Faculty of Electrical and Electronic Engineering Technology

THE DESIGN OF SMART DOORBELL MONITORING USING IOT AND CAMERA READY VIEW

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Bachelor of Electronics Engineering Technology with Honours

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THE DESIGN OF SMART DOORBELL MONITORING USING IOT AND CAMERA READY VIEW

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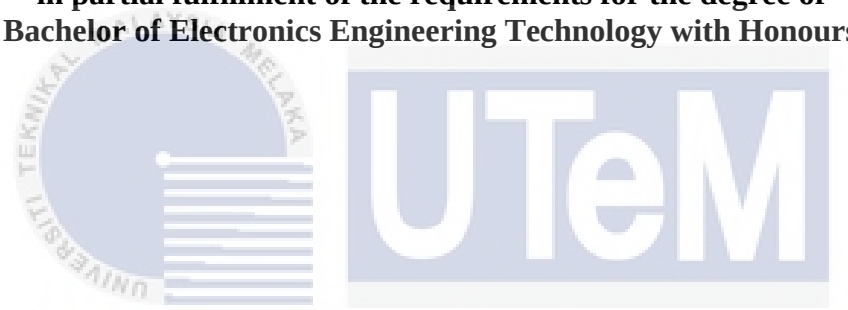
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I declare that this project report entitled “Smart Doorbell Monitoring Using IoT and Camera Ready View ” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Student Name : MUHAMMAD HAZIQ BIN ZAINAL

Date : 10.01.2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

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DEDICATION

This research project was successfully completed. I dedicate this thesis to my beloved parents, supervisor, and fellow classmates. Especially for my esteemed parents who always support and pray for your child's success, may your life be blessed by Allah. For my lecturer as well as my supervisor who have contributed a lot in providing support towards this success, this is a gift for all, may Allah reward all the devotional services rendered. To my friends, housemate and classmate who have supported me all this time, your services are greatly appreciated.

ABSTRACT

Everything has changed in this era of digital technology and communications to the Internet of Things technology (IoT). Home doorbell is one of the things that may be improved to make it smart, more inventive, and secure by control it by using Internet of Things (IoT). The purpose of the project is to develop smart doorbell monitoring using Internet of Things (IoT) and camera ready view. This project will make homeowner capable of monitoring and view area front of the house by using the application for safety and to reduce their time and energy to see who infront the house. The objective of this project is to develop a smart doorbell system via vibration notification on the smartphone, design a system that monitor the doorbell with a camera to capture the image of a person outside the house and analyse a system interface such as coordination of the image captured and a notification comes out with doorbell response. The smart doorbell system used ESP32-CAM module as main component to control input and output of the system. The homeowner will receive notification that vibrates through the smartphone by use the Blynk application and see the visitor's image in front the house that display on the smartphone via Blynk application. User can unlock the door by using the Blynk application if the visitor is the known person otherwise, the user can maintain to lock the door if the visitor is unknown person. Based on the efficiency of the project, the data is recorded based on the number of notication and image captured with time. This smart doorbell offers a method that is user friendly, secure, easy, saves time energy and cost.

ABSTRAK

Segala-galanya telah berubah dalam era teknologi digital dan komunikasi ini kepada teknologi Internet of Things (IoT). Loceng pintu rumah ialah salah satu perkara yang boleh dipertingkatkan untuk menjadikannya pintar, lebih inventif dan selamat dengan mengawalnya menggunakan Internet of Things (IoT). Tujuan projek ini adalah untuk membangunkan pemantauan loceng pintu pintar menggunakan Internet of Things (IoT) dan paparan sedia kamera. Projek ini akan menjadikan pemilik rumah mampu memantau dan melihat kawasan hadapan rumah dengan menggunakan aplikasi untuk keselamatan dan mengurangkan masa dan tenaga mereka untuk melihat siapa yang berada di hadapan rumah. Objektif projek ini adalah untuk membangunkan sistem loceng pintu pintar melalui pemberitahuan getaran pada telefon pintar mereka, mereka bentuk sistem yang memantau loceng pintu dengan kamera untuk menangkap imej seseorang di luar rumah dan menganalisis antara muka sistem seperti penyelarasan imej ditangkap dan pemberitahuan keluar dengan respons loceng pintu. Sistem loceng pintu pintar menggunakan modul ESP32-CAM sebagai komponen utama untuk mengawal input dan output sistem. Pemilik rumah akan menerima pemberitahuan yang bergetar melalui telefon pintar dengan menggunakan aplikasi Blynk dan melihat imej pengunjung di hadapan rumah yang dipaparkan pada telefon pintar melalui aplikasi Blynk. Pengguna boleh membuka kunci pintu dengan menggunakan aplikasi Blynk jika pelawat adalah orang yang dikenali sebaliknya, pengguna boleh mengekalkan untuk mengunci pintu jika pelawat adalah orang yang tidak dikenali. Berdasarkan kecekapan projek, data direkodkan berdasarkan bilangan notis dan imej yang ditangkap mengikut masa. Loceng pintu pintar ini menawarkan kaedah yang mesra pengguna, selamat, mudah, menjimatkan tenaga, masa dan kos.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Ts. Niza Binti Mohd Idris for their precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support through equipment preparation which enables me to accomplish the project. Not forgetting my fellow colleagues, Aiman, Fikri, Hassan and Fadhil for the willingness of sharing his thoughts and ideas regarding the project.

