cutting-edge smart and safe home system that provides smooth control and functional usability. Users may easily control and manage their home devices by adopting a powerful smart application using voice control features. Our system guarantees easy device control and management, offering a complete and high-end smart home solution.

The Chapter I of this document is an introduction to security systems and smart houses. Chapter II provides an overview that sets the context for smart home technology. It starts with a historical background on smart homes and highlights the benefits of using microcontrollers in smart home systems. The section then delves into the description and definitions of various components used in microcontroller-based smart homes, including Arduino boards, sensors, actuators, communication modules, etc.

Chapter III focuses on designing and building a smart home based on an Arduino board and that includes a door security system, gas detection system, and windows security system. The second part of Chapter III deals with control and automation of home appliances, lighting control, and water level system. All designed parts are explained by providing used tools, method of work, and circuits diagrams.

The document finally concludes with a brief conclusion section.

Chapter One:

Introduction to Smart Houses

I.1 Smart House History

A home that has Internet of Things (IoT) technology installed allows for the automation and remote management of several household systems and appliances. Although the idea of a smart home has been around for a while, it has only lately gained popularity as a result of advances in technology and falling prices for IoT devices. [Shea 20]

When businesses started experimenting with home automation systems that could manage lighting, heating, and security in the 1970s, the first smart home technology was created. Although these early technologies were expensive and not extensively used, they set the stage for later advancements. [Hart 22]

Smart home devices can be connected with a central hub or an app thanks to the development of wireless technology and the internet in the 2000s. Wireless communication protocols were created by businesses like X10, Z-Wave, and Zigbee to enable device connection and control. [Chai 20]

It got even simpler for homeowners to operate their own smart systems from anywhere with the introduction of smartphones and other mobile devices. As a result, smart home platforms like Amazon Alexa, Google Home, and Apple HomeKit were created, enabling consumers to manage several devices using a single app or voice commands.

Smart homes are becoming progressively more sophisticated and integrated as technology develops. Smart security systems, for instance, can use facial recognition to identify and provide access to authorized people, while smart thermostats can learn a user's preferences and automatically adjust the temperature. Additionally, modern smart appliances may talk to each other and the homeowner, giving information and alarms regarding their consumption. Examples of these are refrigerators and washing machines. [Moura 21]

More people are able to integrate smart house devices to their homes because this technology has become more accessible and affordable. Lately we witness that people are more aware of technology advances, they are more open to purchase these devices which implies that the market for smart home devices is anticipated to expand over the next years.

I.2 Description of Smart House System:

A smart home is a contemporary and practical residential setup where appliances and equipment can be easily managed from any location using a mobile or networked device with internet connection. Various components of the smart home ecosystem, such as security systems, temperature control, lighting features, and home entertainment systems, can be connected to one another over the internet and remotely regulated and customized to the user's preferences. With the use of this technology, homeowners may remotely access and manage their home's features, which improves convenience and offers a high level of automation and personalization. [Hayes 22]

A smart home is based on microcontrollers as the main control unit for automating and controlling various systems and appliances. Microcontrollers are a Smart circuit that can be programmed to read inputs (such as sensors) and control outputs (such as turning the lights on/off or adjusting the temperature). Various sensors, actuators (like relays, motors, or LEDs), and other devices are linked to the Arduino board and are managed by the firmware running on it.

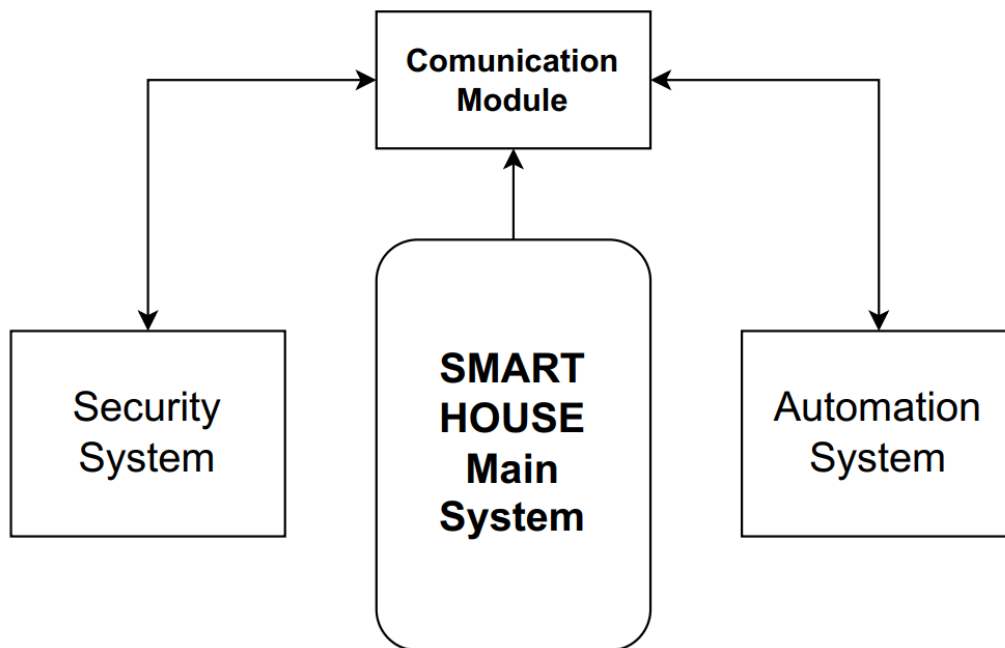


Figure 1:Main System Simple Circuit Diagram

I.2.1 Microcontrollers:

Microcontrollers are tiny integrated circuits that have a processing core, memory, and input/output peripherals. They act as embedded system controllers, allowing for precise command and control of tasks to be carried out in electronic systems. The Arduino Uno, Nano, and ESP32 are notable examples of microcontrollers that are widely used in do-it-yourself (DIY) projects, prototyping efforts, and Internet of Things (IoT) applications. These microcontrollers offer flexible development platforms that make it simple to interface with a range of sensors, actuators, and wireless connectivity modules. [Lutkevich 19]

I.2.2 Benefits of using Microcontrollers in Smart Houses

The following are a few advantages of utilizing microcontrollers in smart house projects:

- **Budget-friendly:** Microcontrollers boards and components are reasonably priced, making them a budget-friendly choice for creating smart home devices.
- **Flexibility:** Due to Arduino's high degree of adaptability and customizability, users can create smart house systems that are tailored to their requirements and preferences.
- **Arduino is open source,** which means that the public has unrestricted access to the software and hardware designs. Users can share their designs with the community and alter and enhance pre-existing designs thanks to this.
- **Arduino can be integrated with other smart home systems,** such as Amazon Alexa and Google Home, enabling users to manage their smart home devices using voice commands.
- **Energy-saving:** Arduino is built to be energy-saving, making it the perfect option for creating smart home systems that must operate constantly while using little power.

Overall, Arduino offers a highly adaptable, scalable, and affordable framework for creating smart home systems that can enhance a home's convenience, comfort, and security. [Surinder Cor 21]

I.2.3 Sensors:

Various types of sensors are used to detect different conditions in your home, such as temperature, humidity, light intensity, motion, etc. Some examples of sensors that can be used with Arduino include the DHT11/DHT22 temperature and humidity sensor, the PIR motion sensor, and the LDR light sensor.

- **PIR sensor:** A PIR sensor detects infrared radiation to sense movements or changes in heat. It's commonly used in security systems and automatic lighting.
- **Ultrasonic Sensor:** sensor uses sound waves to detect objects and measure distances.
- **Touch Sensor:** A touch sensor detects physical touch or pressure to initiate a specific action or response.
- **IR sensor:** detects infrared radiation to sense objects or movements.
- **Gas Sensor:** Gas sensors are devices that detect and measure the presence or concentration of gases in the environment. For example, the MQ-5 sensor detects gases such as LPG, natural gas, and propane, while the MQ-7 sensor specifically detects carbon monoxide (CO).
- **Temperature Sensor:** is an electronic device that measures the temperature of its surroundings. such as the DHT11 and DHT22, are specific types of temperature and humidity sensors commonly used in various applications.
- **Sound Sensor:** A sound sensor detects and captures sound waves in its surroundings.
- **Light Sensor:** A light sensor detects and measures the presence or intensity of light. such as a Light Dependent Resistor (LDR)
- **Shock Sensor:** A shock sensor detects and measures sudden impacts or vibrations.

I.2.4 Actuators:

These devices are used to control various systems and appliances in your home, such as lights, motors, relays, etc. Examples of actuators that can be used with Arduino include the Relay module, Servo motor, and RGB LED. [\[reac-group 20\]](#)

- **Buzzer:** is an electronic device that produces a buzzing or beeping sound as an alert or signal.
- **Led:** A LED, or Light-Emitting Diode, is a semiconductor device that emits light when an electric current passes through it.
- **Servo Motor:** is a rotary actuator that allows for precise control of angular position, speed, and acceleration.
- **Stepper Motor:** is a digital electromechanical device that converts electrical pulses into discrete mechanical movements or steps.
- **Relay:** is an electrically operated switch that controls the flow of current using an electromagnet.
- **Switch:** is a device that allows or interrupts the flow of electric current in a circuit.
- **I2C Lcd:** A display module that uses the I2C communication protocol to connect and transmit data, simplifying connectivity with other devices.

I.2.5 Communication modules:

These modules allow the Arduino board to communicate with other devices such as smartphones, tablets, or voice assistants. Examples include the ESP32 Wi-Fi module, the HC-05/HC-06 Bluetooth module, the NRF24L01 wireless module, and the ESP-01 module.

Chapter Two:

Description Of

Designed System:

II.1 Introduction:

This section outlines the specifications of the system to be designed. It describes the fundamental concepts of the modules that comprise the overall system.

II.2 Smart House Automation:

II.2.1 Automation:

Through its fast development over time, home automation technology has improved the comfort and effectiveness of our lives. Controlling different electrical devices, including lighting, heating and cooling systems, home entertainment systems, and smart appliances, is one of the most widely used uses of home automation.

Homeowners can easily manage their devices using either vocal commands or through a smartphone app with the aid of smart assistants such as Amazon's Alexa or Google Assistant, or manual control via push buttons and other interfaces in addition to a remote control.

A more comfortable living environment can be produced with this degree of automation, which can also help cut down on energy use and utility costs.

We can control many appliances using Relays.

II.2.2 Lighting Control System:

The main function is to control the lighting in the room automatically by recognizing the number of people inside the room using an infrared (IR) sensor system. The system stimulated by anyone who passes through the door, whether they enter or leave the room.

IR sensors are connected to an Arduino Nano or Uno with code that works based on a counter that increases by 1 when a person passes through the door and decreases by 1 when someone passes from the opposite side. The sensors are placed on the branching of the door next to each other. When a person passes through the door, they cut the sensing field of sensor one before sensor two, giving us a small-time difference in the signal that is directed to the Arduino, and based on this time difference, the system increases or decreases the counter.

II.2.3 Water Level Indicator System:

It is a device that is used to monitor and control the level of water in the house tank that is typically used for storing water. The sensor is designed to measure the level of water in the tank and send this information to the main house server to show them to the user. The sensor is an electronic system that is based on a micro-controller and levelling electrodes.

