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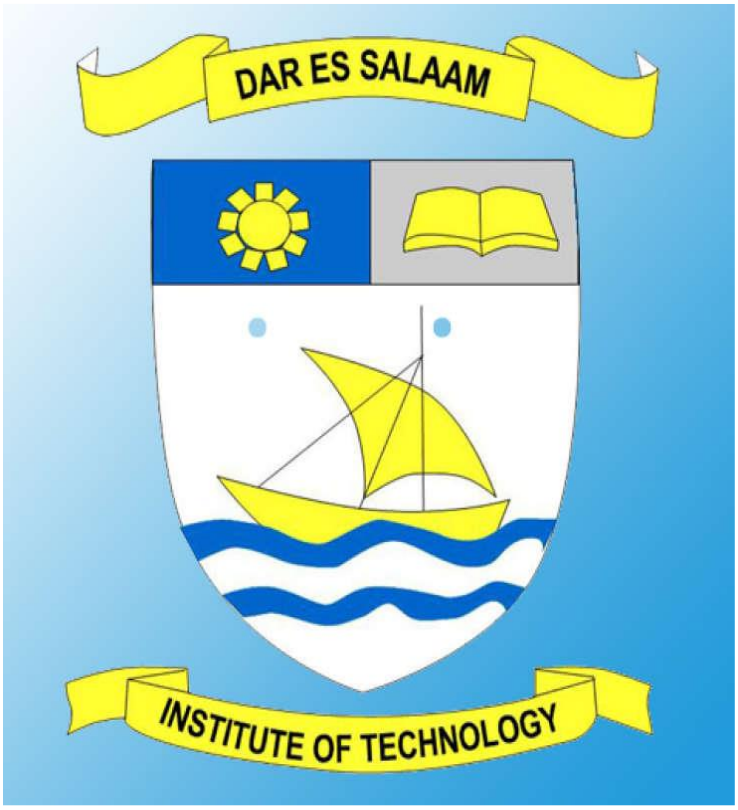

PROGRAM: ORDINARY DIPLOMA IN COMPUTER ENGINEERIMG OD2020
NTA LEVEL 06

TITTLE	**HOME AUTOMATION USING IoT**
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REG NO.	**200220218925**
CLASS	**OD20 COE**
ACADEMIC YEAR	**2022/2023**

DECLARATION

I, SARAFINA LARENT ADRIANO declare to the best of my knowledge that, this project presented here, as partial fulfilment of Ordinary diploma in Computer Engineering is my original work and it has not been admitted at any college or university for a similar award and has not been copied from elsewhere. The content used in this project reports are my own, except where explicitly indicated otherwise.

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I would like to thank our project coordinator who arranged and managed the presentations I would also thank my supervisor Doc. Fimbombaya who guided me and taught me more about this project

I am obliged to thank my fellow students for their valuable guidance and cooperation during the period of this project

ABSTRACT

The Internet of Things (IoT) is a system of interconnected devices, its components are internet, things and connectivity, IoT based systems are used to create smart houses all over the world

The home automation system is implemented for decades but due to its high cost and budgeting of the project, it remains a niche product for high-end consumers. This intelligent system includes the security system, security is one of the major factors that does not implement the home automation system. The hectic daily life routine sometimes makes people forgetful to switch off the lights at home which increases the electricity bills at home, the strength of this project is to control the lamps and doors at home using a smartphone

Automated data is created by automated devices and systems such as smart locks, smart windows and automated lightings

Contents

ABBREVIATIONS

DIT	Dar es salaam Institute of Technology
IoT	Internet Of Things
GSM	Global System of Mobile Communication
IC	Integrated circuit
LDR	Light Dependent Resistors
LED	Light emitting diode
PIR	Passive InfraRed
SD	Secure Digital
SDLC	Software Development Life Cycle
USB	Universal serial bus

CHAPTER 01

INTRODUCTION

1.1 Introduction

A smart home includes sensors, actuators, middleware and a network which has two major interacting components that are a smart network and a smart load. The smart home is known as home automation, which uses new technology to make the domestic activities more convenient, comfortable, secure and economical

IoT home automation was created to automate human lives by activating appliances without a use conventional switch by controlling things by using a smartphone. The main technologies used are GSM, Internet and Bluetooth based It includes setting home security controls such as alarms, controlling appliances through a smartphone and simple or complex lighting systems through a wireless based network

IoT can be defined as connecting various types of objects like smartphones, personal computer and tablets to the internet, which brings in very new type of communication between things and people and also between things

1.2 Problem Statement

Most modern homes have security systems such as CCTV cameras which has blind spots and Electrical wires which can be tempered on both of these can lead to a faulty security system. The mentioned system also are very cost full, This leads to the need of home automation system which will provide security and proper lighting to the user and easily get access to the house

1.3 Objectives

1.3.1 Main Objective

To develop a home automation system through the use of internet hence creating a smart house

1.3.2 Specific Objective

- To design a simple sub-system that will;
    i. Alert the user of any intrusion by alert sound from the buzzer when a motion sensor detects movement or when a door/window sensor is triggered.
    ii. Automatically enable lighting lights when motion is detected
    iii. Send notifications to the user
- To develop the intruder alert and lighting systems
- To integrate the sub-systems with the mobile phone
- To test the security and lighting systems
- To Design and develop a Model house for the System

1.3.2 Scope of the project

i. This project focuses on the hardware and software that is used

ii. The emphasis includes controller and program

1.3 Project Significance

i. Using a smartphone to give command to the lighting system at home
ii. To control the security at home using smart phone
iii. Very affordable Security system
iv. Ensure security by the use of sensors

CHAPTER 02

LITERATURE REVIEW

This chapter explains about the existing system, it's weakness and what should be done to provide users with a better less complicated system

2.1 Existing System

Home automation previous system was created using java it mainly used Wi-Fi as a medium for communications between software and hardware components the main drawback was the range of Wi-Fi was limited hence the user had to be within the range.

The existing, well-established home automation system was based on wired communication known as raspberry-pi based home automation system. This does not pose a problem if the system is planned well in advance and installed during the physical construction of the building. But in case of an already existing buildings the implementation cost goes very high since the system has a complex architecture.

