



BACHELOR OF SCIENCE IN ELECTRONIC AND
TELECOMMUNICATION ENGINEERING

IOT BASED HOME AUTOMATION AND SECURITY

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Declaration

It is hereby declared that the work contained in this thesis is original. The information derived from the literature or work has been duly acknowledged and presented in the reference section. No part of this thesis has been submitted elsewhere for the degree, diploma or other similar title of recognition.

July 2023

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ABSTRACT

The Internet of Things (IoT) has changed the way we interact with our surroundings, and this technology has been increasingly applied to home automation and security systems. This report presents an overview of a IoT-based home automation and security system project, including its structure, functionalities, and benefits. The main components of such systems are discussed, including sensors, actuators, and gateways, as well as the communication protocols and platforms used for data transfer and management. The report also explores the potential applications of IoT-based home automation and security systems, ranging from energy management and entertainment to safety and security. Finally, the challenges and future prospects of this IoT-based home automation and security system project are discussed, including the need for standardization and interoperability, as well as privacy and security concerns. Overall, this report highlights the potential of IoT-based home automation and security systems to enhance the quality of life, improve energy efficiency, and increase safety and security in our homes.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The Internet of Things (IoT) is a rapidly growing technology that is transforming various industries, including home automation and security. The concept of home automation has been around for a while, but the integration of IoT has taken it to the next level. With the increasing need for safety and security, homeowners are looking for smarter and more efficient ways to control their homes. IoT-based home automation and security offers an innovative and practical solution that provides homeowners with complete control over their homes from anywhere, at any time.

In the fast-paced world we live in today, technology continues to advance at an unprecedented rate, transforming every aspect of our lives. One of the most significant technological advancements of recent times is the Internet of Things. IoT has revolutionized various industries, and one of its most prominent applications is in home automation.

IoT-based home automation is a concept that merges the power of the internet with everyday household devices, creating a smart and interconnected network within our homes. It enables us to control and monitor various aspects of our homes remotely, providing convenience, energy efficiency, and enhanced security.

Imagine walking into your home on a scorching summer day, and even before you step inside, your air conditioning system turns on automatically, ensuring a comfortable environment awaits you. As you enter, the lights adjust to your preferred settings, and soothing music starts playing softly in the background. This seamless integration of technology and daily life is made possible by IoT-based home automation.

At its core, IoT-based home automation involves connecting various devices and appliances within our homes to a centralized network, allowing them to communicate and interact with one another. These devices can range from simple household appliances like lights, thermostats, and security systems to more sophisticated gadgets such as smart TVs, refrigerators, and even robotic vacuum cleaners.

The magic of IoT lies in the ability of these devices to collect and exchange data. Sensors embedded within these devices gather information about their surroundings, and through the internet, they transmit this data to a central hub or a cloud-based platform. This data can then be analyzed and utilized to automate and optimize various aspects of our homes.

With IoT-based home automation, controlling our living spaces becomes effortless. We can use our smartphones, tablets, or voice assistants to remotely operate and monitor our connected devices. Whether it's adjusting the temperature, turning on or off the lights, managing home security, or even managing our energy consumption, the power is in our hands, quite literally.

Home automation not only enhances our convenience but also contributes to energy efficiency. By integrating smart thermostats and energy monitoring systems, we can regulate our heating and cooling systems based on occupancy or weather conditions, ensuring optimal energy usage. Additionally, smart lighting systems can automatically adjust brightness and turn off when not needed, minimizing energy wastage.

Security is another significant aspect of IoT-based home automation. With interconnected security systems, we can remotely monitor our homes, receive real-time alerts, and even control access to our properties. Smart door locks, surveillance cameras, and motion sensors provide us with peace of mind, whether we're at work, on vacation, or just in another room. Furthermore, IoT-based home automation is not limited to the inside of our homes. Smart irrigation systems can monitor weather conditions and adjust watering schedules accordingly, conserving water resources. Connected appliances in the kitchen can provide us with personalized recipes, suggest shopping lists, and even order groceries when supplies run low.

As technology continues to advance, the possibilities for IoT-based home automation are boundless. Artificial intelligence and machine learning algorithms can learn our preferences and behaviors, enabling our homes to adapt and anticipate our needs automatically. Moreover, with the integration of renewable energy sources like solar panels, IoT can optimize energy generation and storage, further reducing our carbon footprint.

In conclusion, IoT-based home automation represents the future of modern living. By seamlessly integrating technology into our daily lives, it enhances convenience, energy efficiency, and security. With its potential to transform every aspect of our homes, from lighting and temperature control to home security and appliance management, IoT-based home automation offers a glimpse into a connected and intelligent future.

The purpose of this project is to demonstrate the practical application of IoT technology in home automation and security. The project involves the implementation of a smart home automation and security system that can be controlled remotely using a smartphone or computer. The system includes various IoT devices, such as smart heater, lighting, security locks, that are integrated into a single ecosystem. The system is designed to be easy to use,

energy-efficient, and secure.

This report outlines the details of the project, including the objectives, methodology, implementation, and results. The report also discusses the benefits and limitations of IoT-based home automation and security and provides recommendations for future improvements. The project aims to showcase the potential of IoT technology in transforming homes into intelligent and secure living spaces.

1.2 MOTIVATION

Home automation and security have become increasingly important in today's fast-paced and technologically advanced world. With the rise in home break-ins and burglaries, homeowners are looking for ways to protect their homes and loved ones. At the same time, there is a growing demand for convenience, comfort, and energy efficiency in homes. IoT-based home automation and security offers a practical solution that addresses both of these needs.

The motivation for this project is to demonstrate the potential of IoT technology in transforming homes into intelligent and secure living spaces. By integrating various IoT devices and systems into a single ecosystem, homeowners can remotely control and monitor their homes, making them more energy-efficient, safe, and comfortable. This project aims to provide a comprehensive understanding of the benefits and limitations of IoT-based home automation and security, and to showcase the practical application of this technology.

The results of this project can be used to inform homeowners, designers, and manufacturers about the potential of IoT technology in home automation and security. The project can also be used as a basis for future research and development in this field. Ultimately, this project is motivated by the desire to create a more convenient, comfortable, and secure living environment for homeowners using cutting-edge IoT technology.

1.3 OBJECTIVES

The objectives of the project are given below:

- Developing the project according to the our requirement.
- Developing a working project for automation replicating as home appliances.
- Removing the usual analog or manual activation of the appliances.
- Developing easily controllable sytem.
- Integrating multiple home automation solutions in one project

1.4 REPORT OUTLINE

Six chapters have been covered in the design and construction of this project. The chapters and their material are as follows:

- **Chapter 1** (Introduction) This chapter providing the outline, motivation and purpose of the project.
- **Chapter 2** (Literature Review) This chapter explored previous work or study related to this project.
- **Chapter 3** (Components) The components of this project have been addressed in detail in this chapter.
- **Chapter 4** (System Design) This section covers experimental setup of this project.
- **Chapter 5** (Implementation and Result) Discuss the execution of the project and the performance of the project.
- **Chapter 6** (Conclusion) The overview of this project is explored in more depthin.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

IoT-based home automation and security has gained popularity due to its potential to provide homeowners with greater control, convenience, safety, and energy efficiency. In this literature review section, we will explore the current state of research and development in the field of IoT-based home automation and security.

The literature review aims to provide a comprehensive understanding of the current trends, challenges, and opportunities in this field. The review will cover a range of relevant topics, including the history of home automation and security, the evolution of IoT technology, the benefits and limitations of IoT-based home automation and security, and the current state of research and development.

2.2 REVIEW OF PREVIOUS WORK

The research agenda now includes a wide range of cutting-edge techniques for a streamlined tariff collection system, as well as cutting-edge technology to be implemented on a regular basis. Thus, several fresh methods exist in the area of IoT-based tariff collection system, and a lot more are being looked into. In the sections that follow, I'll provide an in-depth analysis of the work that will be necessary.