II.3 Smart House Security:

II.3.1 Door Security System:

A cutting-edge smart home security solution is a door lock system that uses either a keypad password or a fingerprint sensor to limit access to a property to only authorized people. This cutting-edge technology acts as an additional layer of security, greatly lowering the possibility of unauthorized entrance. The system frequently integrates with smart home automation features, giving users the ability to easily handle and monitor the security settings on their property from a distance. Traditional keys can be replaced with a keypad passcode or a biometric reader, facilitating access control and lowering the risk of lock picking or key duplication.

Additionally, this device has a Vibration sensor that can identify any physical tampering with the lock. The sensor sets on the alarm in the event of such action to notify the user and discourage potential intruders from making additional attempts to enter. This feature increases the system's degree of security, which deters break-ins and makes it a dependable option for securing smart homes.

II.3.2 Gas Detection System:

This gas detector combines two cells, each of which can detect a different kind of gas. The first one is called The Cell MQ9, and it is particularly good at spotting harmful chemicals like methane and monoxide CO. The other cell, MQ2, is made to identify hazardous and combustion gases in addition to smoke. To provide complete protection against dangerous gases and smoke, this gas detector will be installed in every area of the home where there is a possibility of a gas leak or smoke build-up.

II.3.3 Windows Security System:

It is a laser-based security system, simple tripwire system that uses a laser and an LDR to detect when an object crosses the laser beam. The laser beam is pointed towards the window, and the LDR is placed on the other side. When the laser beam is interrupted by an object, the LDR detects the change in light intensity and sends a signal to the microcontroller, which can activate an alarm and notify the user by the control app. LDR: LDR stands for Light Dependent Resistor, also known as a photoresistor. It is a type of passive electronic component that exhibits a change in resistance based on the amount of light falling on its surface. The resistance of an LDR decreases as the intensity of light increases and increases as the intensity of light decreases. This property makes LDRs useful in various applications that involve light sensing or detection.

II.4 Components used in the project

▪ *ESP 32 Board:*

Is a compact yet potent microcontroller with built-in Wi-Fi and Bluetooth connections, making it the perfect option for creating embedded and Internet of Things (IoT) applications. The ESP32 delivers significant processing power and versatility at a reasonable cost because to its dual-core processors and a range of input/output connectors. [Ravi Teja. 21]

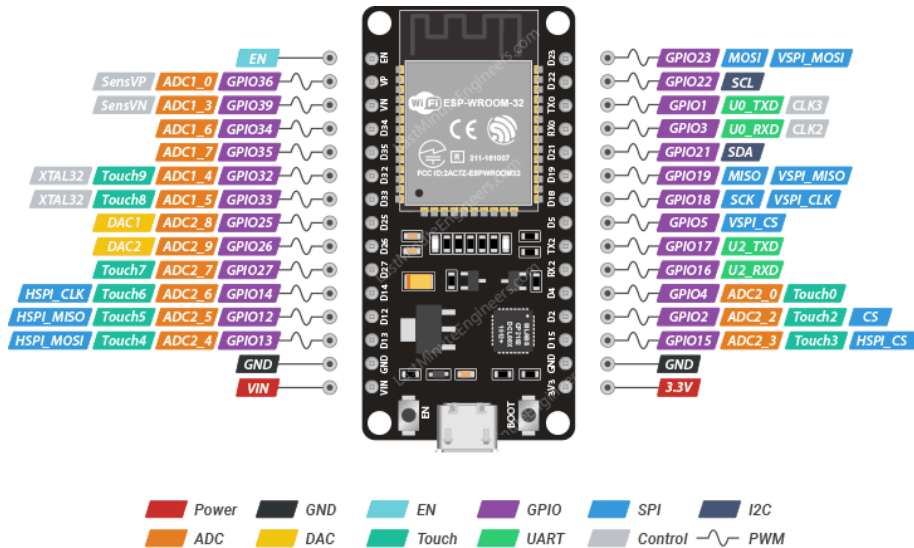


Figure 2:ESP 32 Board

▪ *Adafruit Optical Fingerprint Sensor:*

The Adafruit optical fingerprint sensor is a portable biometric scanner that takes high-resolution pictures of a user's fingerprints and compares them to templates that have been saved in order to verify the user's identity. It has a built-in microcontroller and a straightforward UART port that make it simple to integrate with other microcontrollers or single-board computers. This sensor is frequently employed in biometric applications such as time and attendance monitoring and entry control systems.

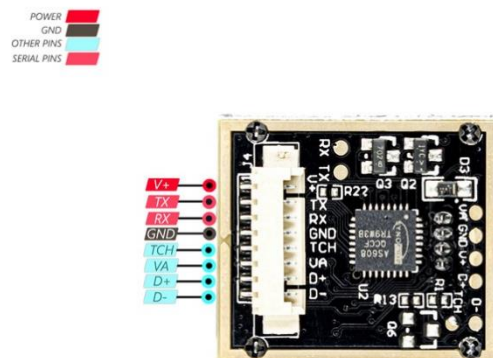


Figure 3:Adafruit Fingerprint Sensor

- **Keypad 4 rows and 4 columns:**

A keypad 4x4 is an input device with 16 buttons laid out in a 4x4 matrix. It has 12 numeric buttons, 4 operation keys, and an internal microcontroller. Each key produces a distinct electrical signal that, when pushed, is transmitted to the microcontroller. This kind of input device is frequently used in a variety of electronic devices and security systems that demand a code or passcode from the user in order to grant access. The keypad 4x4 has become a common option in smart homes due to its accessibility, ease of use, and durability.

- **Vibration Sensor:**

A shock sensor is a piece of electronic equipment that monitors sudden vibrations or impacts and alerts a management system. An electronic element that transforms mechanical stress into an electrical charge is usually attached to a spring-mounted mass. The mass compresses the piezoelectric element when the sensor receives a sudden shock, creating a voltage signal that starts an alarm or other system reaction. Security systems frequently employ shock sensors to safeguard doors for intelligent houses. [Sourav Gupta 19]

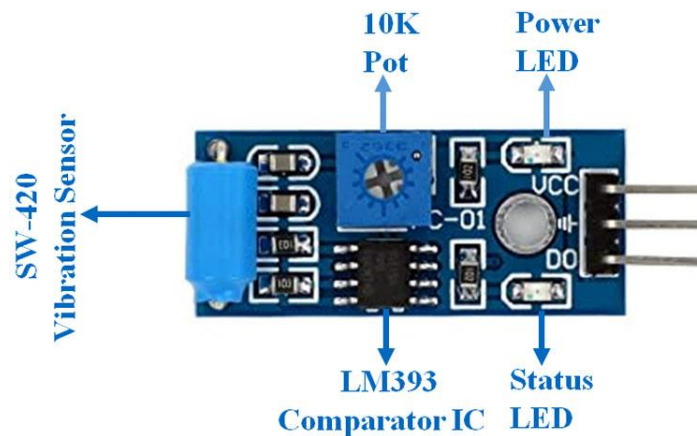


Figure 4:Vibration Sensor SW-420

- **Push Button:**

A push button is a type of switch that is used to create or break an electrical connection by pressing a button. It is made up of a button that is spring-loaded and two contacts that are brought together or apart when the button is pushed or released. To start a specific action or indicate a state change, push buttons are frequently used in electronic devices and control systems.

- **Relay:**

A relay is an electrical switch that enables a low-power circuit to manage a high-power circuit. Its components include a coil, a switch, and contacts that open or shut in response to the coil's energization. This device is frequently used in electricity distribution and home automation devices.

- **Buzzer:**

A buzzer is an electronic gadget that emits a sound when turned on. It produces sound waves using a diaphragm, an electronic device, or a magnetic coil. Buzzers are frequently used in communication devices, and alarms to alert users or indicate a shift in status.

- **Solenoid Lock:**

A solenoid lock is an electronic lock that manages the locking process using an electromagnetic coil. When a current is given to the solenoid, it pulls a metal pin or bolt to unlock or lock the mechanism. Access control, safes, and vending machines frequently make use of solenoid locks, which can be controlled using a variety of inputs. They provide high protection, dependability, and simple electronic system integration.

- **MQ-9:**

The MQ-9 gas sensor is a semiconductor-based gas sensor used for detecting carbon monoxide (CO), methane (CH₄), and LPG (liquified petroleum gas). Similar to the MQ-5 gas sensor, it uses a sensing material made of tin dioxide (SnO₂) that reacts with the target gases and causes a change in the electrical conductivity of the sensor. The MQ-9 sensor has a detection range of 10 to 1000 ppm for CO, 100 to 10000 ppm for CH₄, and 1000 to 10000 ppm for LPG. It requires a heater to operate, which heats the sensing material to a specific temperature to ensure the gas detection accuracy. The sensor also requires a load resistor and a voltage source to measure the change in resistance when it encounters the target gas.

- **MQ-2:**

The MQ2 gas sensor is a multifunctional electronic device made for detecting different gases, including smoke, in the environment. It makes use of a sensitive component that reacts when smoke vapors are present in the air. The electrical resistance of the sensor varies when smoke is present, producing a quantifiable signal. This signal allows for prompt fire detection and warning since it reveals the presence and amount of smoke. Smoke detectors, fire alarm systems, and other devices where early detection of smoke is essential for safety and protection against fire dangers frequently employ the MQ2 sensor. It is a well-liked option in smoke-detecting technology because of its dependable performance and affordability. The sensor also requires a voltage source and a load resistor to measure the change in resistance.

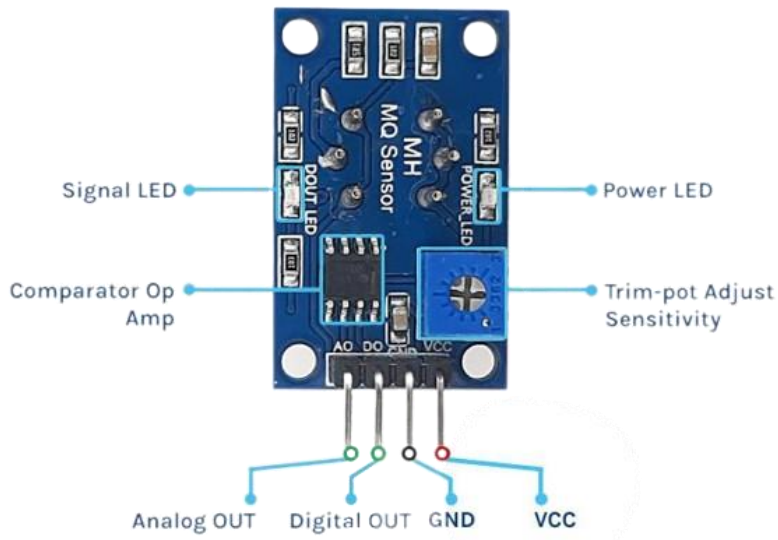


Figure 5:MQ-2 Gas Smoke Sensor

- **LDR:**

The LDR stands for Light Dependent Resistor, also known as a photoresistor. It is a type of passive electronic component that exhibits a change in resistance based on the amount of light falling on its surface. The resistance of an LDR decreases as the intensity of light increases and increases as the intensity of light decreases. This property makes LDRs useful in various applications that involve light sensing or detection.