The block diagram below is the structure of the existing system

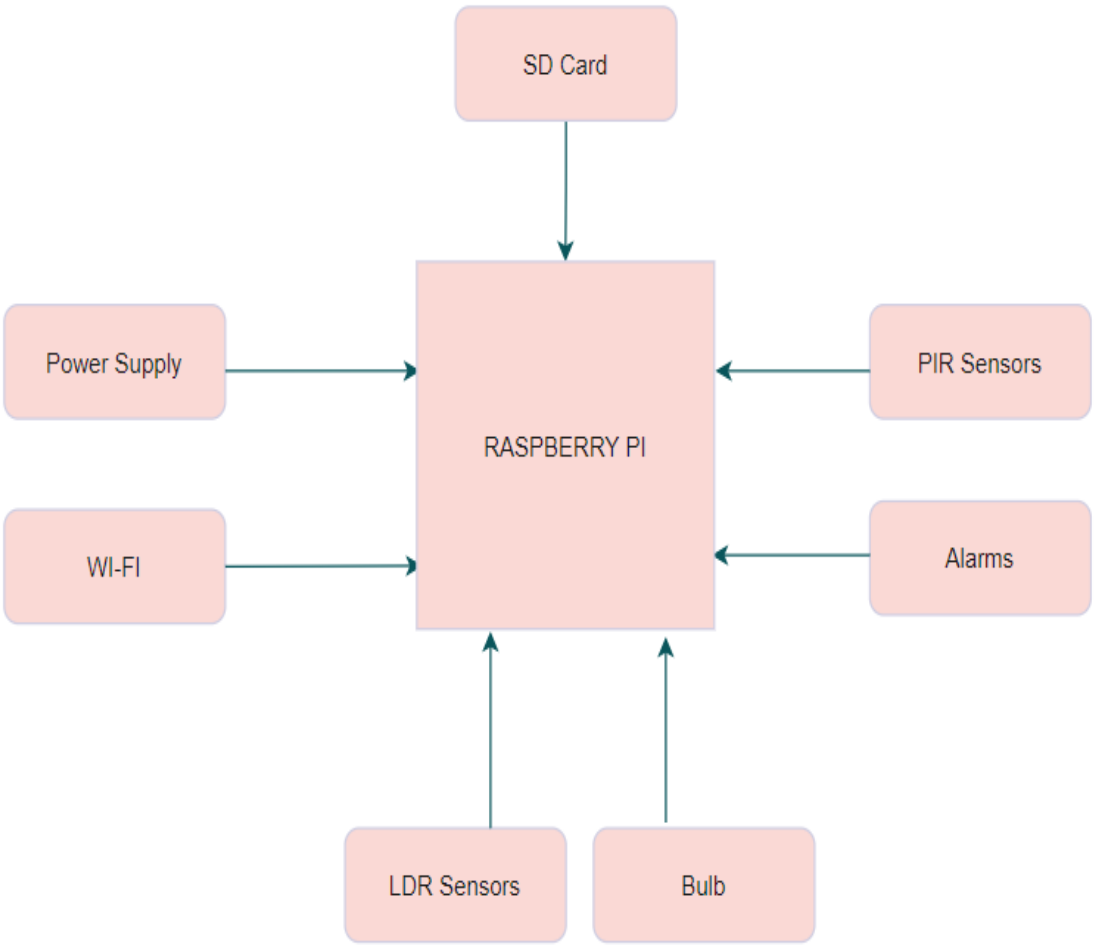


Fig 1.0 PIR Motion sensor.

2.2 Proposed System

A home automation system that is Web based and IOT based will be developed. The client will easily access the house by using a mobile phone Due to its performance, low cost and reliability home automation system will be making its position in global market for easy access to obtain a smart home, the system uses a NodeMCU

THE STRUCTURE OF THE PROPOSED SYSTEM

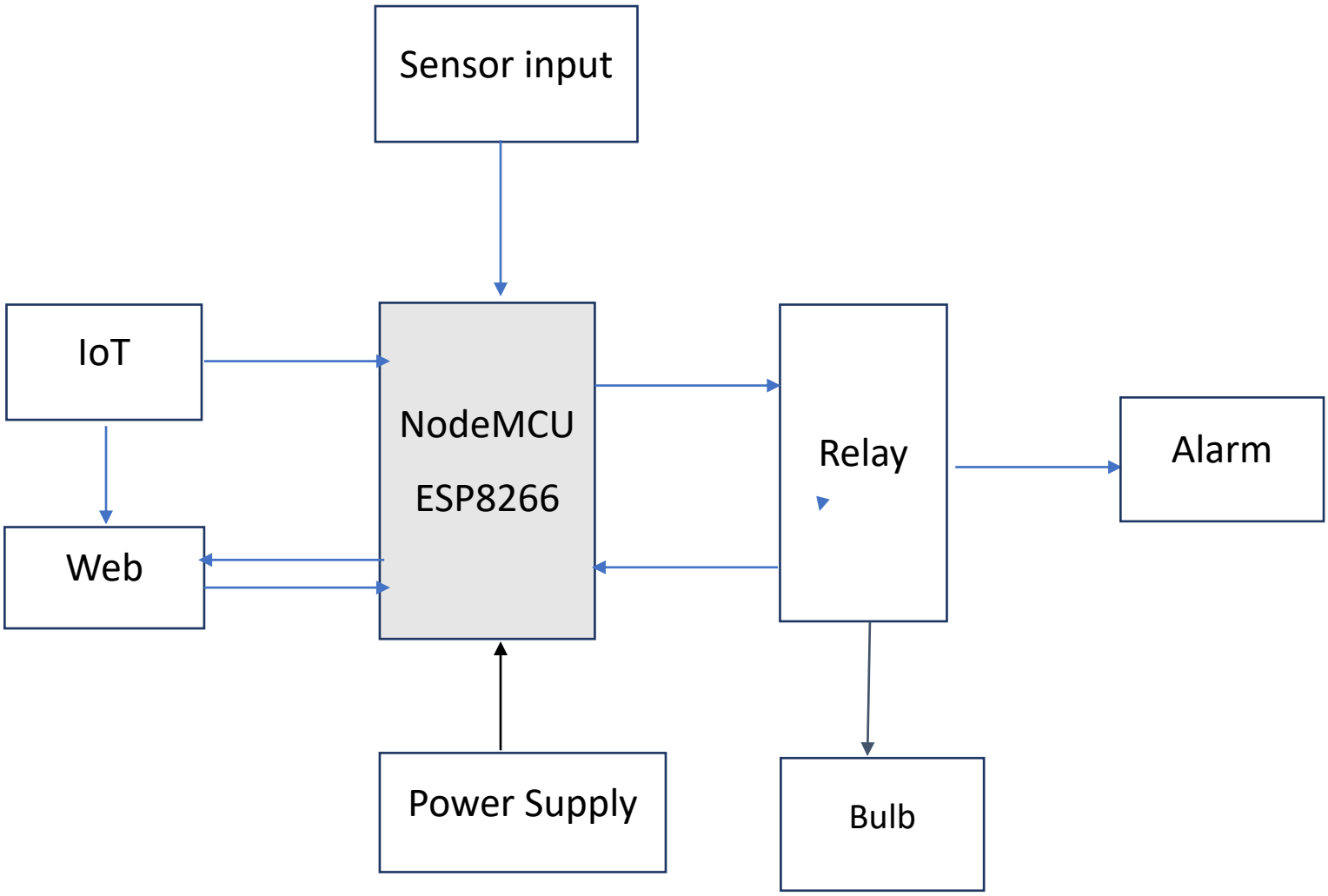


Figure 2.0 Layout of The Proposed System

2.3 ADVANTAGES OF THE PROPOSED SYTEM OVER THE EXISTING SYSTEM

➢ The system is IoT based which makes it easier to work with since it uses simple languages such as C++ and C

➢ The system can perform the desired task even when the client is not within a short range

➢ The system can be created after the construction of the building with a simple architecture

➢ The system will communicate in the wide range of Wi-Fi network, Wireless systems can be of great help for automation systems like Bluetooth, Wi-Fi and IoT based home automation systems. With the advancement of wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere.