2.2.1 Smart Home Automation-Use cases of secure and integrated voice control systems

In this paper the authors suggested a smart home automation system with vital characteristics that is sustainable for the future, we make a small effort to close the gap in the literature in this work. In order to execute smart home automation with a command and control method based on voice, we provide a safe and integrated model integrating IoT devices and appliances. Our technology makes use of IoT systems' seamless connectivity to automatically identify devices across a secure network. The primary goal of the system model that is being proposed is to provide voice-based remote control for consumers while also solving issues with usability, trust, and the administrative burdens associated with managing several IoT devices in a normal home context. Furthermore, we want to show how straightforward and adaptable our suggested approach is for any smart home environment by putting it into practice as a prototype with a range of use cases. Overall, the following are the main contributions of our work: (i) The suggestion of a novel model that

combines end-to-end IoT security that is low-cost, scalable, and easy to configure with voice-controlled command operations of various devices in a smart home.(ii) Application of a tailored virtual private network (VPN) using the Raspberry Pi development platform with sensors, as a single embedded system to securely connect with customized user authentication, allowing access to authorized devices within an IoT network of a smart house. iii) The creation of a voice-control system that can recognize speech commands and operate smart devices securely and intelligently utilizing the verified user's smartphone and a bespoke VPN that connects the Raspberry Pi platform to IoT devices in a smart home.(iv) Showing off the use and applicability of our suggested model using gadgets like a lighting system, music player, computer, and water tank, which can carry out various speech commands to turn on/off specific sensors, play a specific song, conduct a voice-based online search, or even remotely monitor and control water flow from a water tank in a home environment.

2.2.2 IOT Based Home Automation and Monitoring System

This study suggests an IoT-based smart home automation system that automates every aspect of the house through various modules. In one module, the system uses an LDR sensor to measure light level and an IR sensor to detect human movement inside the room. The output of the IR sensor will be used to modify the light level. Additionally, the system uses an AM2301 sensor to control the heater and fans based on the temperature and humidity of the house. A flame sensor and a MQ-135 sensor are both located in a separate module that assists in the detection of fire. The device would also immediately notify the users if a fire is found in the house. Using the Blynk App, a mobile application is utilized to remotely control anything. As a result of being transformed into a smart home, it can offer security, energy efficiency, and the capability to control all of the current appliances in the house remotely or from a central place. The system consequently concentrates on creating the best environmental circumstances while needing the least amount of human work. Beyond everything else, it facilitates time savings in every imaginable way.

2.2.3 Design And Implementation Of An Iot Based Home Security System

The authors of this project reports have done a projects based on implementation of a home security system that uses the Internet of Things. The main goal of this project is to be able to control entrance from anywhere in the world while at the same time making sure it is

secure. It was possible to create an automated door control system that works both through a keypad and a mobile app. IoT stands for the infrastructure of physically linked devices, which is expanding quickly due to the massive increase in the number of items and devices connecting to the Internet. We are utilizing IoT to develop a low-cost home security system since it is a highly beneficial application. To quote from the report, “ METHODS AND MATERIAL WORKING Touch sensor for door is activate buzzer if door is locked and someone wants to open it LPG Gas sensor activate Exhaust FAN and Buzzer (For kitchen) Online from website we can turn ON / OFF light Data of room Temp and Humidity , gas and door touch will send on iot database Temperature and Humidity data we can plot graph online Code lock is use for door open Cloud is the heart of any online system; it is like a central server focus mainly on implementing services without the need of physical hardware. The centralized controller connected with the device sends data generated from our homes and evaluates it and send current data of temperature and humidity on the server. The main benefit of this system is that it uses mobile or computers to control Light functions while sitting anywhere in the world.”

2.2.4 Phone Based Home Automation

Phone Based Home Automation Some systems are described as an enabling system that can be used to provide a common framework for home Automation. It provides a system for a smart home that includes facilities such as a system controller, house-wide wiring and a common interface. This will enable using the existing system for home automation. A hardware based remote controller for power point control has been described. The function of this remote controller is to control the power supplied to devices at a remote location. The system uses the telephone line for transmitting the commands. The controller is a logic system built entirely of hardware. It eliminates the cost incurred with microcontrollers. It uses a DTMF transceiver which is interfaced with a solid state relay to control the power supply. It could also be implemented experimentally with infra red signals and AC power line carrier technology. A home automation system makes use of the dual tone multi frequency (DTMF) used in telephone lines. The system as shown in figure 3 uses the standard public-switched telephone lines. There are three components in the system. The first is the DTMF receiver and ring detector. The second part is the IO interface unit. The third part is the PC which does the online operations. The PC detects the ringing of the line and then authenticates the user. After this the user will be allowed to

use the keypad tones to control the devices as required. An example of stepper motor control is taken up. This system has the advantage of being secure and allowing international standardization. This is because the DTMF tones are the same all over the world. But it suffers from the drawback that the number of appliances is limited by the number of keys in the keypad. An ordinary phone usually has 12 keys only.

2.2.5 Home Automation and Security System

Easy Home or Home automation plays a very important role in modern era because of its flexibility in using it at different places with high precision which will save money and time by decreasing human hard work. Prime focus of this technology is to control the household equipment's like light, fan, door, AC etc. automatically. This research paper has detailed information on Home Automation and Security System using Arduino, GSM and how we can control home appliances using Android application. Whenever a person will enter into the house then the count of the number of persons entering in the house will be incremented, in Home Automation mode appliances will be turned on whereas in security light will be turned on along with the alarm. The count of the number of persons entering the house is also displayed on the LCD screen. In Home Automation mode when the room will become empty i.e. the count of persons reduces to zero then the appliances will be turned off making the system power efficient. Moreover a person can control his home appliances by using an android application present in his mobile phone which will reduce the human hard work. At the same time if anyone enters while security mode is on a SMS will be sent to house owner's mobile phone which will indicate the presence of a person inside the house. The alarm can be turned of using SMS or Android application.

2.2.6 Applications, Systems and Methods in Smart Home Technology

LoRa devices are also well-suited for many common smart home applications on the market today, such as smart lighting, door and window sensors, motion sensors, smart locks, smart irrigation, and more. The lower power consumption of LoRa devices offers a compelling alternative to Wi-Fi or Bluetooth-based battery-operated IoT devices. Frequently recharging or changing batteries on sensors can be inconvenient, particularly when sensors are placed in hard to reach areas. Worse, home security devices that drain battery power quickly can pose a risk, failing at the very moment when they are needed. LoRa solves these shortcomings by enabling devices which leverage its extremely low power

communication capabilities to run for years on a single battery or charge.

2.2.7 Smart Home Automation System Using Internet of Things

The proposed system consist of a hardware interface and software interface. In the hardware interface, the integration of ESP8266 Wi-Fi technology for controlling home appliances and sensors is manifested, and an application is provided for controlling to multiple users of home, with smart phones, tablets, and laptops.. The access to the whole system is given by its admin only to different users. This system is also expandable for controlling various appliances used at home and also for the security and safety purpose of the home through sensors as long as it exists on Wi-Fi network coverage.

CHAPTER 3

HARDWARE COMPONENTS

3.1 INTRODUCTION

An undertaking can't be completed successfully without its components. The procedure of choosing the right components is very critical and difficult. In this part, we'll talk about the materials that will go into our project's construction. In this section, we'll make an effort to describe the hardware, including its function, design, block diagrams, and so on.

3.2 LIST OF COMPONENTS

The components that are used in this project are given below:

1. NodeMCU Esp32
2. 4CH Relay Module
3. Wires
4. Switch Mode Power Supply
5. Buck converter
6. LDR
7. Delay timer
8. Ac Dimmer
9. Ultrasonic Sensor
10. Lock module
11. 12V led
12. Cooler fan
13. Wires
14. PCB Board

3.3 ESP32

NodeMCU ESP32 is a versatile development board that combines the power of the ESP32 microcontroller with the convenience of NodeMCU firmware. The ESP32 is a highly capable Wi-Fi and Bluetooth-enabled system-on-chip (SoC) manufactured by Espressif. NodeMCU, on the other hand, is an open-source firmware based on the Lua programming language that simplifies the development of Internet of Things (IoT) applications.