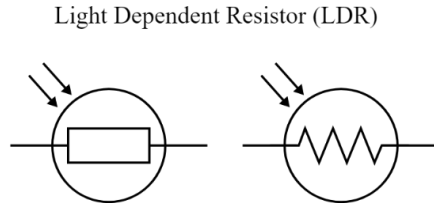


Figure 6:Light Dependent Resistor Sensor Symbol

- **Arduino Uno:**

Is a micro-controller widely used in electronic projects and prototypes. It adopts precise controller ATmega328P has 14 digital input/output pins, 6 analog inputs, 16 MHz quartz crystal. It can be programmed using Arduino IDE, available for Windows, Mac OS X and Linux. Arduino Uno is suitable for a wide range of applications and can interact with many sensors, triggers, and other electronic components. It is also well suited for educational purposes.

- **Infrared sensor:**

Infrared sensor is a device that detects and measures infrared (IR) in its surrounding environment. Works by detecting heat emitted by objects or temperature changes and turning them into an electrical signal that can be analyzed and used to stimulate different actions. Infrared sensors are commonly used in various applications, such as temperature sensing, motion sensing and remote control.

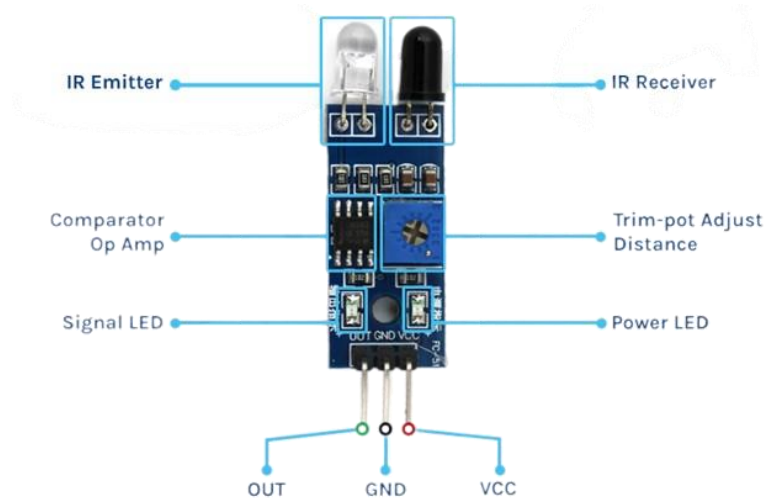


Figure 7: Infrared Sensor

- **The water level sensor:**

The sensor is an electronic system that is based on a levelling electrode, when the water level increases or decreases it touches the electrodes which make the electrons pass from the source electrode to the touched one, and that allows the electricity to pass through the touched electrodes.

- **NRF24L01 module:**

The NRF module, also known as the NRF24L01 module, is a 2.4 GHz-capable wireless communication module. It is frequently employed for low-power, close-proximity wireless communication between devices. The Nordic Semiconductor NRF24L01 chip, which is used in the NRF module, provides features including high data rates, low power consumption, and simple microcontroller and Arduino board integration. It is frequently employed in applications like wireless sensor networks, home automation, remote control systems, and Internet of Things (IoT) initiatives. In a variety of electronic projects, the NRF module offers a dependable and affordable option for wireless communication demands.

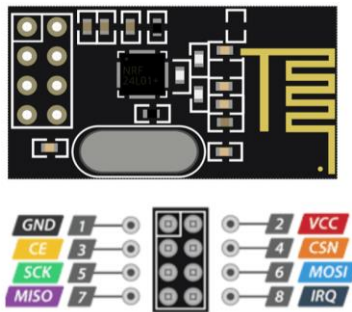


Figure 8: NRF24L01 module

- **Arduino Nano:**

The Arduino Nano board is a compact and versatile microcontroller board based on the ATmega328P chip. It is a scaled-down version of the Arduino Uno board with comparable features and abilities. Due to its compact size, simplicity of use, and compatibility with a variety of sensors, actuators, and modules, the Arduino Nano is a popular among amateurs and electronics enthusiasts. It is frequently used to develop various IoT applications as well as interactive electrical gadgets and prototype projects.

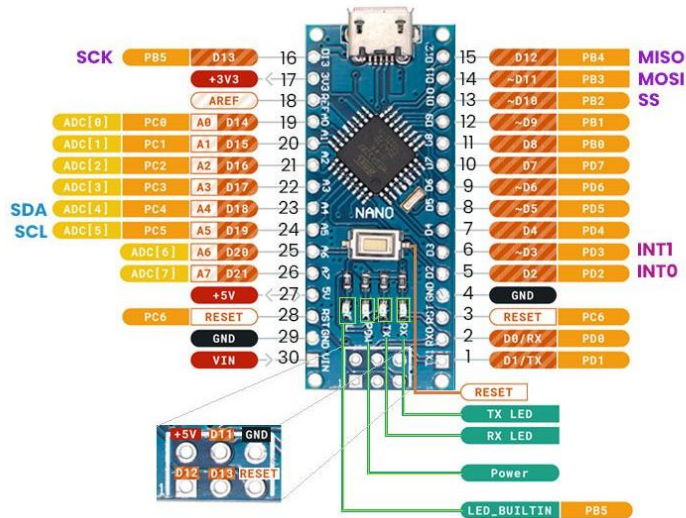


Figure 9: Arduino Nano Board

- **ESP-01 Module:**

The ESP-01 module is a tiny and capable Wi-Fi module based on the ESP8266 microcontroller chip. Devices may connect to networks and interact over Wi-Fi thanks to its wireless connectivity. It is frequently employed in Internet of Things (IoT) projects, allowing objects to transmit and receive data wirelessly, making it a crucial element for developing interconnected and intelligent systems.

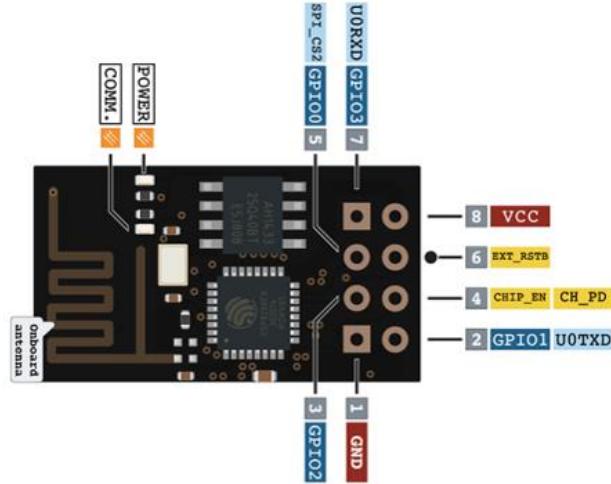


Figure 10:ESP-8266 ESP-01

Chapter Three:

Building a Smart

Home with

Microcontrollers

III.1 Smart Home System Description:

The smart house project integrates several networked systems that are managed by a central ESP32 board with Wi-Fi connectivity. By using electronic locks and authentication techniques, the secure door lock system provides increased security. The Windows security system uses sensors to find attempts at unauthorized opening and notifies the user in real-time immediately. The gas detection system continuously checks gas levels and sends out alarms in the case of a leak to enable quick response. The water level system uses sensors to detect water levels and sends messages for prompt maintenance or water conservation. The lighting system allows for automated scheduling, voice commands through Google Home and Amazon Alexa, and manual control utilizing push buttons, giving users broad control over lighting conditions. Additionally, through relays, the system expands its control capabilities to additional devices such as heating, cooling, and entertainment systems. This comprehensive smart home system incorporates several features for improved convenience, security, and energy management.

III.1.1 Main System Control Application:

Sinric Pro is a cloud-based platform for developing smart home applications and devices. It gives developers access to a wide range of tools, APIs, and libraries that they can use to include voice control, automation, and remote access features into their smart home devices. Using popular voice assistants like Amazon Alexa and Google Assistant, developers can quickly connect to and operate a wide range of devices, including lights, thermostats, locks, and more, using Sinric Pro. It provides a practical and scalable approach to building reliable, approachable smart home experiences.

Additionally, this application includes automation and scheduling tools, allowing customers to establish personalized routines and situations for their smart devices. To increase efficiency and convenience in their daily routines, users can automate things like turning on lights at a specified time or regulating the temperature based on predefined parameters.

Overall, Sinric Pro provides a comprehensive framework for developers to design cutting-edge smart home solutions. Sinric Pro enables the building of complex and user-friendly smart homes that improve comfort, convenience, and control for consumers thanks to its broad capabilities, seamless voice assistant integration, automation features, and remote access functions.

- **Application Control System:**

Our Sinric Pro program is compatible with popular voice assistants such as Google Home and Alexa, allowing for extensive control and management of many devices.



Figure 11: Application Control System

III.1.2 Main System Diagram:

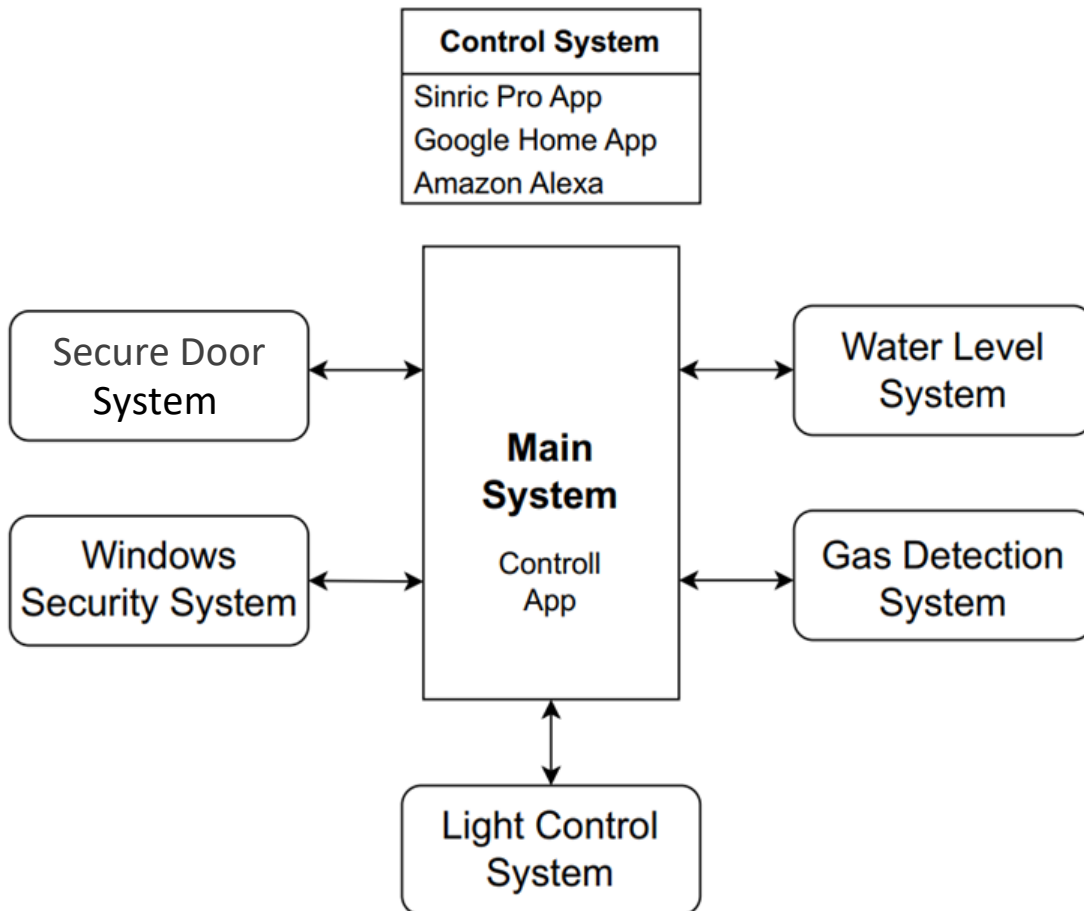


Figure 12: Main System Circuit Diagram

III.1.3 Main System Algorithm:

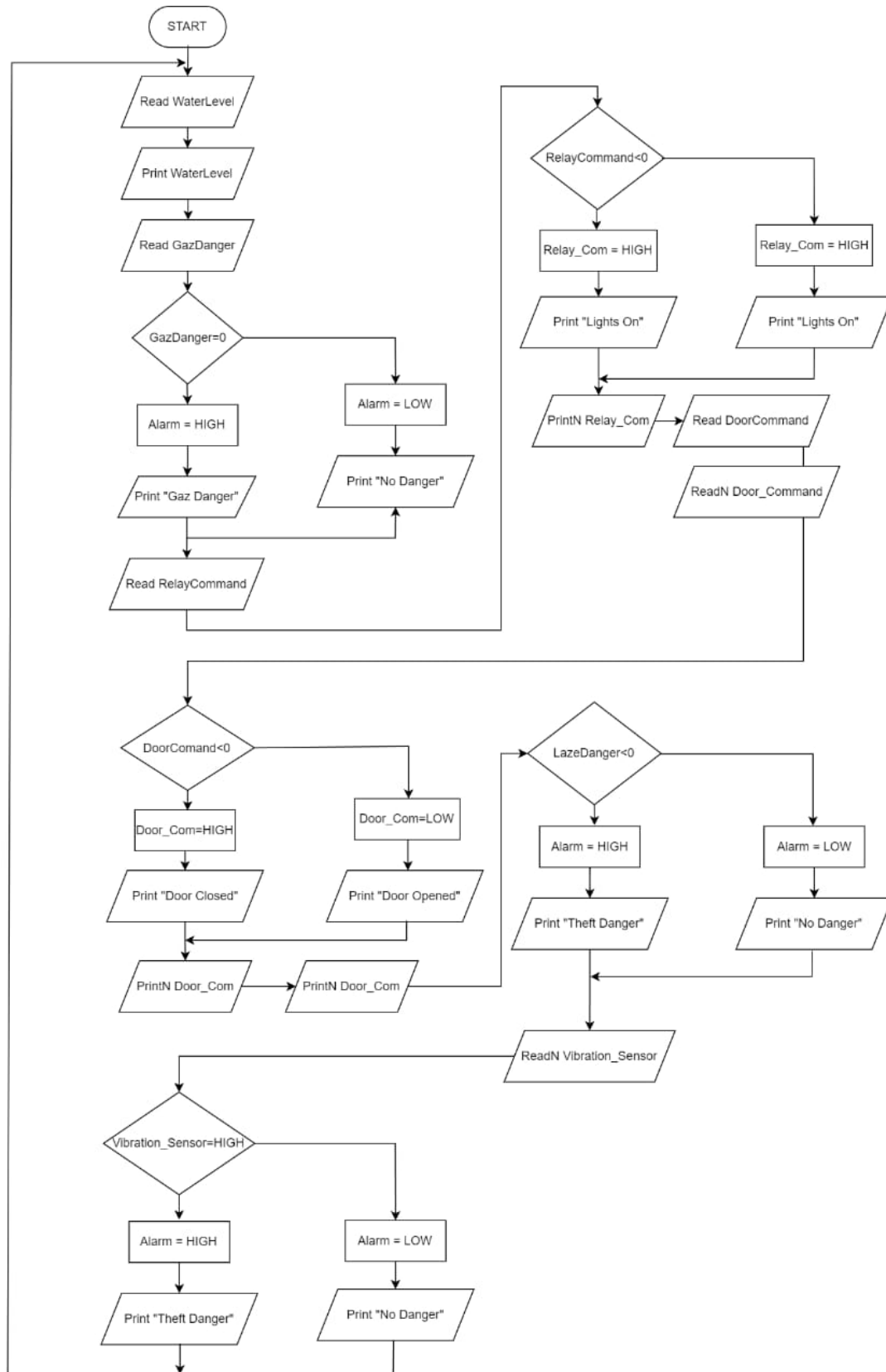


Figure 13:Main System Circuit Algorithm

III.2 Automation:

III.2.1 Principle of Automation:

Our smart house is a high-tech automation system that gives homeowners access to a range of home gadgets and appliances via an ESP32 board with four relays. Any household appliance, including heaters, air conditioners, TVs, and lighting, can be linked to these relays, which can be controlled manually with push buttons or remotely with Wi-Fi and voice-activated devices like Google household, Alexa, or Sinric Pro. Additionally, users can control their smart house systems using a specific app on their laptop or smartphone. Numerous advantages come with smart homes, such as increased security, comfort, and convenience, as well as the ability for homeowners to control their properties at any time and from any location in the world.

III.2.2 Automation Diagram:

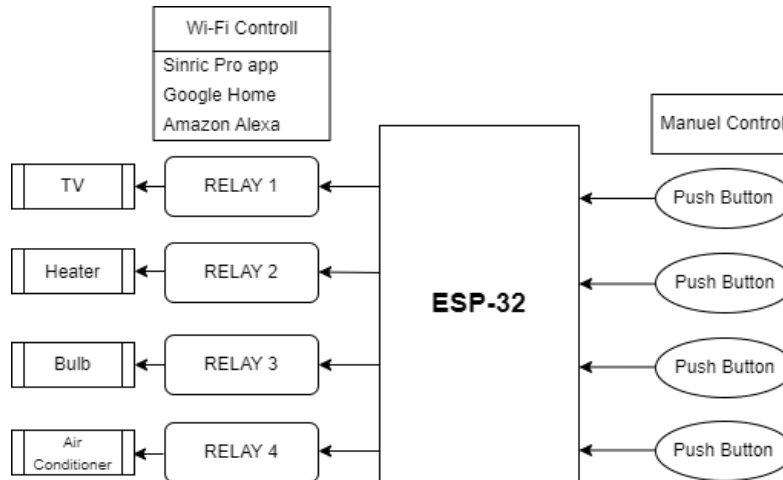


Figure 14: Control Relays System Circuit Diagram

III.2.3 Circuit Design:

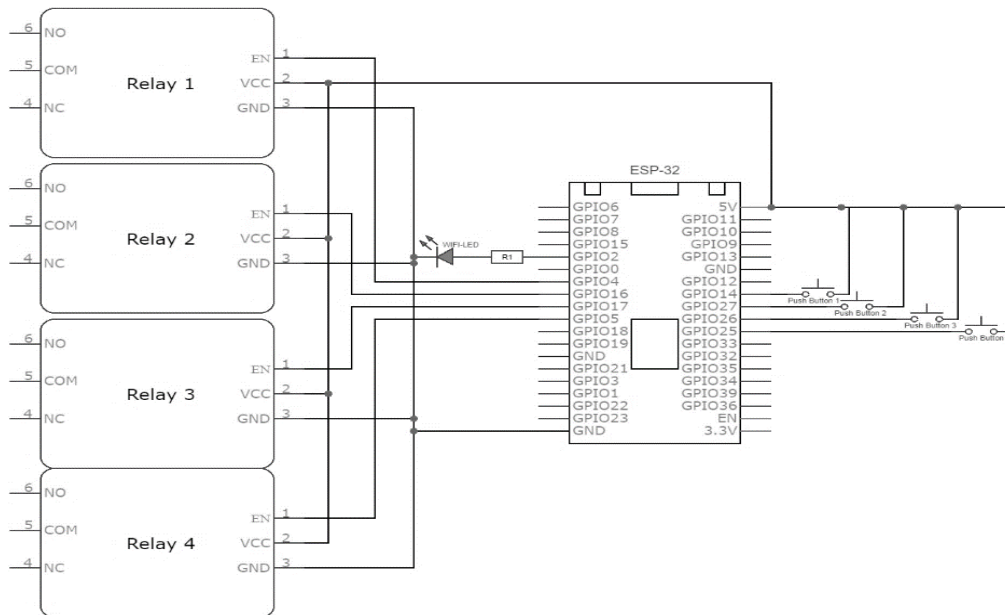


Figure 15: Control Relays System Circuit Design

III.2.4 Circuit Algorithm:

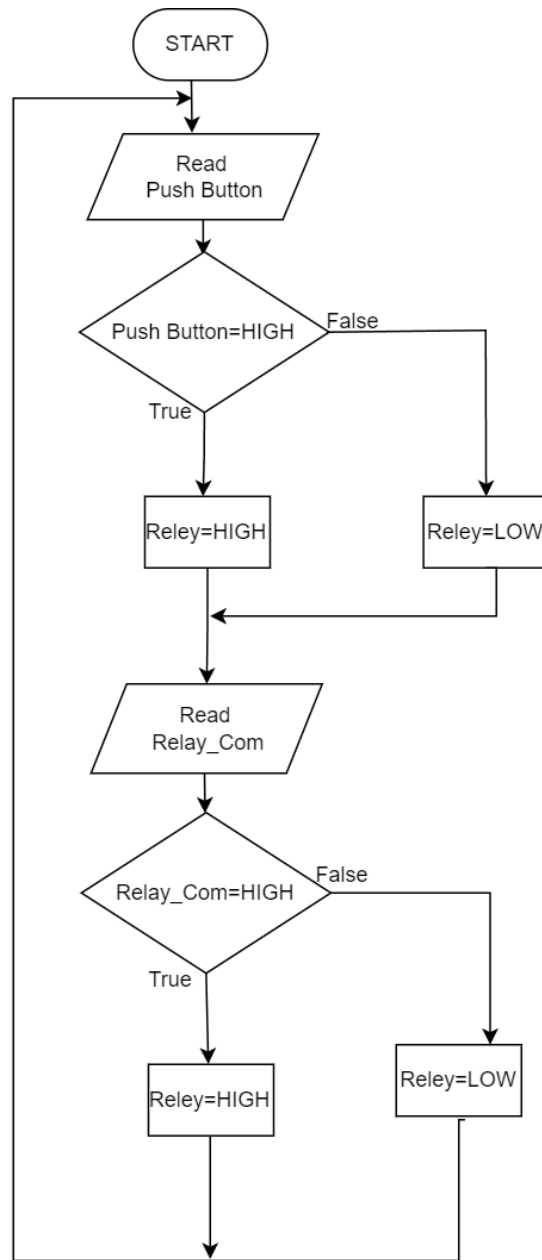


Figure 16:Control Relays System Circuit Algorithm

III.3 Lighting Control System:

This system works using 2 infrared sensors installed on the doorstep on the first sequence and then the second. This system depends on the calculation of the time difference between the two sensors and therefore we mean that people pass through the door whether to enter or exit the room and this gives a signal and time difference that allows our system to admit if the person has entered or left the room.