CHAPTER 3

RESEARCH METHODOLOGY

This is a method of study that is described as a structured set of steps, techniques and process used to attain desired objectives.

3.1 DATA COLLECTION

Data collection is the systematic method of obtaining, observing, measuring and analyzing accurate information to support conducted research, the two types of data are primary and secondary data. Primary data is the data that justify the project and secondary data is the data that is collected by reviewing relevant literatures from different books and documentaries from the internet, websites and researches.

This chapter explains data collected concerning the design of the project, the data collected is used to determine what the customers want and how to present and design the system

Importance of data collection

- ➢Satisfy customer needs
- ➢Resolve problems and improve system
- ➢Study and analyze trends better
- ➢Better understanding of the customer

The specified data collection methods used for this project are Observation and questionnaire

3.1.1 Observation

This method involves seeing people in a certain setting or place then studying the individuals and their environment

Advantages of using Observation

- ➢Ease of data collection
- ➢Offers detailed data collection
- ➢Not dependent on people's proactive participation

3.1.2 Questionnaire

This method involves a series of questions that are asked to obtain information from the answers and help to understand the problem from the user's angle

Advantages of using questionnaire

- ➢ Easily done
- ➢ Easy access
- ➢ Low price method
- ➢ Flexibility when analyzing data

3.1.3 Example of questions asked

- ➢ How do you control your lighting system at home?
- ➢ What security system do you use?
  - ➢ Why do you use your current security system?
- ➢ What are the weaknesses of the security system you are using?

➢ What should be improved in the lighting system at home?

QUESTIONNARE RESULTS FROM 10 PARTICIPANTS	
motion detected in or around your home?	YES 09 NO 01
Do you want to have the ability to schedule and automate certain tasks, such as turning on/off lights at specific times?	YES 08 NO 02
Are you interested in having a smart door lock that can be controlled with a mobile app?	YES 09 NO 01
Do you want to receive notifications on your phone when you forget to turn off the lights at your home?	YES 08 NO 02
Would you like to have a smart security system that can be armed and disarmed remotely?	YES 07 NO 03
Would you like the lighting system at home to be improved ?	YES 06 NO 04

process

Table 1: QUESTIONNARE SUMMARY RESULTS

3.3.2 Analysis

In this phase system requirement is gathered, after gathering these requirements are analyzed for their validity for their and possibility of incorporating the requirements in the system to be developed its also studied in this phase

3.3.3 Design

The design phase deals with creating physical models that satisfy all the requirements documented for the system.

3.3.4 Implementation

The primary goal during this phase is to build the solution components code as well as documentation.

3.3.5 customer evaluation

The prototype developed is presented to the customers for evaluation and feedback, and the feedback is then collected from the customers. If the customer is indeed satisfied by the proto type, then the project is moved to the next phase and incase the customer is not satisfied the prototype is changed and advanced according to the customers' needs

Iterations occurs as the prototype is turned to satisfy the needs of the customer, while at the same time enabling the developer to better understand what is to be done

3.4 advantages of prototype model

- Missing functionality can be identified
- Customers are actively involved in the development
- Errors are detected much earlier and improves quality of software
- Confusing or difficult functions can be identified
- Better solutions due to quicker customer feedback

STRUCTURE OF PROTOTYPE MODEL

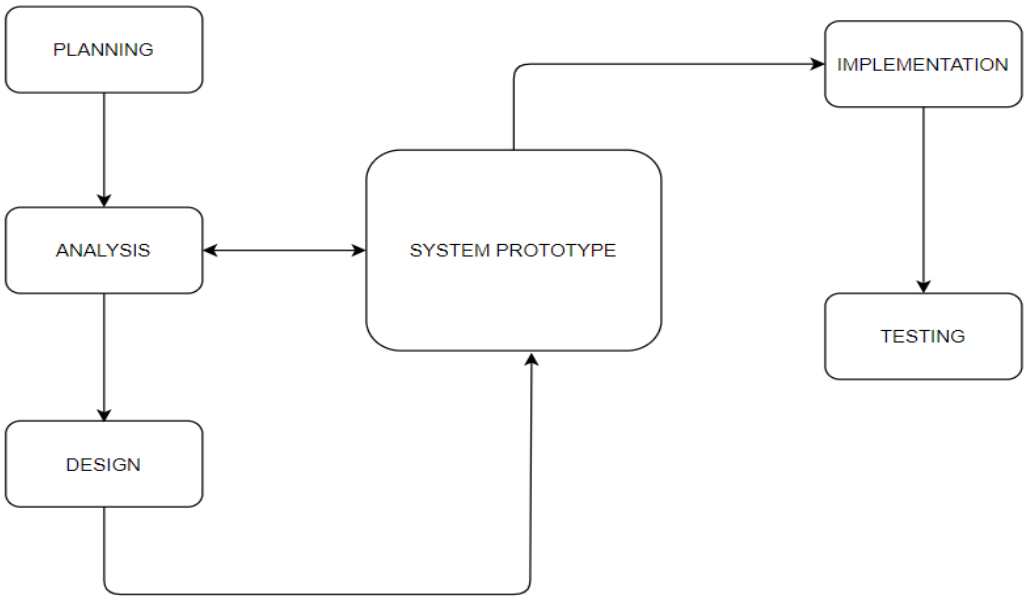


Figure 10 System Prototype

CHAPTER 4

4.0 HARDWARE AND SOFTWARE REQUIREMEMNTS

4.1 HARDWARE COMPONENTS

The following are some components that used, these are:

4.1.1 Microcontrollers

A microcontroller is a type of processor that manages a device's operation. The processing unit of the microcontroller is used to understand the data that it receives from its I/O devices. Using their I/O devices, microcontrollers send and receive data and process that data to carry out specific operations. An integrated circuit's microcontroller is specifically designed to carry out and complete one task at a time. A microcontroller has a CPU, programmable input/output devices, and memory units. A microcontroller has a CPU and an embedded ROM and fixed amount of RAM.