Fig 3.1 : ESP32

NodeMCU Pin Diagram of ESP32:

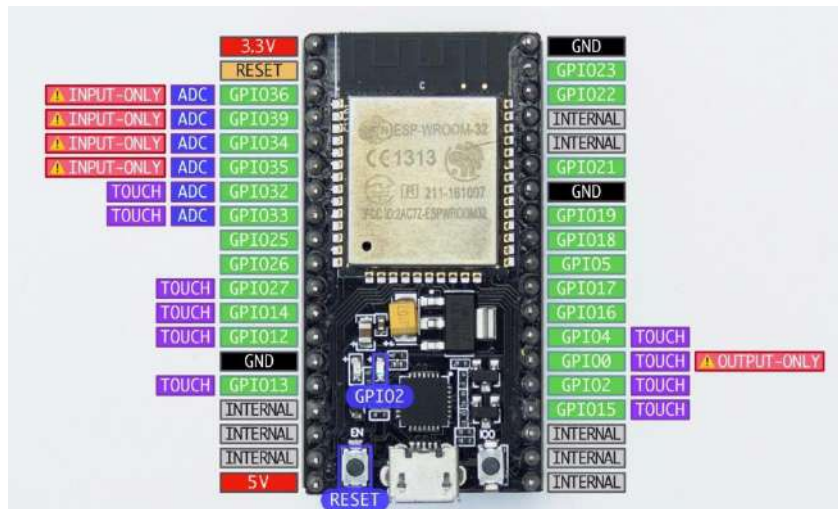


Fig 3.2 : NodeMCU Pin diagram for ESP32

The NodeMCU ESP32 board provides a compact and cost-effective solution for building IoT projects. It offers a wide range of features and capabilities, making it suitable for various applications such as home automation, sensor monitoring, robotics, and more. Some notable features of the NodeMCU ESP32 include:

- i) **Dual-Core Processor:** The ESP32 chip on the NodeMCU board is equipped with two powerful Tensilica Xtensa LX6 microprocessor cores. This enables multitasking and parallel processing, allowing for efficient handling of complex tasks.
- ii) **Wi-Fi and Bluetooth Connectivity:** The ESP32 supports both Wi-Fi 802.11 b/g/n and Bluetooth Classic as well as Bluetooth Low Energy (BLE) communication protocols. This

makes it easy to connect to local networks, control devices remotely, and interact with other Bluetooth-enabled devices.

iii) GPIO Pins and Interfaces: The NodeMCU ESP32 board offers a generous number of General-Purpose Input/Output (GPIO) pins that allow interfacing with various sensors, actuators, and peripheral devices. It also includes interfaces for I2C, SPI, UART, and ADC, expanding its connectivity options.

iv) Built-in Development Environment: NodeMCU ESP32 boards can be programmed using the Arduino IDE, which provides a familiar and user-friendly environment for writing and uploading code. Additionally, NodeMCU firmware supports the Lua scripting language, offering an alternative programming option.

v) Integrated Flash Memory: The board includes a substantial amount of built-in flash memory, providing ample space for storing program code, configuration data, and web server files without the need for external storage.

vi) OTA (Over-the-Air) Updates: The NodeMCU ESP32 supports OTA updates, allowing firmware updates to be applied wirelessly. This feature simplifies the process of deploying new features or bug fixes to devices in the field.

vii) Power Management: The ESP32 chip incorporates power-saving features like fine-grained clock gating, various sleep modes, and adjustable CPU frequency, enabling efficient power management and extending battery life in battery-powered applications.

3.4 SWITCH-MODE POWER SUPPLY

For efficient electrical power conversion, electronic devices often use what is known as a switched-mode power supply (SMPS), switching regulator, switched power supply, or switcher.



Fig 3.3 A switched-mode power supply for project use [23]

3.4.1 Theory of operation of Switch-Mode Power Supply

- Input Rectifier Stage
- Inverter Stage
- Voltage Converter & Output Rectifier
- Regulation

3.4.2 Input Rectifier Stage

The initial step in the operation of a switched-mode power supply (SMPS) is ac-dc conversion, if necessary. The term for this is "correction." When using a DC input SMPS, this is not necessary. Some power supply allow the rectifier circuit to be used as a voltage doubler by installing a switch with manual or automated operation. As a result, it may run on standard 115- or 230-volt electrical outlets. A massive filter capacitor receives the rectifier's unregulated direct current voltage. This rectifier circuit uses AC voltage peaks to pull power from the grid for short periods of time. These short, intense bursts of energy have a low power factor because of their high frequency. Power factor is corrected in many modern SMPSs by use of a dedicated power factor correction (PFC) circuit, which transforms the input current into a sinusoidal function of the incoming alternating current (AC). Most active PFC power supplies are "auto-ranging," meaning that they can accept input voltages anywhere from 100 VAC to 250 VAC without requiring manual adjustment. An SMPS designed for AC input may often be powered by a DC source, since the DC would pass through the rectifier unaltered. The required DC voltage is 163 VDC ($115 * 2$) if the power source is rated for 115 VAC but lacks a voltage selection switch. However, because only half of the rectifier's diodes are being used for the entire load, this kind of application might be harmful to the rectifier stage. This might lead to overheating and the early failure of these parts.

3.4.3 Inverter Stage

The inverter stage takes DC from the input or the rectifier stage and converts it to AC using a power oscillator with a small output transformer with few windings, often operating at frequencies in the tens or hundreds of kilohertz range. The frequency is often over 20 kHz, making it inaudible to humans. A MOSFET amplifier with many stages (high gain) is used to effect the switch. High current may be handled by MOSFET transistors despite their low on-resistance.

3.4.4 Voltage Converter & Output Rectifier

High-frequency transformers employ reversed alternating current to power their primary windings when separating the output from the input, as is frequent in mains power supply. This adjusts the secondary winding voltage such that it produces the desired output. In the block diagram, this function is carried out by the output transformer. In order to get a direct current from a transformer, the alternating current must be rectified. For output voltages higher than around 10 volts, regular silicon diodes are often used. Due to their low forward voltage drop and fast recovery times, Schottky diodes are often used as rectifier components at lower voltages, allowing for low-loss operation at higher frequencies. For even lower output voltages, MOSFETs may be used as synchronous rectifiers due to their reduced voltage drops between their conducting states compared to Schottky diodes.

The output of a rectifier may be filtered using inductors and capacitors to reduce ripple. Components need lower capacitance and inductance to accommodate higher switching frequencies.

3.4.5 Regulation

The voltage at the circuit's output is measured and compared to some standard. Depending on the specifics of the design and the necessary level of safety, the controller may have an isolation mechanism that physically separates it from the DC output. The output voltage of electronics like computers, TVs, and VCRs is carefully regulated by these opto-couplers, which are utilized in switching supplies. There is no feedback in an open-loop regulator. Rather, they only assume that the output is correct so long as a steady voltage is applied to the input of the transformer or inductor. To account for the impedance of the transformer or coil, regulated designs use compensation circuitry. Even more so than with dipole designs, magnetic hysteresis in the core is taken into consideration by monopolar ones. Since the feedback circuit must be powered in order to generate energy, a non-switching power source is supplied for standby.

3.4.6 Block Diagram of a Switch-Mode Power Supply

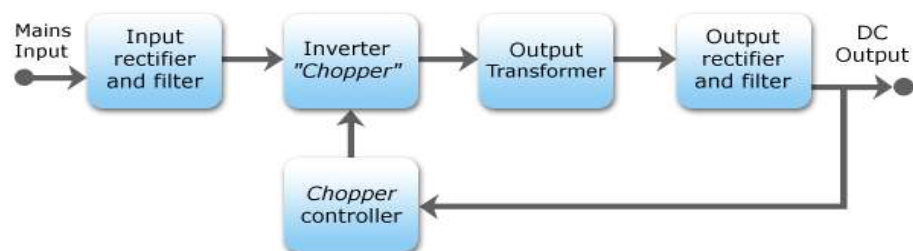


Fig 3.4 Block diagram of a mains operated AC/DC SMPS with output voltage regulation

3.5 Buck Converter

A buck converter, also known as a step-down converter, is a type of DC-DC (direct current to direct current) converter used to efficiently step down voltage levels. It is widely employed in various applications, ranging from power supplies for electronic devices to renewable energy systems. The primary function of a buck converter is to convert a higher voltage input to a lower voltage output while maintaining a stable and regulated output voltage.