III.3.1 Circuit Diagram:

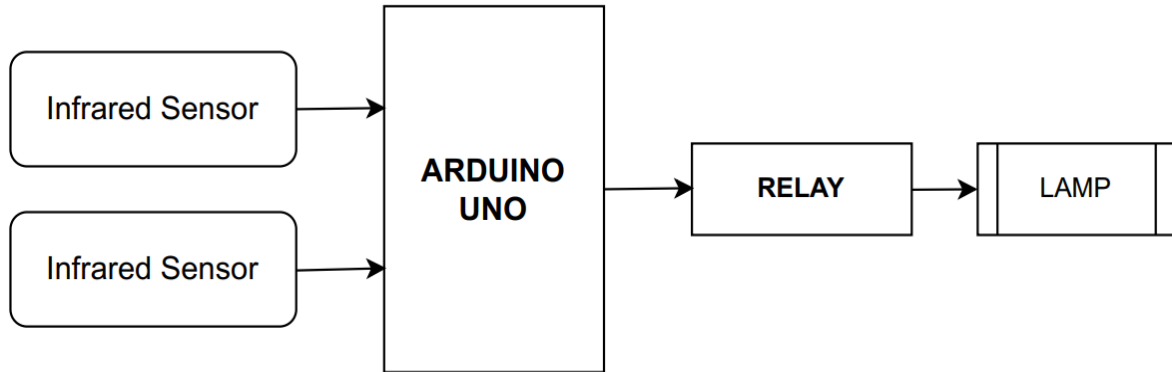


Figure 17:Lightning Counter System Circuit Diagram

III.3.2 Circuit Design:

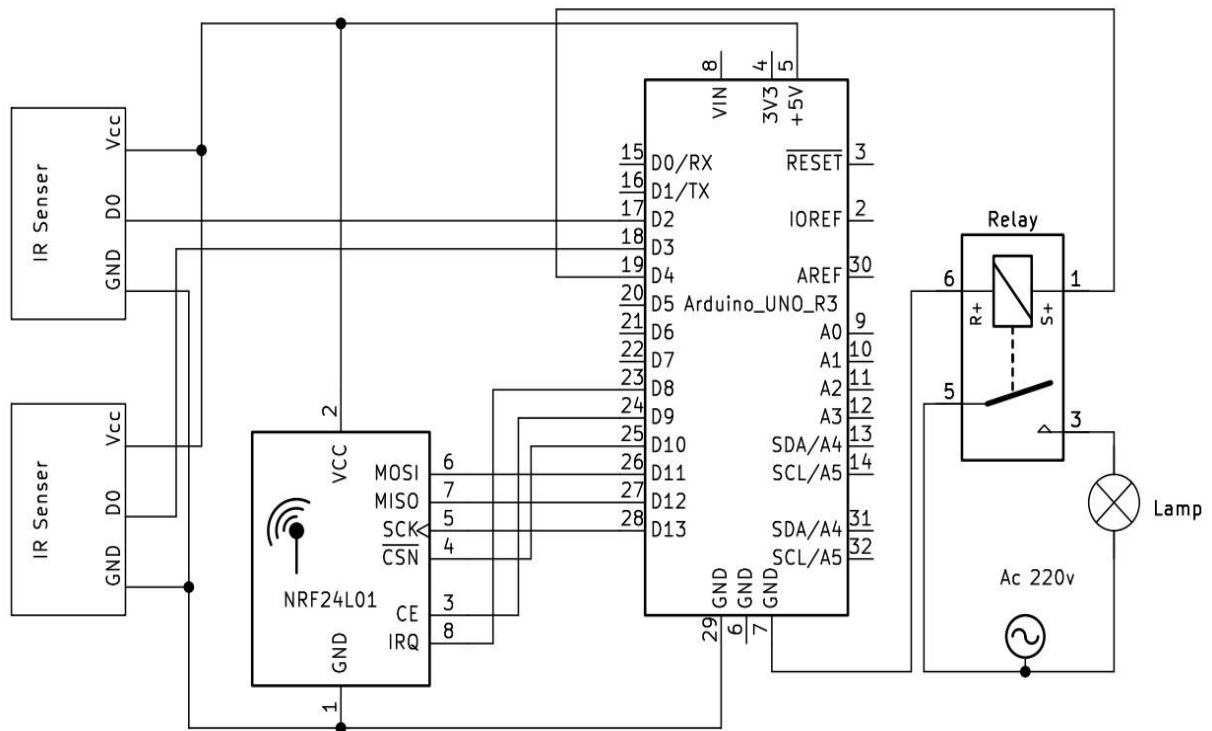


Figure 18:Lightning Counter System Circuit Design

III.3.3 Circuit Algorithm:

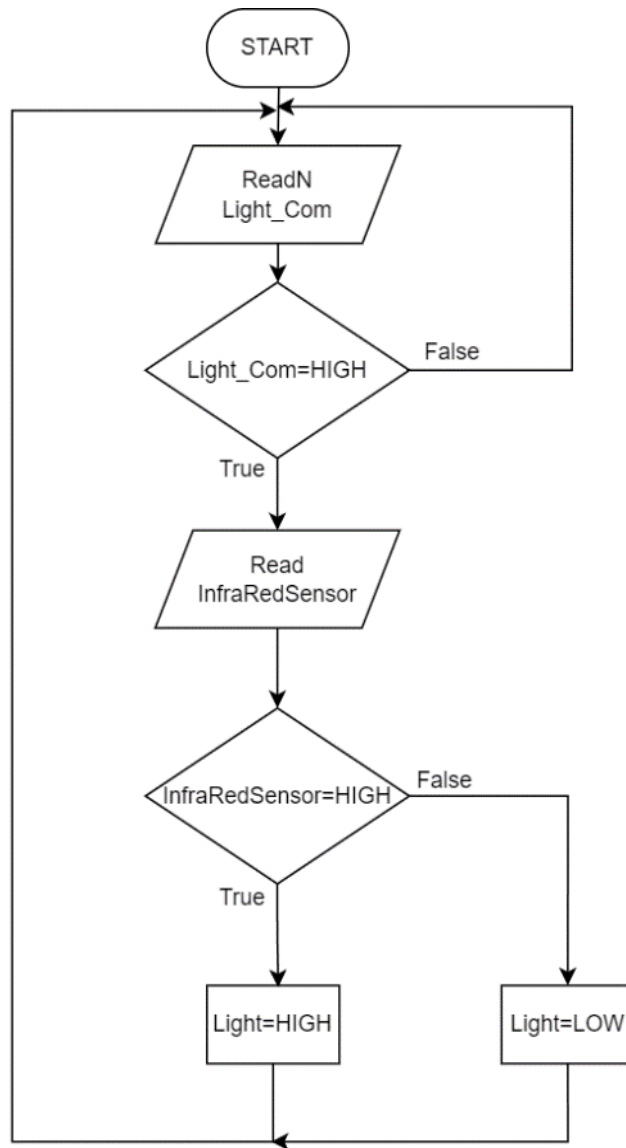


Figure 19: Lightning Counter System Circuit Algorithm

III.4 Water Level System:

The system contains a microcontroller, water level sensor and network connection device. The microcontroller, which is responsible of collecting the data, analyse them and do the actions, it is directly connected to the water sensor which gives the information about the water level, while the uC analyse the data and send them to the main server through the network connection device.

III.4.1 Circuit Diagram:

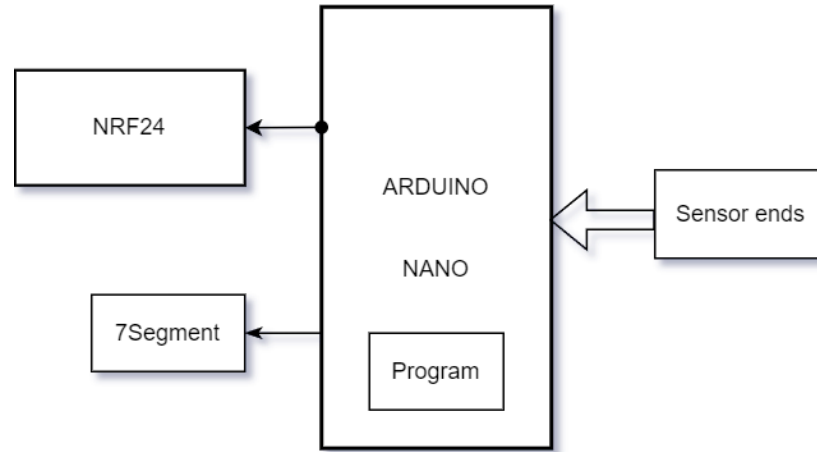


Figure 20: Water Level System Circuit Diagram

III.4.2 Circuit Design:

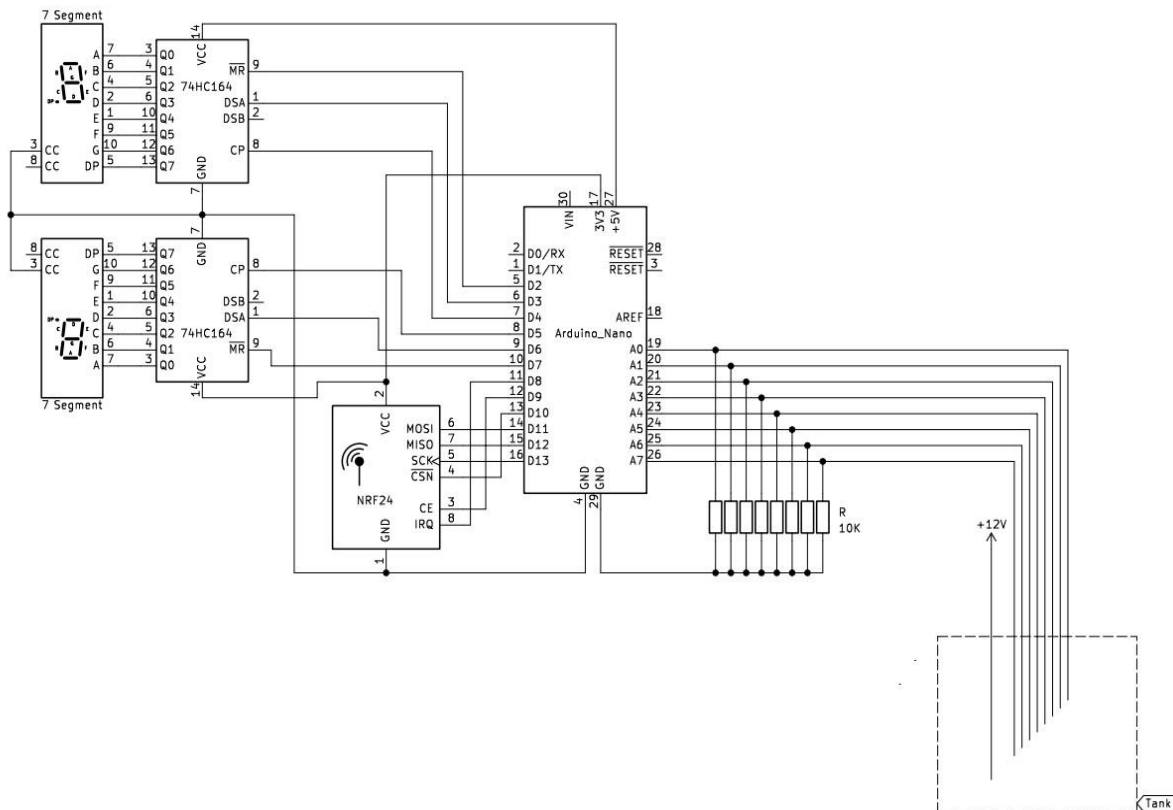


Figure 21: Water Level System Circuit Design

III.4.3 Circuit Algorithm:

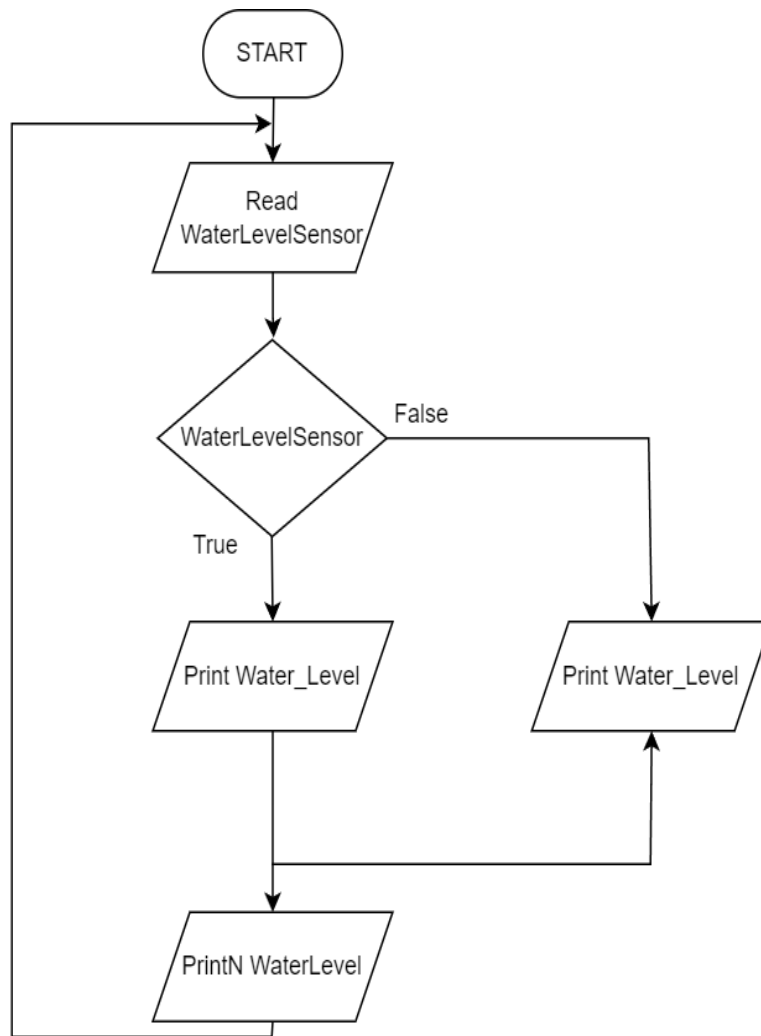


Figure 22: Water Level System Circuit Algorithm

III.5 Security System:

III.5.1 Door Security System:

The door security system works by recognizing the correct code entered on the keypad or the right fingerprint scanned by the sensor. Once the correct input is detected, the Arduino Nano sends a command to the relay, which in turn unlocks the solenoid lock for a period of 10 seconds. This system provides a secure and convenient means of access control, eliminating the need for traditional keys and reducing the risk of unauthorized entry. Additionally, the door lock can be opened from the inside using a push button. When the push button is pressed, the Arduino Nano receives a signal and sends a command to the relay to unlock the solenoid for the same duration.

The door security system is designed to detect and respond to impact events. When an external force strikes the door, the built-in vibration sensor activates and sends a signal to the integrated Arduino Nano microcontroller. Upon receipt of this signal, the Arduino Nano issues a command to activate the built-in alarm, which includes a buzzer.

- Circuit Diagram:

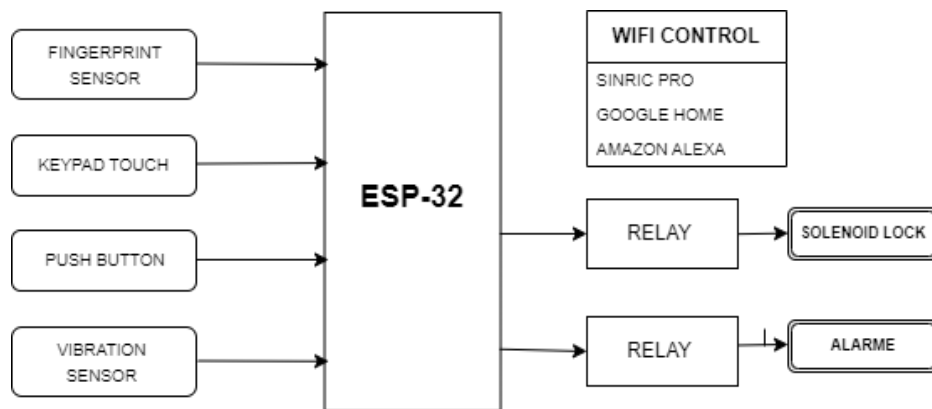


Figure 23:Door Secure System Circuit Diagram

- Circuit Design:

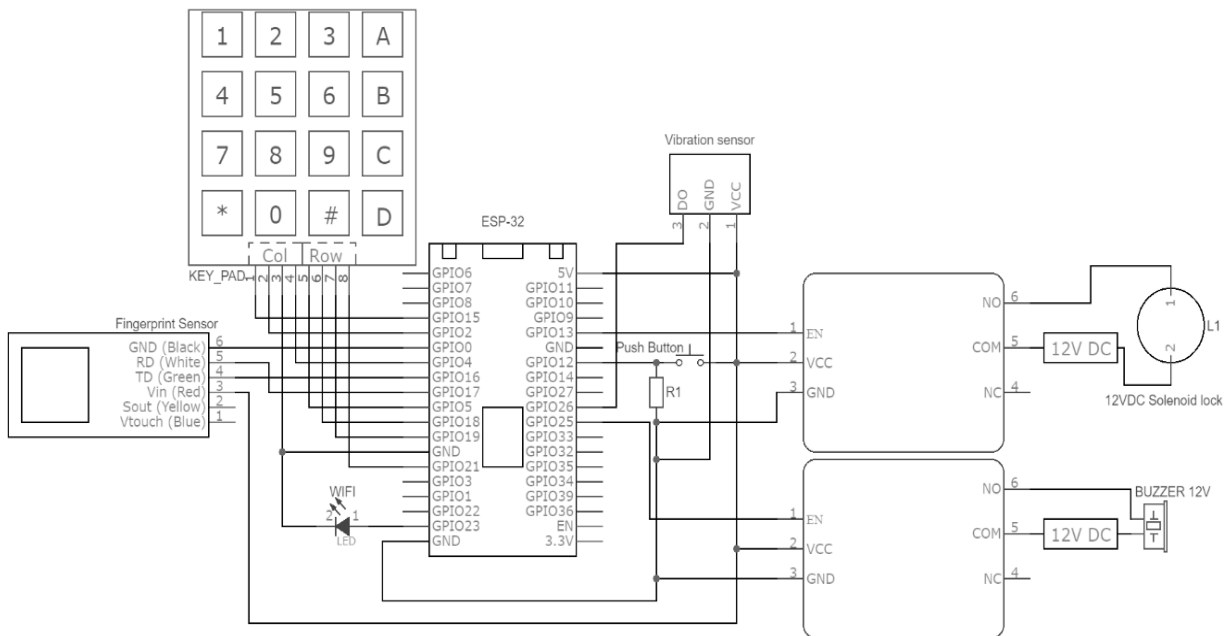


Figure 24:Door Secure System Circuit Design

- **Circuit Algorithm:**

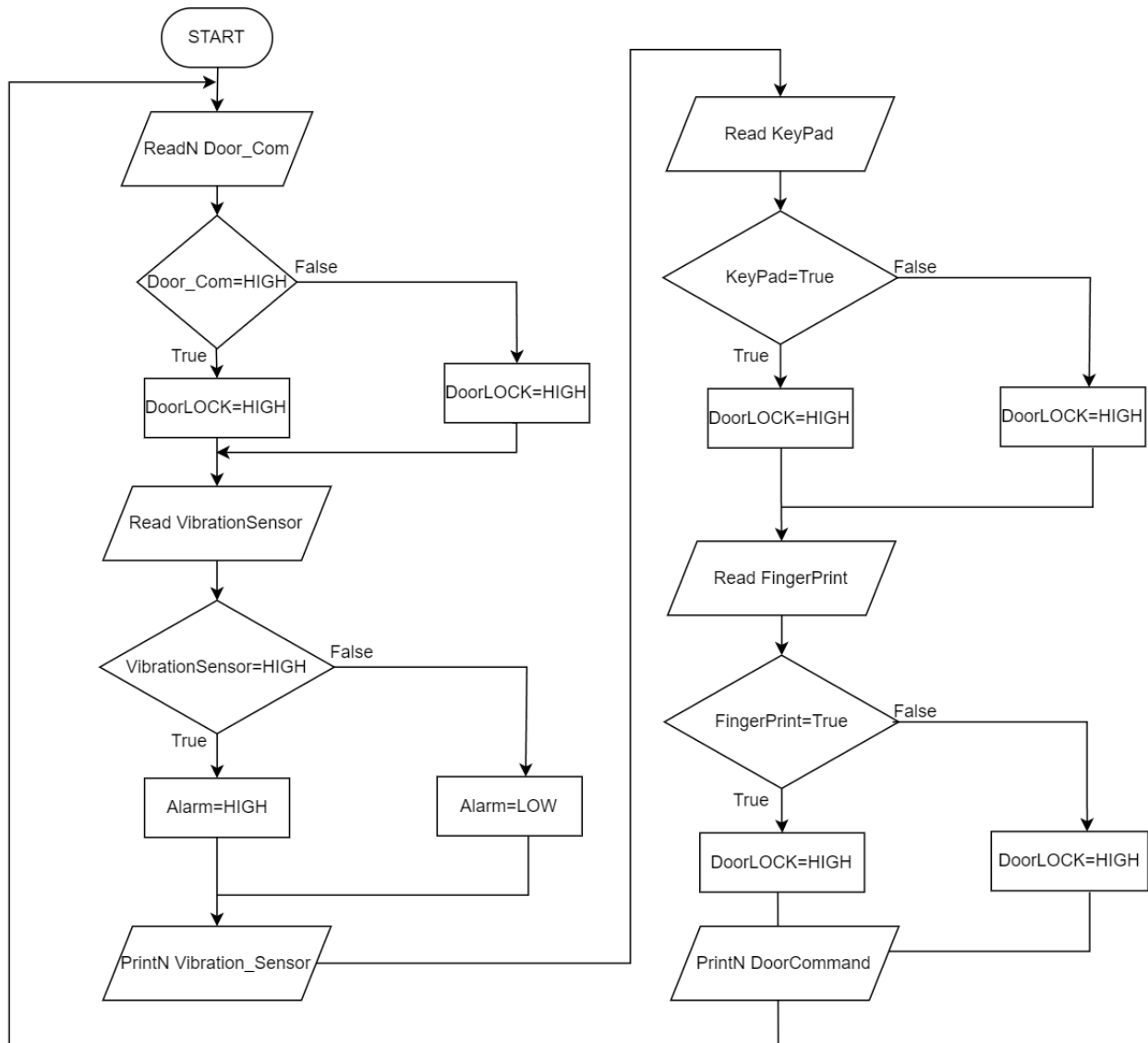


Figure 25:Door Secure System Circuit Algorithm

III.5.2 Gas Detection System:

This gas detector is a combination of 2 cells, each one capable of detecting multiple types of gases and smoke. They are both directly connected to a micro-controller, which analyzes the data provided by the cells. This micro-controller then sends the analyzed data to the main system through a network connection device, determining whether there is a risk or not. The gas detector is designed to detect a range of gases, including smoke, as well as other toxic, flammable, and combustion gases.