4.1.1.1 NodeMCU

The NodeMCU, based on the ESP8266 microcontroller, is a popular choice for home automation projects due to its affordability and built-in Wi-Fi capabilities and its dependable, high-range Wireless Fidelity microprocessor with TCP/IP stack and Arduino functionality. This module creates TCP/IP connections using Hayes-style commands and enables microcontrollers to connect to Wi-Fi networks.

Fig3.0 Wi-Fi ESP8266 Shield.

4.1.2 Power Supply

NodeMCU is a popular development board based on the ESP8266 microcontroller, widely used for IoT projects. It can be powered by a USB connection, which provides both power and communication capabilities. Here's how NodeMCU can be powered via USB:

USB Connection: NodeMCU has a micro-USB port that allows you to connect it to a power source, such as a computer, USB power adapter, or power bank, using a micro-USB cable.

USB Power Supply: When you connect NodeMCU to a USB power source, it receives power through the USB cable. The USB power source should provide a stable 5V power output to ensure proper functioning of the NodeMCU board.

By connecting NodeMCU to a USB power source, you can conveniently power the board while also establishing a data connection for programming and communication purposes. This makes it easy to develop and deploy NodeMCU-based projects in various IoT applications.

4.1.3 Communication Module

The communication in this project will be done through Wi-Fi ESP8266 and the users’ phone

4.1.3.1 EXTENSION MODULE

Breadboards typically have more extension plugs than extensions.

Breadboard

A breadboard is a base for building electronic prototypes, and the term "solderless breadboard" refers to a plug board (terminal array board) that doesn't need to be soldered and may be reused. Creating temporary

prototypes and experimenting with circuit design is simple with breadboards. Semi-permanent soldered prototypes that cannot be reused are built using a strip board. The clips are frequently referred to as contact points or tie points.

4.1.3.2 Connecting wire

This is the wire used to connect different components in the circuit like connecting the bulb to the power supply and the 4-channel relay with the bulb and the power supply

4.1.3.3 Jumper wire

These wires include male to male, female to female and male to female these wires were used throughout the project to connect sensors, Buzzer, 4-channel relay and the NodeMCU

4.1.4 RELAYSWITCH

A 4-channel relay module allows you to control multiple electrical devices or circuits using a single module. Each channel typically consists of a relay and associated circuitry.

some key points about a 4-channel relay

Connect Power: Connect the power supply to the relay module. Typically, a 5V power supply is used, which can be obtained from a separate power source or the NodeMCU itself if it provides a 5V output pin.

Connect Control Pins: Connect the control pins of the relay module to the GPIO pins of the NodeMCU. The number of control pins required depends on the relay module you are using. Each control pin corresponds to a specific channel on the relay module.

Connect Load: Connect the electrical devices or circuits you want to control to the output terminals of the relay module. Ensure that the power requirements of the devices are compatible with the relay's specifications. You may need to use separate power sources for high-power devices or consider using solid-state relays for certain applications.

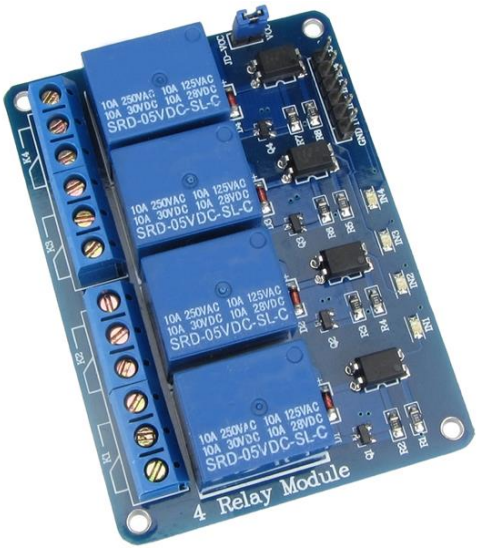


Fig 5.0 1-channel Relay switch.

4.1.5 SENSORS

A sensor is a device or module that monitors its surroundings for events or changes and transmits that information to other electronics, typically a processor. Other devices almost always use sensors. Everywhere you look, sensors are used, including on touch-sensitive elevator buttons, automatic doors, smoke alarms, etc.

4.1.5.1 Motion sensor

An electronic sensor known as a passive infrared sensor (PIR sensor) is used to gauge the amount of IR light that objects in its range of vision are emitting. The majority of the time, PIR-based motion detectors employ these sensors. Typically, PIR sensors are utilized in security

Fig 6.0 PIR Motion sensor.

Advantages of PIR Sensor.

i. Detects motion reliably in indoors as well as day or dark.
ii. Consumes less energy (0.8 W to 1.0 W)
iii. They are cheaper
iv. It senses 7 meters

4.1.6 Light bulb

In an automation system, the combination of a door and a light bulb can be utilized to create various functionalities in my home automation project the purpose of this bulb light is as follows

Automatic Door Light: By integrating a motion sensor or a proximity sensor with the automation system, the door light bulb can be set to turn on automatically when someone approaches the door. This ensures that the entrance area is well-lit for safety and convenience.

Fig 7.0 light Bulb.

4.2 Application of Ide in Arduino Controller

The open-source programming language Arduino features a number of built-in library functions and keywords. It is straightforward and easy to upload code to the Arduino board using Arduino.cc. An integrated platform that supports Arduino is necessary for Arduino to function since it needs a platform to do so. The C/C++-coded Integrated Development Environment (IDE) that Arduino employs is employed in this process, as is the Arduino web editor.

The working environment for Arduino programs is provided by the IDE. The Arduino board is connected to the Internet using an Ethernet shield, which has access to the Arduino server and all the features necessary to operate any sensors and modules without the requirement for user-preprogrammed programs.

4.3 IMPORTANCE

Microcontrollers like Arduino, Raspberry Pi, and others are used to automate processes and operate electrical equipment remotely. The Wi-Fi, a wireless network, may be simply controlled using any other Wi-Fi network by connecting from another Wi-Fi network to the home network thanks to improved technologies.

Smart automation can lower electricity costs since it switches off everything while no one is home. The wireless connection is automated and doesn't need any switches. Utilizing intelligent software created for energy conservation and smart homes, it is possible to monitor, control, and manage power usage inside the building when the loads are off.