The operation of a buck converter involves the use of inductors, capacitors, switches (usually MOSFETs), and control circuitry. Here's a simplified description of how a buck converter works:

- i) **Switch On-State:** Initially, the switch in the buck converter (typically a MOSFET) is turned on, allowing current to flow from the input voltage source through the inductor and into the load. During this on-state, energy from the input source is stored in the inductor's magnetic field.
- ii) **Inductor Energy Storage:** As the current flows through the inductor, the inductor stores energy in its magnetic field. The inductor opposes changes in current flow, resulting in a continuous flow of current through the load even when the switch is turned off.
- iii) **Switch Off-State:** At a predetermined time, the switch is turned off. As a result, the energy stored in the inductor's magnetic field is released and transferred to the load. The inductor voltage reverses polarity, causing current to flow through the load.
- iv) **Output Capacitor:** To smooth out the voltage ripple caused by the switching action, an output capacitor is connected in parallel with the load. It helps maintain a stable output voltage by supplying or absorbing charge as needed.
- v) **Control Circuitry:** A control circuit monitors the output voltage and adjusts the duty cycle of the switch accordingly. By controlling the on and off times of the switch, the control circuit maintains the desired output voltage level despite variations in the input voltage or load conditions.



Fig 3.5: Buck Converter

3.6 LDR

An LDR (Light Dependent Resistor) sensor, also known as a photoresistor, is an electronic component that detects and measures the intensity of light in its environment. It consists of a semiconductor material whose resistance changes with variations in light levels. The LDR sensor is widely used in applications where light detection or measurement is required.

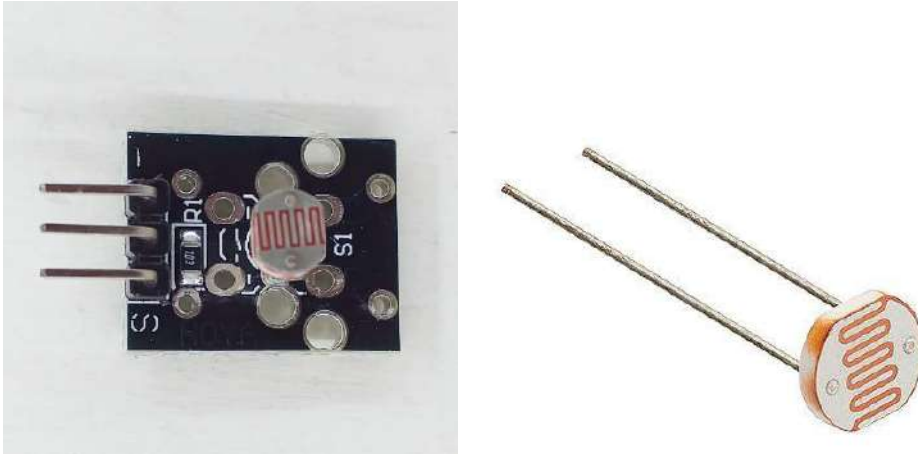


Fig 3.6 and 3.7 : LDR

3.7 Delay Timer Circuit

A delay timer circuit is an electronic circuit that introduces a time delay before a specific action or event occurs. It is commonly used in various applications where precise timing is required. The circuit typically consists of timing components such as resistors, capacitors, and sometimes integrated circuits (ICs) to achieve the desired delay and a potentiometer.

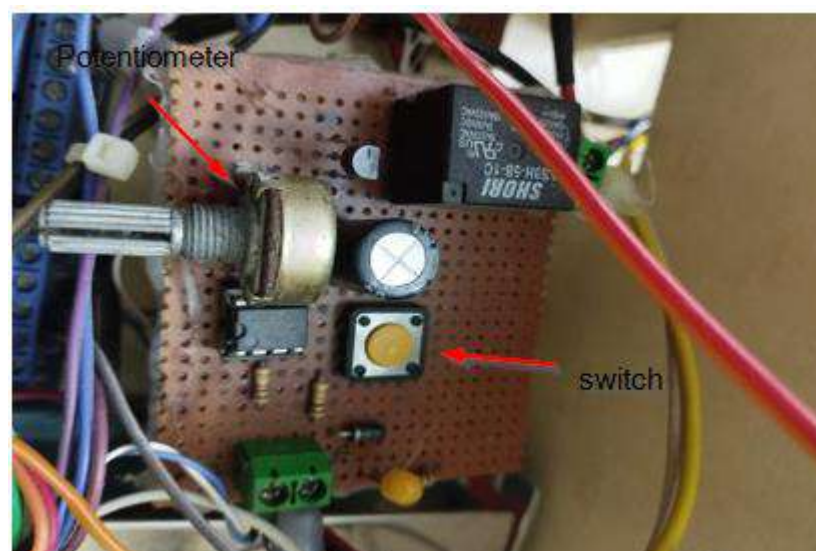


Fig 3.8 : Delay circuit

3.8 AC Dimmer Circuit

An AC dimmer circuit is an electronic circuit used to control the brightness of an AC (alternating current) powered light or appliance. It allows for adjustable dimming levels by varying the amount of power delivered to the load. AC dimmers are commonly used in lighting systems to create ambiance, save energy, and extend the lifespan of light bulbs.

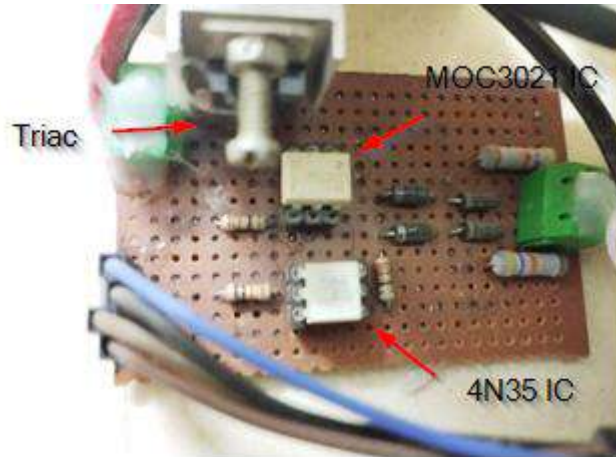


Fig 3.9 : AC Dimmer Circuit

The working principle of an AC dimmer circuit involves controlling the conduction angle of the AC waveform. Here's a simplified description of how an AC dimmer circuit operates:

Phase Control: The AC dimmer circuit utilizes phase control, which adjusts the portion of the AC waveform that is allowed to pass through to the load. This is typically achieved by controlling the firing angle of a semiconductor device, such as a TRIAC (Triode for Alternating Current).

Triggering: The dimmer circuit receives control signals, either from a manual control interface or a microcontroller, to determine the desired dimming level. These control signals are used to trigger the TRIAC and determine when it conducts and switches off.

Variable Power Delivery: By adjusting the conduction angle of the TRIAC, the dimmer circuit varies the power delivered to the load. The shorter the conduction angle, the less power is delivered, resulting in dimmer output. Conversely, a longer conduction angle allows more power to flow, resulting in brighter output.

Smooth Dimming: To achieve smooth and flicker-free dimming, the AC dimmer circuit utilizes zero-crossing detection. This ensures that the TRIAC is triggered at the appropriate point in the AC waveform, minimizing abrupt changes and improving the overall dimming performance.

CHAPTER 4

DESIGN METHODOLOGY

4.1 INTRODUCTION

The most important part of each project report goes here. In this section, we'll go through the methodology behind the project's design, which is represented visually in the form of a block diagram, a flowchart, and a circuit diagram, along with some short explanatory text. The following is a detailed description of how to do this task:

4.2 BLOCK DIAGRAM

We have completed the project's block diagram. The microcontroller ESP32 has been utilized. The ESP32 is a microcontroller board that utilizes the ATmega2560. It has a Single-core Xtensa LX7 CPU, 20 KiB SRAM, 128 KiB ROM, and 16 KiB RTC SRAM, WiFi 2.4 GHz which we will use to control wirelessly, 43 programmable GPIOs and 2×13 -bit SAR ADCs, up to 20 channels.