- **Circuit Diagram:**

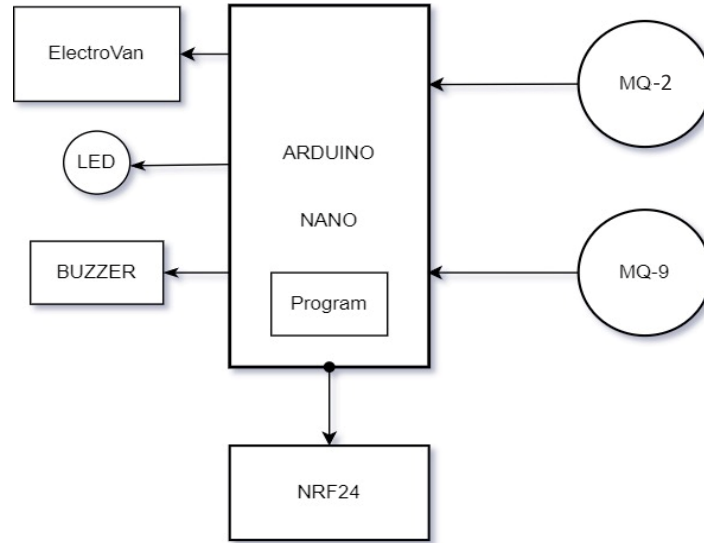


Figure 26: Gas Detection System Circuit Diagram

- **Circuit Design:**

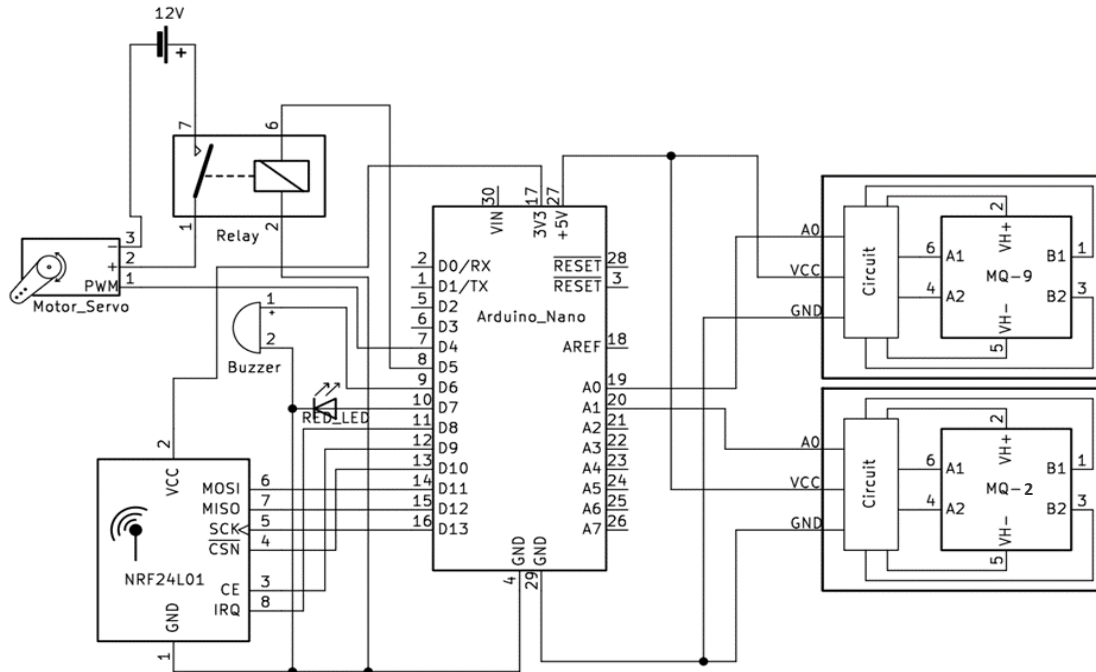


Figure 27: Gas Detection System Circuit Design

- **Circuit Algorithm:**

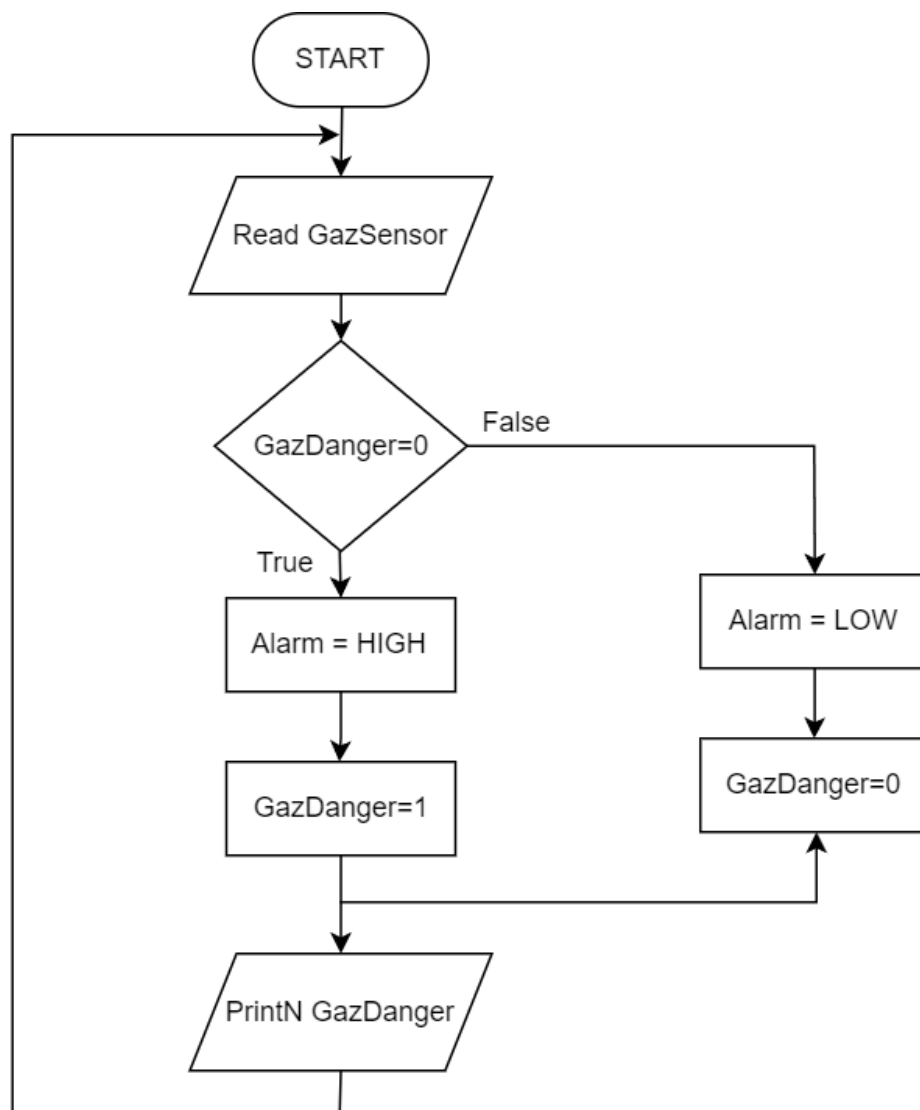


Figure 28:Gas Detection System Circuit Algorithm

III.5.3 Windows Security System:

It is simple tripwire system that uses a laser and an LDR to detect when an object crosses the laser beam. The laser beam is pointed towards the window, and the LDR is placed on the other side. When the laser beam is interrupted by an object, the LDR detects the change in light intensity and sends a signal to the microcontroller, which can activate an alarm and send the data through the connection device to the main system to notify the user by the control app.