4.4 SYSTEM DESIGN

System design is the construction of technical, computer-based solution for the requirements identified in the system the structural implementation of the system analysis of this project is done in the wokwi website

SIMULATION OF HOME AUTOMATION SYSTEM

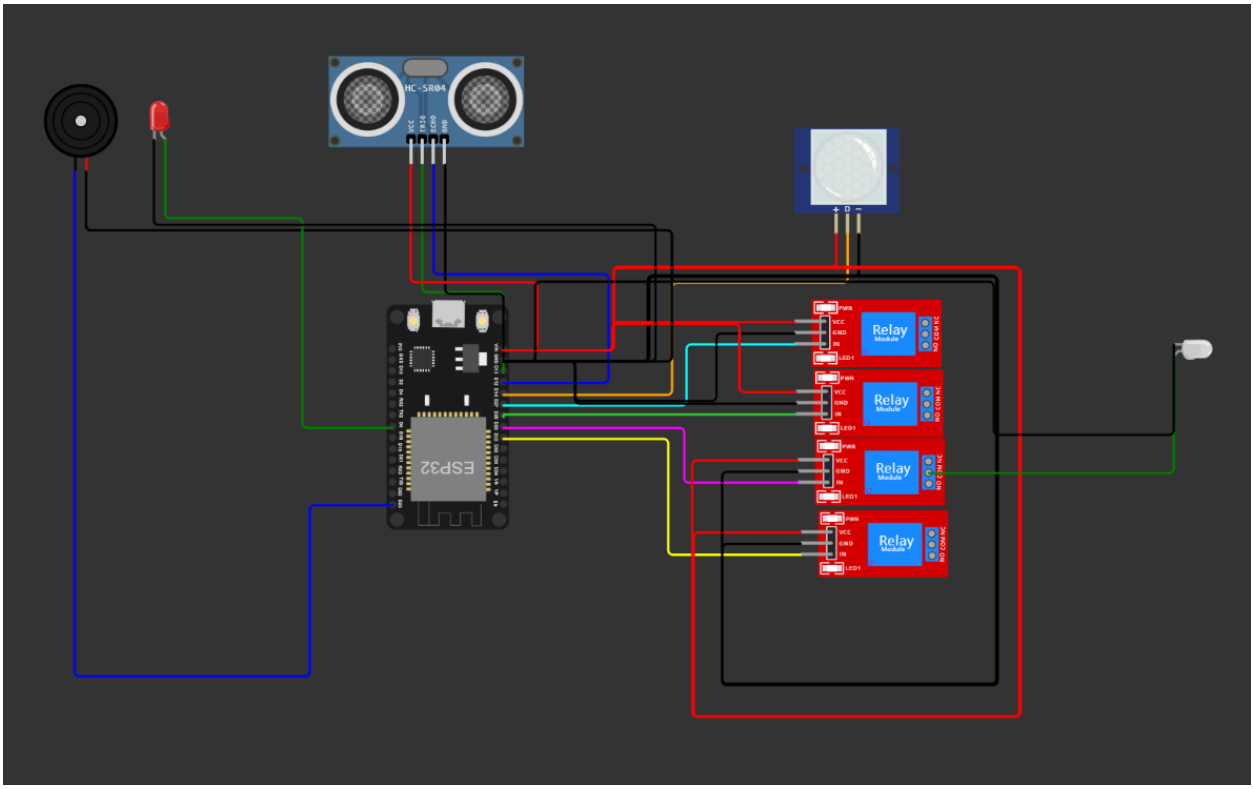


Fig 8.0 Home Automation Simulation

The simulation shows how the circuit works and it has NodeMCU, 4-channel Relay Module, PIR Sensor, Ultrasonic sensor, Buzzer and a Bulb

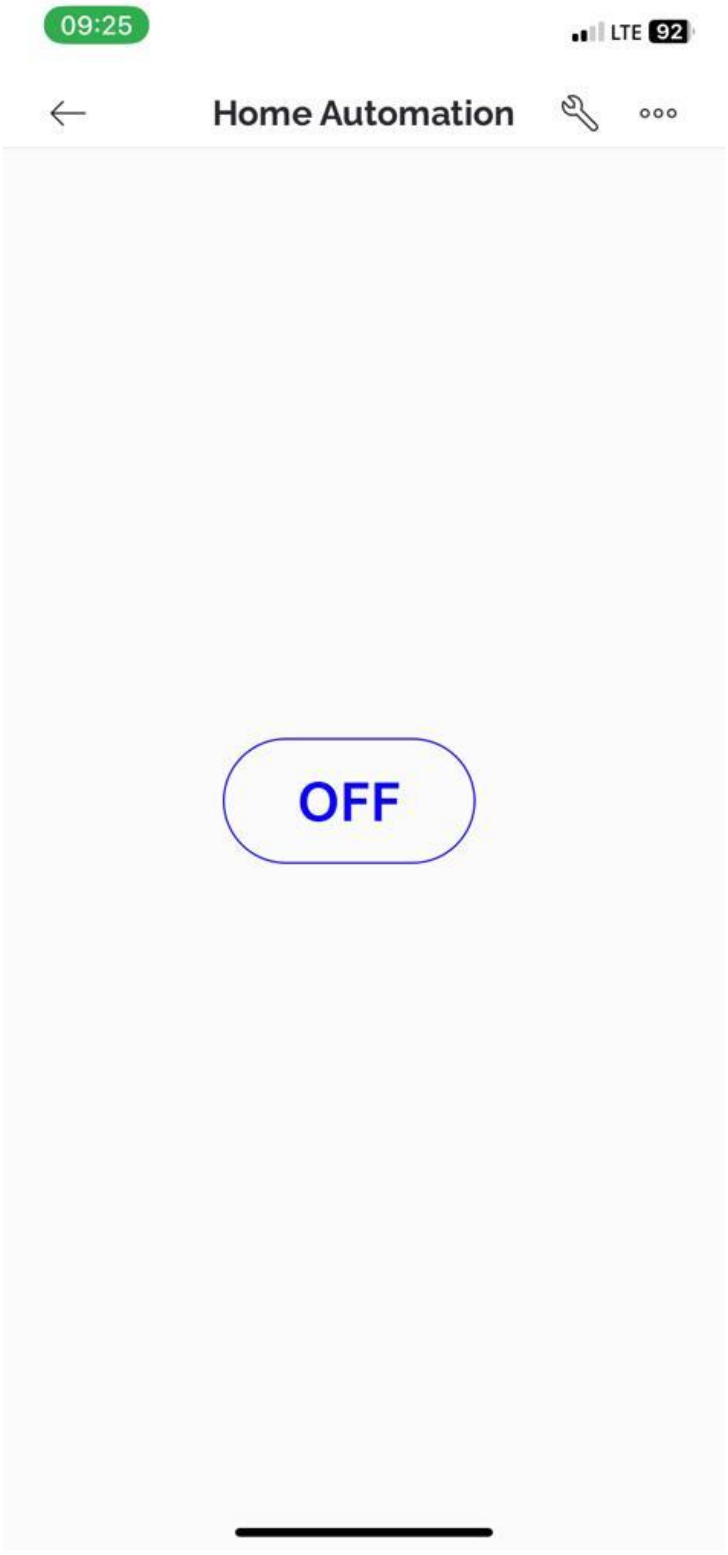
4.5 PROJECT SOFTWARE

4.4.1 BLYNK

Blynk is a popular platform that enables us to create mobile apps and web to control and monitor your hardware-based home automation projects. It provides an easy-to-use interface and cloud infrastructure to connect your hardware to a mobile device. Here's how Blynk works with the hardware part of home automation projects:

1. Choose Supported Hardware: Blynk supports various hardware platforms, including NodeMCU, Arduino, Raspberry Pi, and others. Ensure that your chosen hardware is compatible with Blynk by checking the supported devices list.IN my project I am using NodeMCU

2. Setting Up Blynk App: Installing the Blynk app on your mobile device after Creating an account, logging in, then I created a new project.


09:25
LTE 92
Home Automation
OFF

3. Obtaining Authentication Token: In the Blynk app, receive an authentication token unique to the project. This token is necessary to establish communication between the hardware and the Blynk cloud.

The token and id received was

#define BLYNK_AUTH_TOKEN"mOw9EJTpZFuwmyaI3uxbco5CelvmmY2d"

#define BLYNK_TEMPLATE_ID "TMPL2wD6Mbq_S"

#define BLYNK_TEMPLATE_NAME "Home Automation"

4. Configuring Blynk Library: By Using the appropriate Blynk library for my hardware platform (such as the Blynk library for Arduino or the Blynk library for NodeMCU). I included the library in my code editor or IDE.

5. Writing Hardware Code: Developing the code for the hardware using the preferred programming language which is Arduino IDE. Then Utilizing the Blynk library functions to establish a connection with the Blynk cloud and define interactions between the hardware and the mobile app.

6. Establishing Communication: Within your code, By using the authentication token obtained from the Blynk app to establish a connection with the Blynk server. This connection enables bidirectional communication between the hardware and the mobile app.

7. Defining Virtual Pins: Blynk uses virtual pins to facilitate communication between the hardware and the mobile app. In your code, assign specific functions or values to virtual pins, which will be reflected in the Blynk app's interface.

8. Design User Interface: In the Blynk app, designing the user interface by adding widgets (buttons, sliders, displays, etc.) corresponding to the virtual

pins defined in your code. Customize the appearance and functionality of each widget to suit your project requirements.

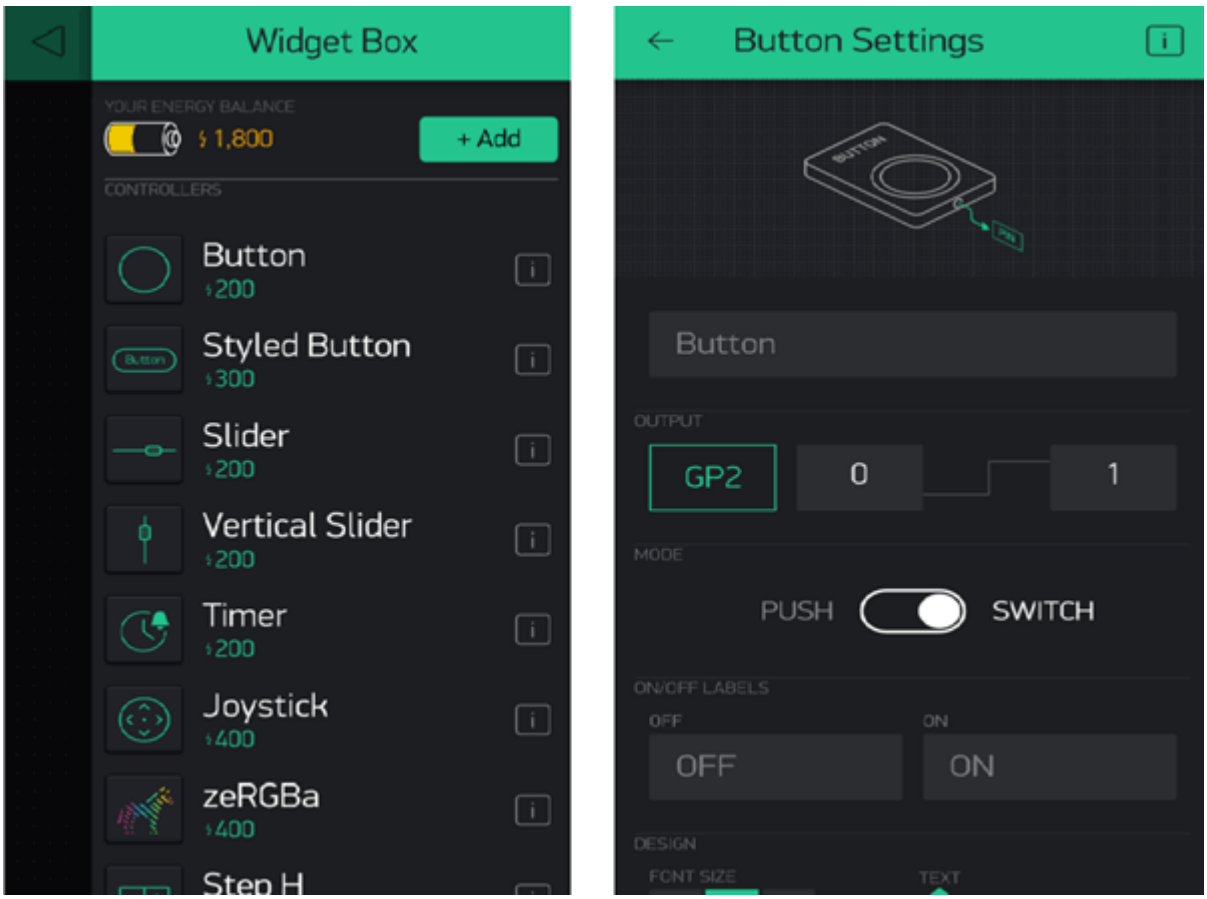


Figure 09 Adding Widgets on Blynk

9. Test and Control: Uploading the hardware code to your device. Launch the Blynk app and connect to the project. You can now use the mobile app's interface to send commands, receive data, and control your hardware in real-time.

Blynk provides a wide range of features beyond basic control, such as data logging, push notifications, event-driven actions, and integration with other services. These features can be explored to enhance a home automation project.