The necessary block diagram is shown in Fig 4.1. In this case, we use the microprocessor-based IC. Code may be stored in the board's 128 KB of storage memory (of which 8 KB is used for the bootloader), 20 KB of SRAM and 16 KiB of RTC SRAM (which can be read and written with the library). I/O, central processing unit, and power supply are the microcontroller's three primary components. Most of the components in our project are connected to the microcontroller as shown in block diagram shown in Fig 4.1.

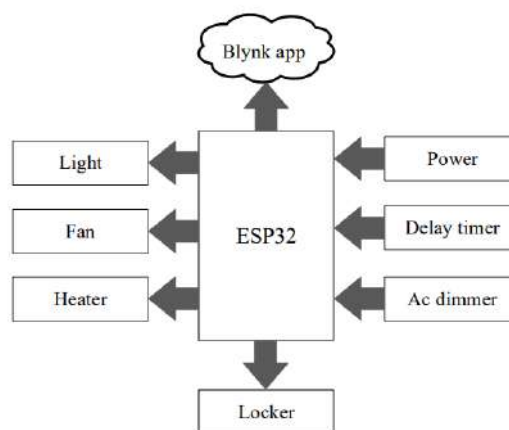


Fig 4.1 Block Diagram of This Project

The microcontroller serves as the central hub for all of the electrical components and

sensors. Here, the input voltage range for microcontroller is 7v and 12v.

Input There are two additional circuits known as the delay timer circuit and AC dimmer which are also connected to the microcontroller. We use pass input from the micro-controller through them to be delayed through the delay circuit and to be resisted through the AC dimmer circuit.

4.3 FLOW CHART

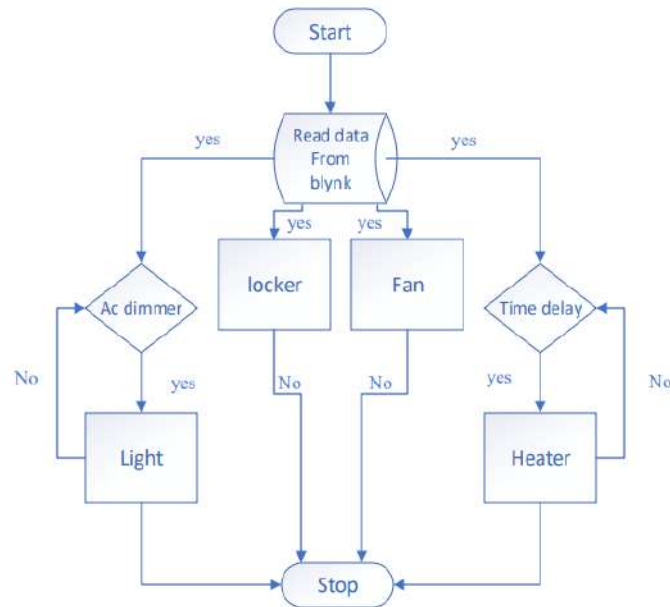


Fig 4.2 Flow chart of this project

The process of making a system is the initial step in making the system itself. It's easy to see how everything works thanks to the flowchart. Thus, we have developed a process flow diagram. Developed project flow is shown in Fig 4.2.

The operation of the flow chart is discussed below

- Initiating the program's algorithm through the blynk is the first step.
- Following this, the app interface will show all the components
- There will be a transition to the next stage of the process if the previous phase determined that the program was accurate by matching the RFID card. In such case, the algorithm will halt and the car will have to do a U-turn.
- Next, the system will act in accordance with the program's current condition. The algorithm will send it to the loan system if the balance is less than \$500. If the automobile's owner decides to get a loan, the algorithm loops back to that point, but if they don't, the car has to do a U-turn, and the procedure ends. Once the tariff is

subtracted and the remaining balance is larger than 500, the gate will open and the algorithm will stop searching for an output until one is discovered.

- This will lead to the expected result.

4.4 CIRCUIT DIAGRAM AND PIN CONNECTION

For this project, the circuit diagram was made with the Proteus Software. The circuit schematic and its pin-to-pin connection are detailed below:

4.4.1 Circuit Diagram of the Project

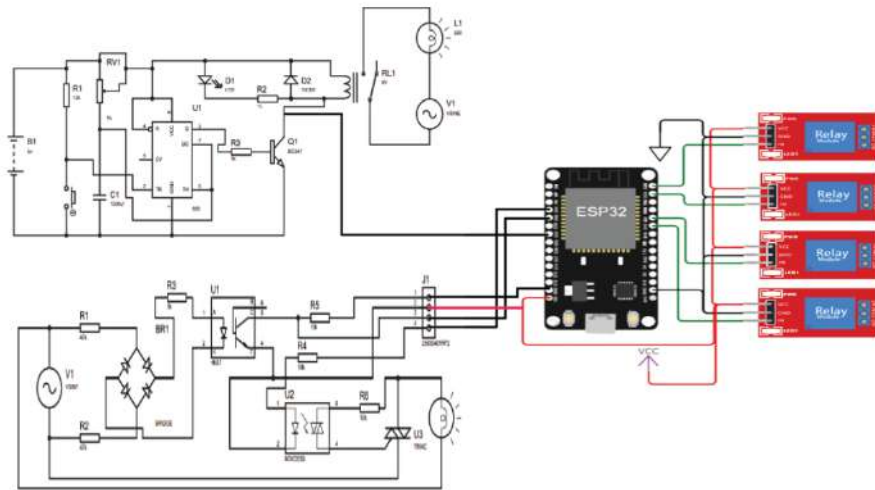


Fig 4.3: Circuit Diagram

4.4.2 Pin Connection of the Project

This system's ESP32, or microcontroller, is linked to all of its parts. We have used ESP32 as the main microcontroller of this project. We have used relay module with microcontroller. The gnd pin of the relay module is connected to the power gnd pin, and the vcc pin is connected to 5 volts. The output of the relay module is connected to pin number 12,13,19,16. Here we have used an AC dimmer circuit, which includes, bridge rectifier, 4N35 optocoupler, moc3021 ic, diac, triac. With this dimmer circuit we can increase and decrease the intensity of the AC light. The zvc pin of the AC dimmer is connected to pin 14 of the microcontroller, and the trig-out pin is connected to pin 5. Vcc and ground pins are connecte. Using a delay timer circuit to automatically turn off the heater element within a specified time. In which the time can be adjusted. Push switch, capacitor, 555 IC, potentiometer, relay are used in this circuit. The output pin of which is connected to pin 11 of the microcontroller.

CHAPTER 5

IMPLEMENTATION AND RESULT

5.1 INTRODUCTION

The goal of this project is to compile more than one home automation technique into one platform. The code for this project was written in Arduino. We have developed an enhanced home automation project where we can control the appliances from distance and also set a timer.

5.2 IMPLEMENTATION

All the system's hardware fits onto a single partex board. The microcontroller is linked to several sensors and actuators, including an Sonar sensor, LDR, Solinoid lock, and motor. Connectors are used to link each component to the the microcontroller board. We also use connectors for a variety of connections.

5.2.1 COMPLETE OVERVIEW

Our whole project was mapped out using Proteus software, and all of the interconnections between components were drawn out as a circuit diagram. We used an infrared sensor, RFID readers, a keypad, an LCD, a servo motor, and some wires in this project. A schematic representation of the whole system is shown in Fig 5.1.