- **Circuit Diagram:**

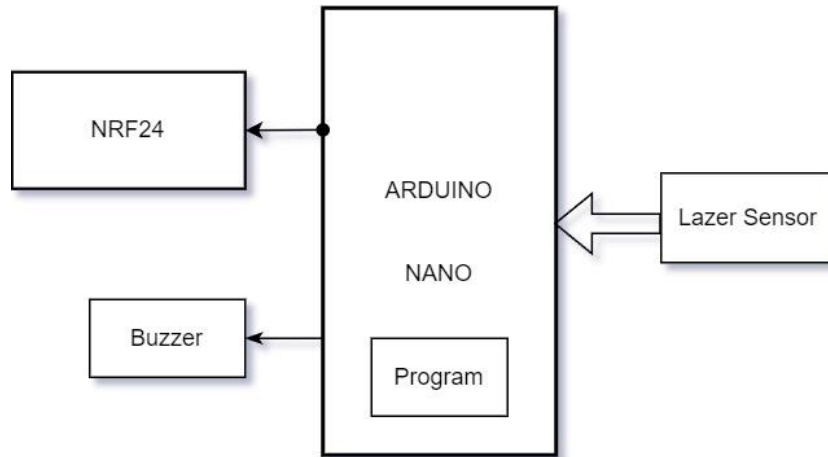


Figure 29: Windows Security System Circuit Diagram

- **Circuit Design:**

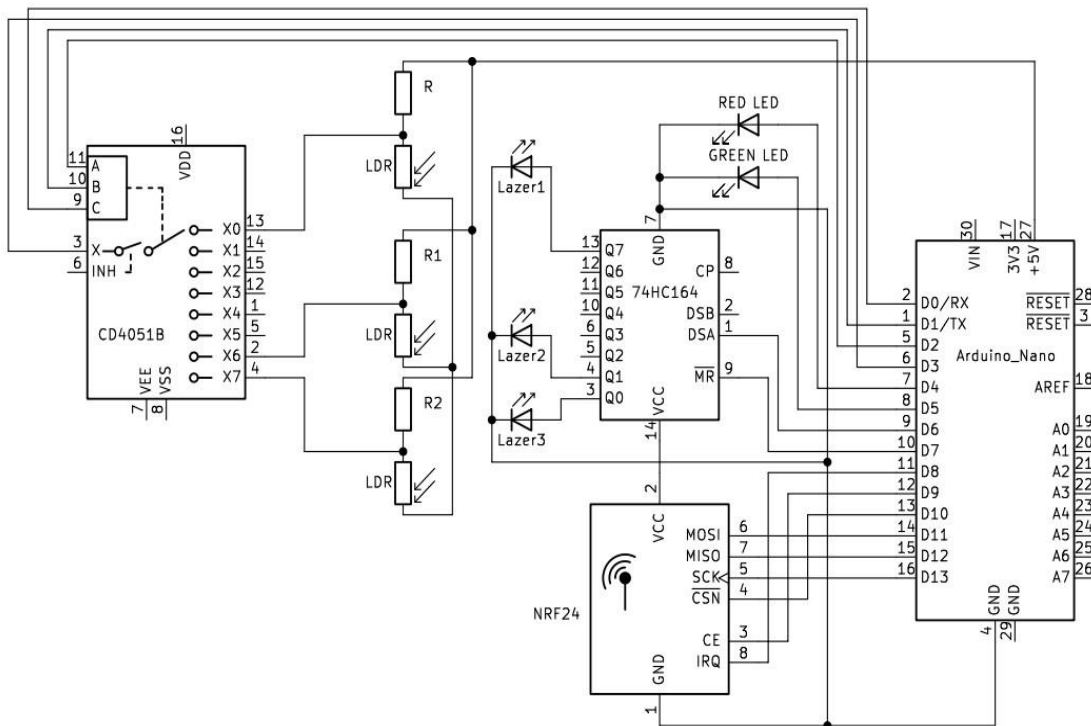


Figure 30: Windows Security System Circuit Design

- **Circuit Algorithm:**

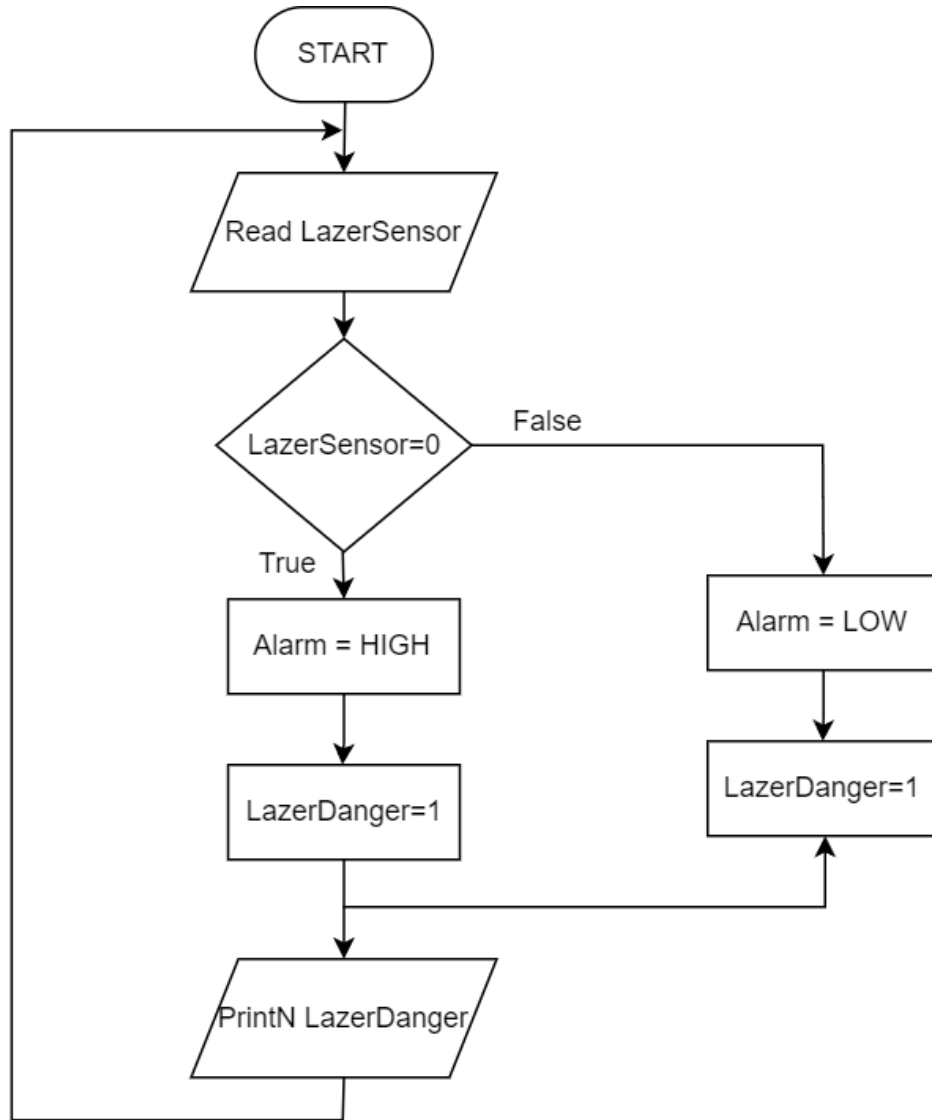


Figure 31:Windows Security System Circuit Algorithm

Here's illustrations of the project:

- **Application Control:**

This is the application's user interface, and these are some of the gadgets included in our project that allow us to control the smart home system.

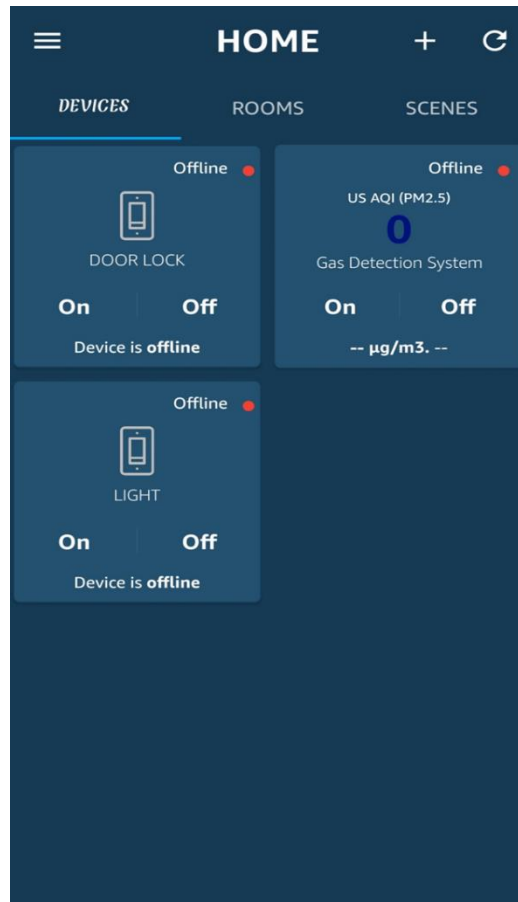


Figure 32:Sinric Pro Application

- **Visual Proof:** The Secure Door Lock System in Action

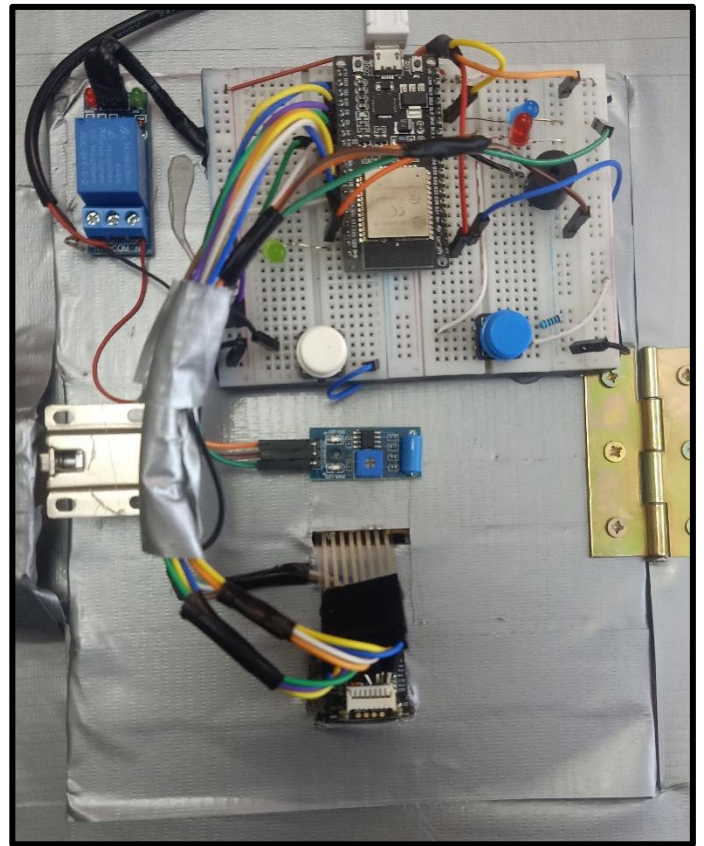
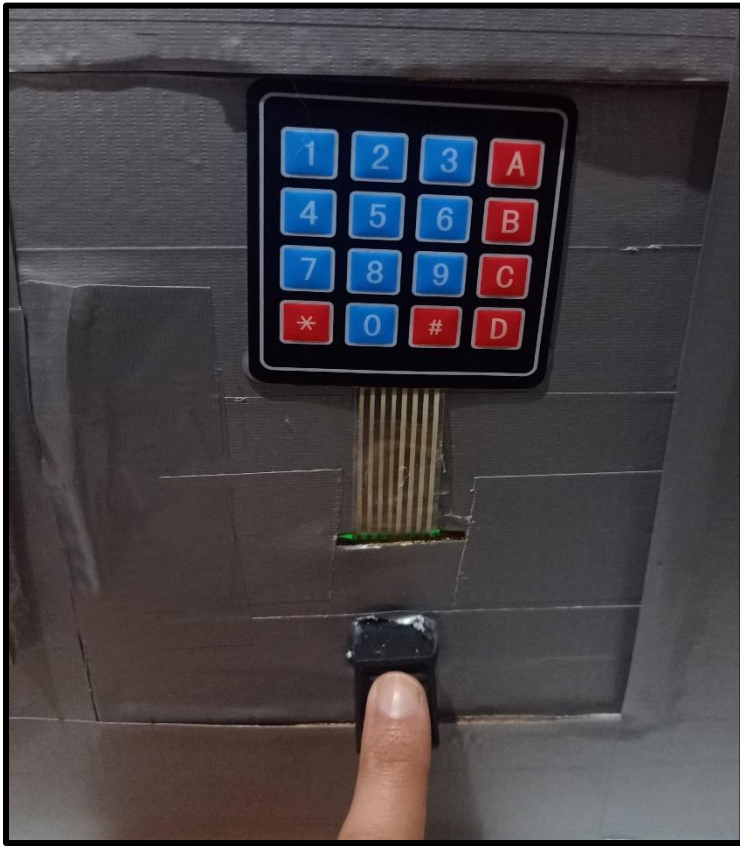


Figure 33: Secure Door Lock System real pictures

Secure Door Lock System

Conclusion

In conclusion, our project's integration of automation and safe home technologies marks an important turning point in residential innovation. Homeowners now have more control, convenience, and peace of mind over their living environments thanks to this transformational project.

Our project offers the smooth management and optimization of numerous home operations through seamless automation. Residents can easily customize their living spaces to suit their preferences and schedules, all while promoting energy economy, by controlling everything from lighting and temperature to entertainment systems and appliance monitoring.

Furthermore, our project's emphasis on security offers the highest level of protection for inhabitants and their possessions. A strengthened barrier against potential dangers is created through robust surveillance systems, encrypted networks, and smart locks, allowing homeowners to remotely monitor and control access to their properties. The integrity of the home security system is further strengthened by the inclusion of cutting-edge security technologies like facial recognition and biometric authentication.

Our project promotes sustainable practices while simultaneously providing convenience and security. Homeowners can decrease energy use, lower utility costs, and have a beneficial environmental impact by utilizing intelligent energy management systems, smart thermostats, and automated power usage optimization. [\[Hammad 13\]](#)

The Sinric Pro IoT system has shown to be an invaluable tool in our project to build a smart and safe home, operating flawlessly and resolving a variety of issues common to smart homes. Our initiative has transformed domestic life by seamlessly integrating automation and safe home technology, giving homeowners unheard-of levels of control, convenience, and comfort.

This system has proven to be a crucial component of our project, tackling the challenges of contemporary living, and providing homeowners with an all-inclusive and trustworthy solution. Because of its success in boosting sustainability, convenience, and security, smart homes will eventually become a natural part of our daily lives, providing unmatched comfort and peace of mind.

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