4.4.2 ARDUINO IDE

File Edit Sketch Tools Help

Home_Automation | Adafruit_Sensor.cpp | Adafruit_Sensor.h

```
#define BLYNK_TEMPLATE_ID "TMPL2wD6Mbq_S"
#define BLYNK_TEMPLATE_NAME "Home Automation"
#define BLYNK_AUTH_TOKEN "mOw9EJTpZFuwmyaI3uxbco5CelvmmY2d"

#include <WiFi.h>
#include <ESP8266WiFi.h>  // Updated library for ESP32

char auth[] = "mOw9EJTpZFuwmyaI3uxbco5CelvmmY2d"; // Updated to use quotes

// WiFi credentials. Set password to "" for open networks.
char ssid[] = "Fina";
char pass[] = "adriano42";

BlynkTimer timer;

#define button1_pin 26
#define button2_pin 25
#define button3_pin 33
#define button4_pin 32

#define relay1_pin 13
#define relay2_pin 12
#define relay3_pin 14
#define relay4_pin 27

int relay1_state = 0;
int relay2_state = 0;
int relay3_state = 0;
int relay4_state = 0;

```

CHAPTER 4

4.0 SYSTEM ANALYSIS

The system used for this home automation system is based on NodeMCU ESP8266 and using Blynk IoT to ensure communication between the hardware and the software

The information used is captured from the motion detection sensor that alerts the user of any intrusion inside the house and automatically light up when the motion is detected

System analysis is an essential step in the development of a home automation project. It involves understanding the requirements, identifying components, and analyzing the system's overall functionality.

Stakeholders: The key stakeholders who will interact with the home automation system are homeowners, family members, or other users.

4.1 SYSTEM REQUIREMENT SPECIFICATIONS

Analyze Existing Infrastructure: Evaluate your home's existing infrastructure, including electrical wiring, networking capabilities, and compatibility with smart devices. Determine any necessary modifications or additions required for the successful implementation of the home automation system.

Component Identification Identify the necessary hardware and software components for your home automation system. This may include microcontrollers which is NodeMCU, motion sensors, relays, communication protocols, and Blynk.

My project is connected to Blynk IoT which helps the project integrate the software and hardware parts

Security and Privacy Considerations

The program is safe because every user can register or login into his or her account and the Blynk IoT allows the user to add more security features like finger prints and biometrics that is face ID in ios

Scalability and Flexibility

Since home automation involves various things like security system, lighting system, gas leakage system, automatic systems fire detection and so many others. Those various features can be added to the project

Cost and Resource Estimation

The project consists of different hardware parts and activities and these activities include the use of money for financing purposes, the estimated budget for my project is as follows

PROJECT MANAGEMENT AND COSTING

Cost of the project

	COMPONENTS	COST In Tsh.
	Equipment	80,000
	Model House	20,000
	Airtime	32,000
	Transport for Questionnaire	20,000
	Stationary	28,000
	TOTAL	180,000

Table 2: Project Budget

CHAPTER 5

5.0 IMPLEMENTATION AND TESTING

Implementing a home automation project using Blynk involves using the Blynk platform to create a mobile app that communicates with your smart devices. Blynk is a popular Internet of Things (IoT) platform that allows you to control and monitor your devices remotely. Here's a step-by-step guide to implementing a home automation project using Blynk:

1. Gathering the necessary hardware: Identifying the smart devices I want to control and make sure they are compatible with the Blynk platform. That is ESP8266 according to my project. I also used additional components such as sensors, relays for my project

2. Setting up the Blynk app: Download the Blynk app on your mobile device from the respective app store iOS. Then I Created a new account and IFTTT account

3. Creating a new Blynk project: Open the Blynk app and create a new project. Give it a name and select the hardware model ESP8266 Then Blynk generated an authentication token that was need to communicate with the hardware.

4. Setting up the hardware: After installation of the necessary libraries and tools to enable communication with the Blynk platform. Refer to the Blynk documentation for specific instructions on setting up your chosen hardware.

5. Connecting the hardware to Blynk: In the hardware code, include the Blynk library and initialize the connection using your authentication token.

This will establish the communication link between your hardware and the Blynk platform.

6. Add widgets to your Blynk project: In the Blynk app, you can add various widgets to create a user interface for controlling and monitoring your devices. Examples of widgets include buttons, sliders, switches, and displays. Customize the widgets according to your project requirements.

As referred to figure 09

7. Defining actions and triggers: In your hardware code, define the actions that should be triggered based on user input from the Blynk app. For example, if a button widget is pressed, you may want to turn on a light or activate a motor. Use the Blynk library functions to handle these actions.

8. Test and refine: Upload the code to your hardware and test the functionality using the Blynk app. Verify that the actions and triggers work as expected. Make adjustments to the code and widget configurations as needed.

10. Security considerations: When implementing the home automation project with Blynk, I ensured that I followed the best practices for securing my devices and network. Set strong passwords, use secure communication protocols (such as HTTPS), and applying firmware updates regularly to address any security vulnerabilities.

5.1 Testing

Testing was done to the system to ensure thar it works properly and all the connections are in the right order to avoid any errors that may occur