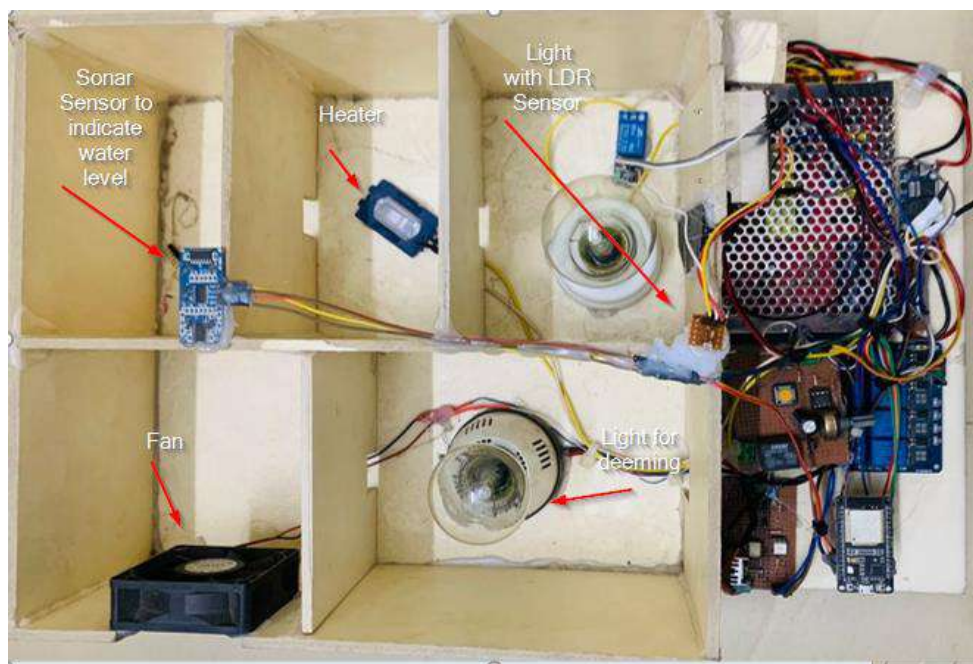


Fig 5.1 Total overview of the system

5.3 PERFORMANCE OF THE SYSTEM

First, we must download the software from PC-Arduino via a programming cable. The software will then be started by providing electricity. When a car tries to pass through the toll gate, the IR sensors identify it. The RFID reader will then scan the data contained in the RFID tags, and the system will provide output based on the car owner's balance. The use of video will make the entire procedure easier to understand.

5.4 DEMONSTRATION AND RESULT OF THE PROJECT

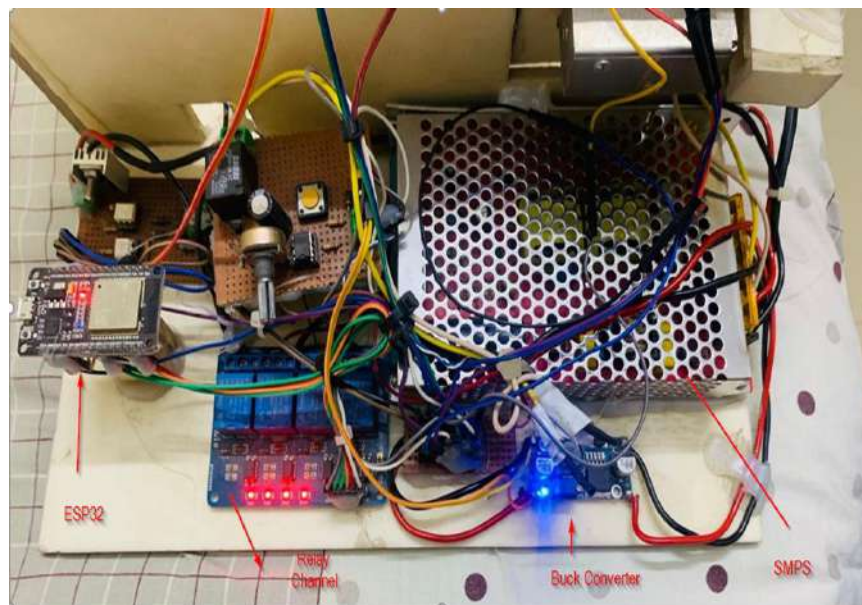


Fig 5.2: Main segment

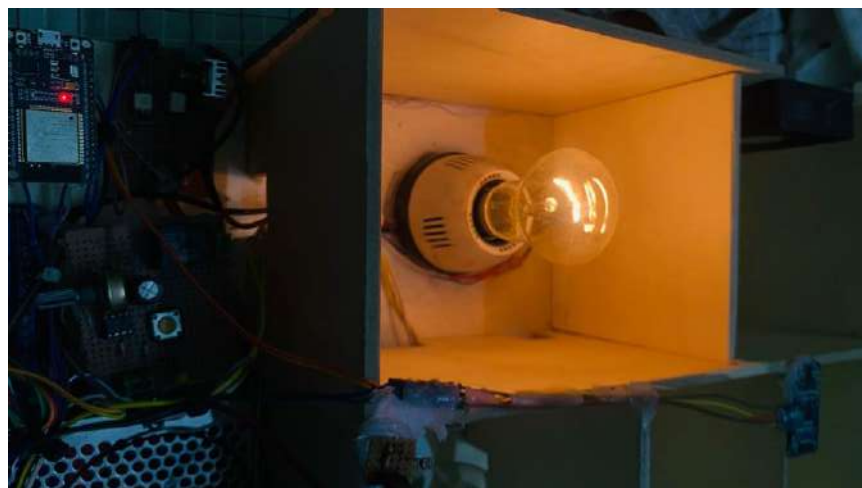


Fig 5.3: Light Deeming

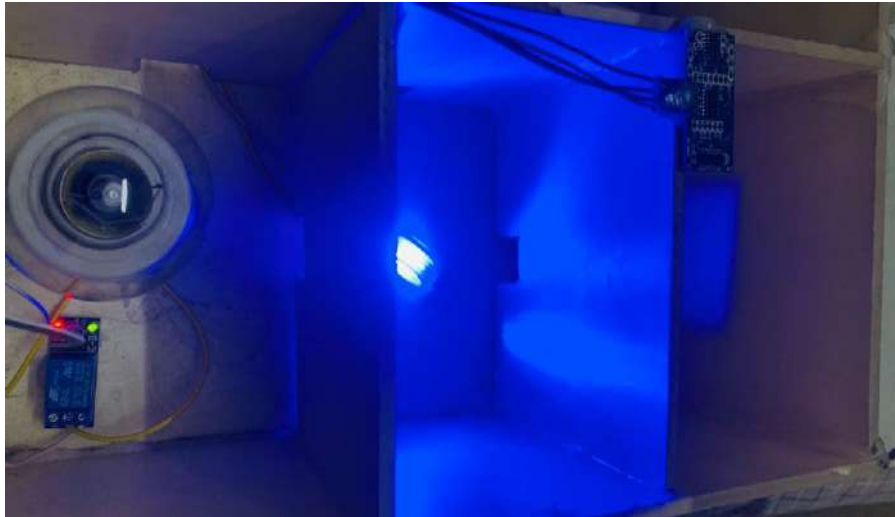


Fig 5.4: Heater on/off



Fig 5.5: Fan

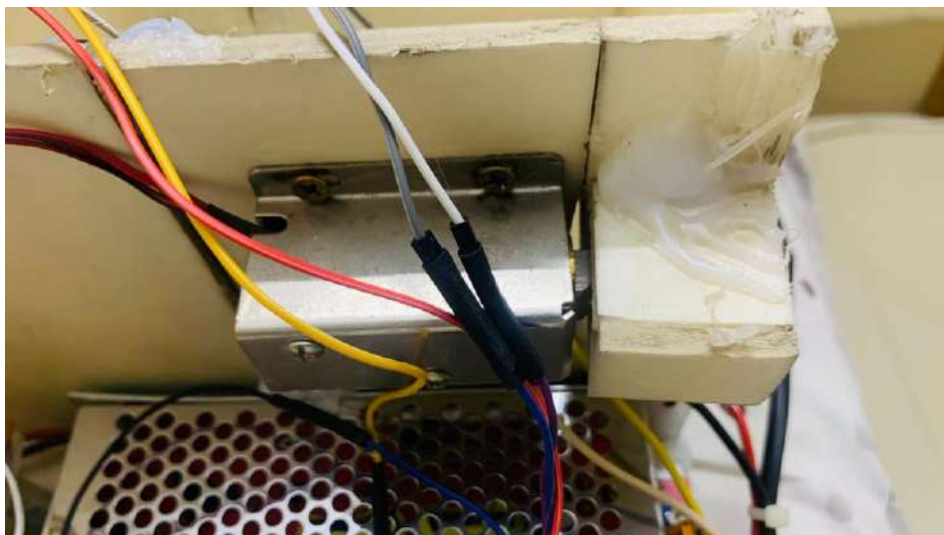


Fig 5.6: Lock

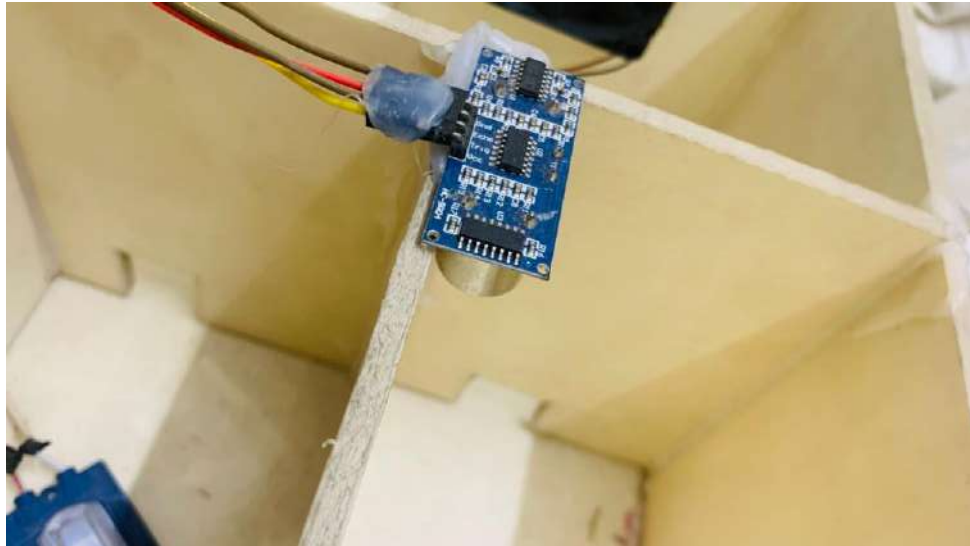


Fig: 5.7 : Sonar sensor for water level detection

5.5 RESULT ANALYSIS:

This project has working as intended. The purpose of this result analysis is to evaluate the outcomes and effectiveness of a home automation project. The project aimed to automate various aspects of a home, such as lighting, temperature control, security systems, and entertainment devices, through the integration of smart devices and a centralized control

Components	Time	From Source	Energy consumption/ wastage(d)	Power usage/Saved in a month	Cost saved
Motor still on/water level low	5h	5v/5w	0.025w		
Motor turned off/water level high	5h	0w		0.75kw	3.75tk
Led turned on	2h	12v/12w	0.023w		
Led turned off	2h	0w		0.72kw	2.98tk
Bulb not deemed	5h	30w	0.15w	4.5kw	-18.73tk
Bulb deemed	5h	+5w	0.025w	+0.75kw	3.75tk

Fig 5.9: Power and cost analysis

system. The analysis will focus on the achieved objectives, performance, user satisfaction, and potential areas for improvement.

After we turned on the blynk app we were greeted with some buttons and a slider for deeming light. We tried each of the options and they were working as expected except the sonar sensor. We were able to turn on/off the fan, the light, the heater turned off according to the potentiometer timer but the sonar sensor was giving fluctuated results. We believe a little bit tweaking can cause this to behave normally.

5.6 TOTAL COST OF THE PROJECT

Due to having typical/regular components, our project is not that costly. This endeavor cost about 3000 taka. We may reduce expenses by getting rid of or selling off some of the less essential equipment. The overall budget for this project is shown in Table 5.1.

Components name	Cost
Esp32	550
4ch relay module	400
Switch mode power supply	380
Buck converter	80
Delay timer	200
Ac dimmer	200
Ultrasonic sensor	100
Lock module	700
ldr	10
12V led	20
light	50
Cooler fan	50
Light holder	30
Pcb board	50
Total	2820

COMPARISON OF RESULT WITH OTHER WORKS

When comparing IoT-based home automation systems to other works in the field, several key factors come into play. Firstly, the integration and connectivity capabilities of IoT devices set them apart. Unlike traditional home automation systems that often operate in silos or require complex wiring, IoT devices can seamlessly communicate with each other and with the internet, enabling a higher level of automation and control. Most of the previous works we mentioned here has a particular system automated to showcase automation of a single appliance or machine and some of those works focused on making particular type of deviced automated. Our project has different types of devices or

machines implemented in one single home automation system. We wanted to show that it's possible to interconnect regularly used home devices and automate them based on one another. We have implemented multiple home automation techniques integrated into one when most of the previous works focused on improving one single technique to make it better or more efficient. Our result worked as intended.

5.7 COST COMPARISON

Our research shows that this project, with a projected budget of BDT 5000, is, 'IOT BASED HOME AUTOMATION AND SECURITY' and that it costs less than similar projects that have been published in reputable journals and publications. The fundamental idea here is to use micro-controller and real-time data input to control the components used in the project. Most of the similar projects we mentioned have anticipated cost of BDT 10000-15000tk. Although some of them are with reliable component and mechanisms for convenience purposes but our project is done with what's typically available in the market easily and are of low price. We think that anyone can gather up these components and implement the same without breaking the bank.

The things we found most relevant to our own included things are fully automated lights and fans without the control of blynk and advanced Monitoring. However, these elements often coexist in construction projects. The development costs for a project with these features will be high, and will likely not be less than BDT 10,000-15,000.

We built a fully functional automated home system using a phone which is a element everyone has access to. Our project is expected to cost BDT 5000 only and includes lock, monitoring and multiple mechanism implemented in one. We can confidently claim that our project is more affordable than the alternatives.

5.8 Cost saving Advantage:

Our project has mechanism that can save power. One of the instance where we can do that is the automatic heater turn off after a defined period and light deeming. What we wanted to show by it is how we can turn off a certain device after a fixed time without physical interference. Second thing where we can save power is through automatically turning off the motor when the water level is full without physical interference. By doing that the motor will go off when the water fills up a tank and will be shut off automatically. These can result in a significant amount of power saved in daily usage. Most of these cost saving measure are not visible in the previous work. Imagine if some ran a motor for longer period than necessary. The electricity bill will increase. Same as the heater or any other electronic

equipment. If they are ran longer than necessary because of forgetfulness or other reason then it will result in a increased bill.

For example, If the light runs on its full power for 8 hour average a day using 15 watts constantly the electricity bill will be much higher. If we deem it when not necessary the power usage will go down i.g 3-5watts. That power usage for the same 8 hour time or more will result in a much lower cost. The heater and motor works the same. If we don't turn them off in time or when not necessary they will a lot of power which will result in a lot of power waste. Because of having a automatic switch off the heater will turn off after a predefined time and the motor will turn off when the water level fill the tank. Even if someone forgets to turn off the motor it will still automatically shut down when the tank is filled, resulting in power saved. Hence a lower electricity bill and power waste.