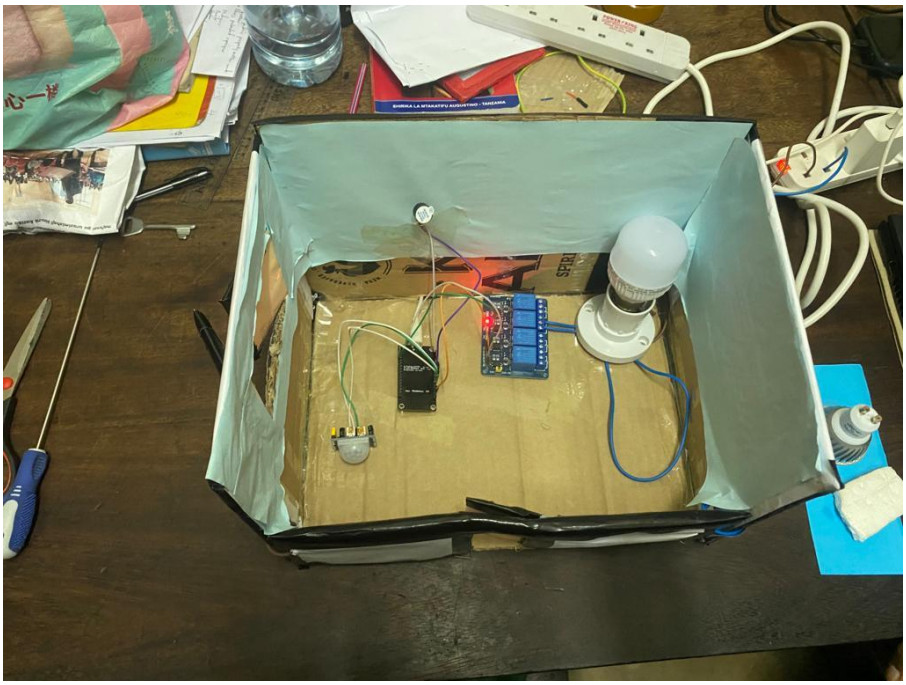


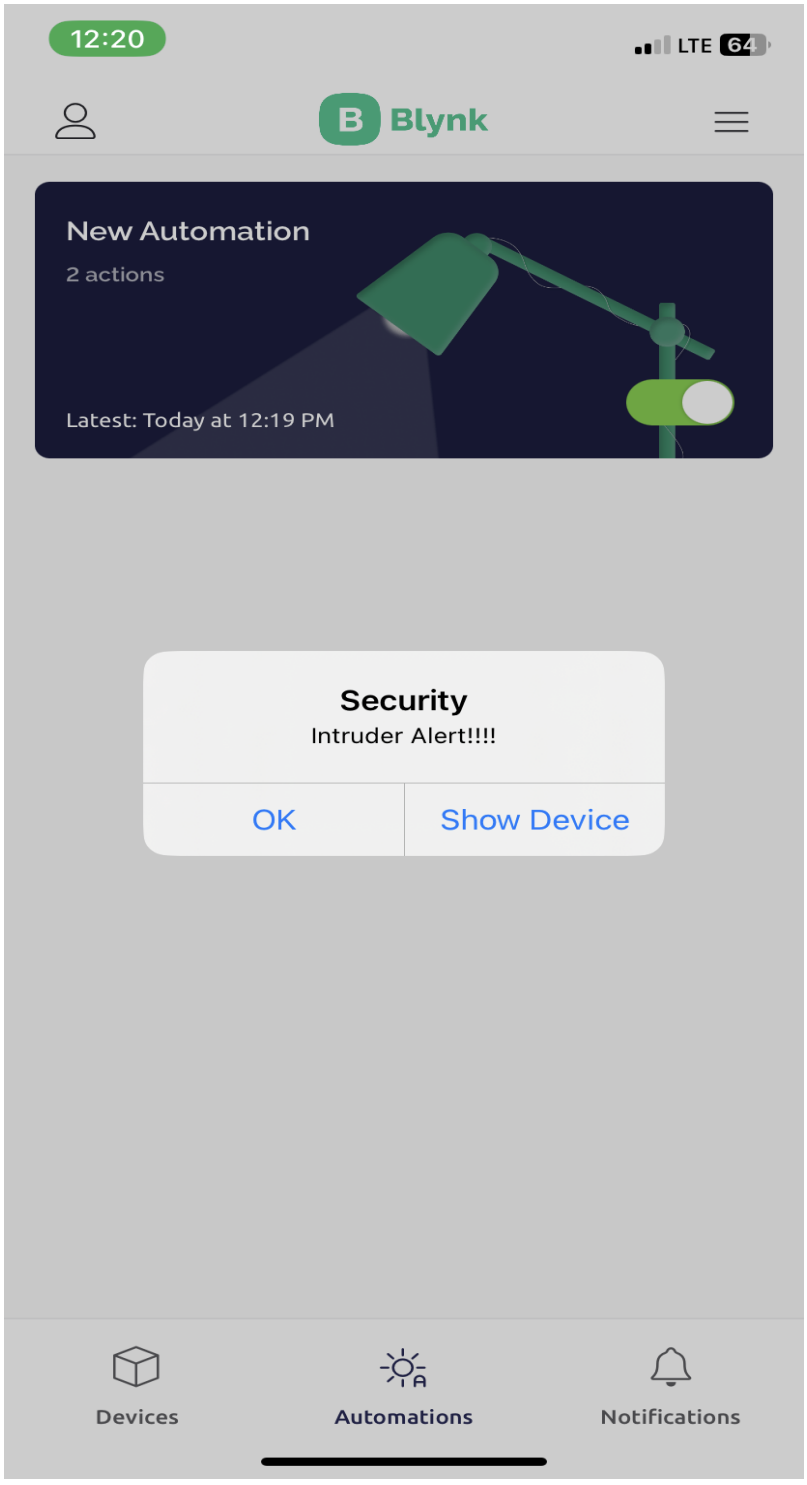
Figure 12 System Prototype

Figure 11 Testing

5.2 The final implementation

Figure 12 House Model

The notification Sent to the user will look like the following photo



CHAPTER 6

6.0CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

A home automation low budget system is benefited by this project since the architecture is simple and not very cost full this makes it possible to have a home automation at a reasonable price and ensure that the house is secured

6.2 RECOMMENDATION

Since home automation includes variety of features and has a very wide scope then some additional features should be added to the system

The following are some of the recommended features to be included

1. Voice Control: Incorporate voice control into your home automation system using popular platforms like Amazon Alexa or Google Assistant. This allows you to control various devices and functions simply by speaking commands.

2. Smart Lighting: Install smart bulbs or switches that can be controlled remotely or programmed to turn on and off automatically. You can also set up lighting scenes for different moods or activities.

3. Thermostat Control: Integrate a smart thermostat that can adjust the temperature based on your preferences and schedule. You can control it remotely or set up automation rules to optimize energy usage.

4. Security and Surveillance: Set up a home security system with smart cameras and motion sensors for door/window options.

This will create a very secure system with real time photos of the smart house You can receive alerts on your smartphone and monitor your home remotely. Integration with a smart lock can also enhance security.

5. Entertainment System: Create a centralized control system for your entertainment devices. Use a smart hub or a universal remote to control your TV, speakers, streaming devices, and gaming consoles. Voice control can make it even more convenient.

6. Smart Appliances: Consider upgrading to smart appliances such as refrigerators, ovens, or washing machines. These can offer advanced features like remote monitoring, energy optimization, and integration with your home automation system.

7. Automated Blinds and Curtains: Install motorized blinds or curtains that can be controlled remotely or programmed to open and close at specific times. They can also be integrated with lighting automation for enhanced energy efficiency.

8. Water and Energy Management: Utilize smart devices to monitor and control your water and energy consumption. Smart water valves can detect leaks and shut off the water supply, while smart plugs can track and manage energy usage of individual devices.

9. Garden and Outdoor Automation: Install smart irrigation systems to control watering schedules based on weather conditions. Outdoor lighting automation and security cameras can also be integrated into your home automation system.

10. Integration and Automation: Use a smart home hub or automation platform to integrate and control all your devices and systems from a single interface. This allows you to create complex automation routines and customize your smart home experience.

Remember to research compatibility and interoperability between different devices and systems before making purchases. By Starting small and gradually expand the home automation project based on your needs and preferences.

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