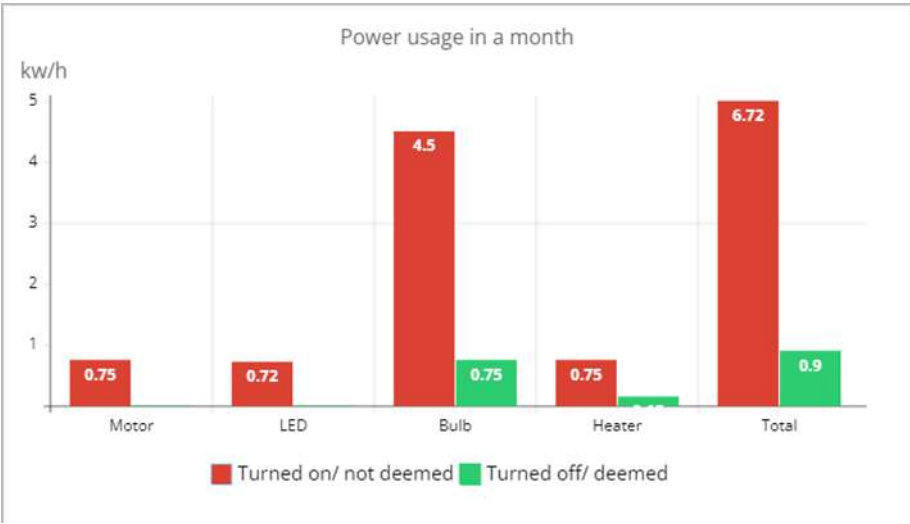


Fig 5.10: Power wasted in a month

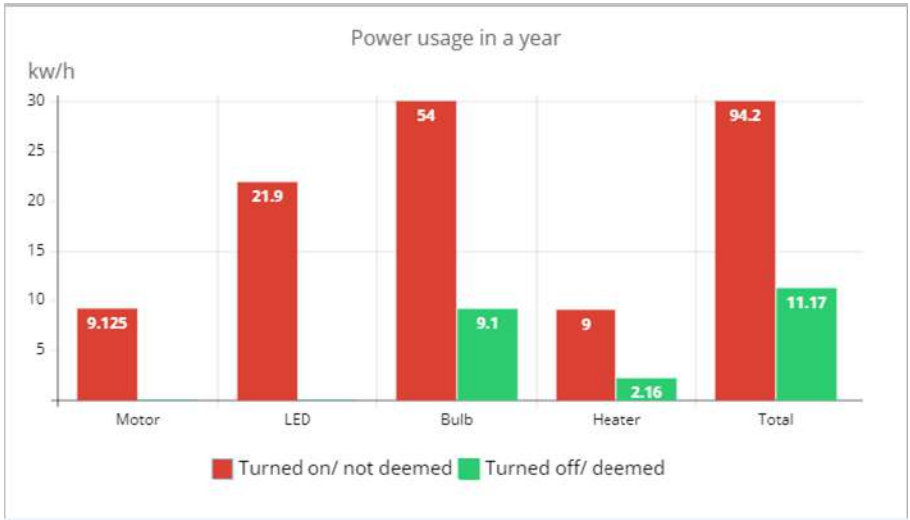


Fig 5.11: Power wasted in a year



Fig 5.12: Saved cost

CHAPTER 6

CONCLUSION

6.1 INTRODUCTION

This is the project report's last chapter. In this chapter, we will talk about the project's completion. We will also talk about the project's limits, potential developments, applications, and benefits.

6.2 CONCLUSION

When compared to the performance of competing home automation initiatives, we can observe that our solution achieves the intended objectives with good accuracy at a low cost. So far, we've seen that earlier developed systems were expensive than our implementation while showing the same things that we did. Previous created systems were focused on certain themes such as controlling the appliances through app only but with our system we can demonstrate a variety of systems at a lower cost. The application of technological innovation has now become important for scientific development in this industrial revolution. In this aspect, our project is quite effective and will benefit the automated home automation techniques. It has the potential to be used making cheap home automation products in our country and make daily heldups easiers.

6.3 APPLICATIONS

Our project has real life applications which are given below

- Switching system wirelessly through an app.
- Monitoring water level.
- Automated light system.
- Automated motor system according to the water level.

6.4 ADVANTAGES

Our project has some advantages which are given below

- Because it's through an app we can switch the devices from a distance
- When a business or home uses automation, costs go down.
- It can improve the life of home dwellers or workers in a certain industry.
- Worth the money, what's it made for.

6.5 LIMITATION

Anything that exists in this world is bound by certain constraints. In that regard, there are several

restrictions attached to this project, which are detailed down below

- Due to the fact that it is a simple project, it cannot be used for industrial or real application in its current state. In the industry, this kind of basic design and layout are followed but more advanced modules of the components that are employed are used.

6.6 FUTURE IMPROVEMENT

Some changes can be made to this project in the future, which are discussed below.

This project's topic allows us to develop a sophisticated home automation system with fully automated system.

When doing a home automation project like this one of the areas which can be improved upon is hand gesture-controlled home appliances

The cost of the full home automation system that includes all the functionality will be large so development for each of the device that are regularly used in a typical home to bring automation in them is necessary. So more focus should be given to improve each category in home automation system and bring as much as appliances possible to integrate in the system.

The future of home automation is expected to be characterized by the integration of increasingly sophisticated technology and the expansion of the Internet of Things (IoT). One area where we can expect to see significant advancements is in the field of artificial intelligence (AI) and machine learning (ML).

These technologies will enable home automation systems to become more intelligent and adaptable, allowing them to learn and respond to the preferences and behaviors of homeowners. For example, smart home systems will be able to automatically adjust lighting, temperature, and other settings based on a person's schedule and habits, without the need for manual adjustments. Another area where we can expect to see growth is the integration of virtual and augmented reality (VR/AR) technology.

This will allow homeowners to interact with their smart home systems in new and innovative ways, such as using voice commands or gestures to control appliances and devices, or using VR/AR technology to remotely monitor and control their home from a different location. The IoT will also continue to play a major role in the future of home automation, as more and more devices become connected to the internet and able to communicate with each other.

This will enable the creation of new and innovative home automation applications, such as smart appliances that can work together to manage energy consumption, or security systems that can automatically arm or disarm based on the presence of people in the home.

In addition, the future of home automation also includes more advanced security features such as facial recognition, biometric authentication, and real-time monitoring. This will provide homeowners with more secure and personalized control over their home.

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Appendix

```
#define BLYNK_TEMPLATE_ID "TMPLxgQ6BXtI"
#define BLYNK_DEVICE_NAME "home automation"
#define BLYNK_AUTH_TOKEN "t9ZiTiZBOnC6cTCbt1oS6lge1g3zDsT"
#define BLYNK_PRINT Serial

#include <WiFi.h>
#include <BlynkSimpleEsp32.h>

#define trigpulse 2
#define sw 4
#define zvc 15
#define motor 5
int x = 0;
int Slider_Value;

#define echoPin 12
#define trigPin 13

long duration;
int distance;
char auth[] = BLYNK_AUTH_TOKEN;

char ssid[] = "password";    // Your WiFi credentials.
char pass[] = "Sakiballl";

#define VPIN_BUTTON_5 V4

BLYNK_WRITE(V0){
  int pin = param.asInt();
  digitalWrite(18,pin);
}
BLYNK_WRITE(V1){
  int pin = param.asInt();
```

```

    digitalWrite(19,pin);
}
BLYNK_WRITE(V2){
    int pin = param.asInt();
    digitalWrite(22,pin);
}
BLYNK_WRITE(V3){
    int pin = param.asInt();
    digitalWrite(23,pin);
}
BLYNK_WRITE(V4)
{
    Slider_Value = param.asInt();
    Serial.println(Slider_Value);
    x = map(Slider_Value, 0, 1024, 7200, 200);
}
void setup() {
    Serial.begin(115200);
    pinMode(motor,OUTPUT);
    pinMode(18,OUTPUT);
    pinMode(19,OUTPUT);
    pinMode(22,OUTPUT);
    pinMode(23,OUTPUT);
    pinMode(trigPin, OUTPUT);
    pinMode(echoPin, INPUT);

    pinMode(zvc, INPUT_PULLUP);
    pinMode(trigpulse, OUTPUT);
    pinMode(sw, INPUT);
    digitalWrite(sw, INPUT_PULLUP);
    attachInterrupt(digitalPinToInterrupt(zvc), acon, FALLING);
    WiFi.begin(ssid, pass);
    while (WiFi.status() != WL_CONNECTED) {
        Serial.println(".");
        delay(100);
    }
}

```

```

Blynk.config(auth);
Blynk.connect();
}

void ultrasonic()
{
    digitalWrite(trigPin, LOW);
    delayMicroseconds(2);
    digitalWrite(trigPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(trigPin, LOW);
    duration = pulseIn(echoPin, HIGH);
    distance = duration * 0.034 / 2; //formula to calculate the distance for ultrasonic sensor
    if(distance>9){
        digitalWrite(motor,LOW);
    }
    else{
        digitalWrite(motor,HIGH);
    }
    Serial.print("Distance: ");
    Serial.println(distance);
    Blynk.virtualWrite(V5, distance);
    delay(500);
}

void loop() {
    Blynk.run();
    ultrasonic();
}

void acon() {
    delayMicroseconds(x);
    digitalWrite(trigpulse, HIGH);
    delayMicroseconds(50);
    digitalWrite(trigpulse, LOW);
}

```

IOT base Home automation and security system

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