My highest appreciation goes to my parents and family members for their love and prayer during the period of my study. An honourable mention also goes to Puan Asmah for all the motivation and understanding.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

δ	-	Voltage angle
	-	
	-	
	-	
	-	
	-	
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LIST OF ABBREVIATIONS

V	-	Voltage
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LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

This chapter describes the idea to design Smart doorbell monitoring using IoT and camera ready view. It includes background of project, problem statements, objectives, and scope of project. The background is to know the previous history about the project. The problem statement is to summaries to provide a solution while the objective is to aim the goal and solution for the project. Lastly, the scope is to cover the functionalities provided by this project.

1.2 Background of Study

Nowadays, conventional devices or equipments like home doorbell must be replace with something more sophisticated and secure. Several intelligent doorbell systems already exist on the market, that have a varying range of features and available functions. All of these solutions make use of a smartphone app to interact with and receive notifications from the doorbell [1].

A doorbell was a signalling device that is usually installed near a building's main entrance door like a house. When a visitor touches a doorbell button in front of the house, a bell sounds to alert the owner to the visitor's presence. The doorbell is also used at the entrances to a partially enclosed area like near a gate or other gates. Mostly the homeowners were unaware of the dangers that can arise when they use their conventional doorbell without

knowing who pressed the doorbell. The owner then must approach the door and any possible threat to determine who is at the door. When a necessity arises, the owner may be forced to open the door to strangers, such as the delivery person or anybody else.

All of these things put owner in risk where all of these scenario can be avoided with the use of a smart doorbell. The smart doorbell system will improve the mechanism of the conventional doorbell by collaborating with the Internet of Things (IoT) by using application and smartphone to monitor the front area of the house, view and capture the image of the visitor who presses the doorbell button for own safety.

1.3 Problem Statement

Nowadays, the conventional doorbells or the old mechanism of the home doorbell are very easy to connect and use but does not provide personal safety to homeowners who have disabled people in the house. Moreover, disabled people needs time and the ability to determine who rang the home doorbell where any potential threat may occur. In addition, the front door is one of the most often used entrances in the house, so it is easy to overlook locking it where intruders can easily enter the house and will pose a danger if there are disabled people in the house. By design this smart doorbell system by using Internet of Things (IoT) and camera ready view, it is helpful for the disable people who are alone at home to checking who was outside the house. When someone press the smart doorbell, the system will send notification alert with vibration to the user's smartphone and can view image of the visitors. Meanwhile, to rise the disabled people safety, user can allow the known visitor to enter the house by control the door lock by using smartphone and at the same time will reduce the movement, time and energy for the disabled people due to lack of self-efficacy.

1.4 Project Objective

The objectives of this research work are:

1) To develop a smart doorbell system via vibration notification on the smartphones.
2) To design a system that monitor the doorbell with a camera to capture the image of a person outside the house.
3) To analyse a system interface such as coordination of the image captured and a notification comes out with doorbell response.

1.5 Scope of Project

This project is to design smart doorbell system that will assist disabled people via notification and vibration on their smartphones to help them to see and check who was outside the house for their safety while they are alone at home. The disabled person may have a problem about time where they going to take times to do something because their energy and ability not as normal person. Meanwhile, this project has limitations as follows which is this project can display the camera by using one device only and will only capture visitor image by pressing the doorbell. Then, the application is used to give notifications, capture visitor image and control the door lock. Lastly, captured image and notification need internet connection to send on user smartphone.

1.6 Summary

This section discuss the introduction for this project. Therefore, this project is to design a Smart doorbell monitoring using Iot and camera ready view so the system can start to design based on the background researched, problem statement, objective and the scope.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is a collection of text used to review crucial points of current knowledge for any related material in order to better understand the concept and language used in the project.. The resources are obtained from the journals, books and websites which provide more information on IoT applications in house security, researches about building security measures and notification system. The aims of this chapter are to find knowledge, important information and any related thesis that are in line with the concept of Smart doorbell control using IoT and camera ready view. Furthermore, theoretical, methodical and hypothetical researches about security as well as notification system using ESP32 CAM and IoT are emphasize and analysed.

2.2 Internet of Things (IoT): Genesis, Challenges and Applications

The Internet of Things (IoT) was the network of the physical objects. Devices, vehicles, buildings and others were the example where all the objects integrated with electronics, softwares, sensors and network connectivity that allow to grab and share information [2]. IoT was an extension interaction between people and application. The "Things" can be clarify as the combination of hardware, software data and service. Nowadays, Internet of Things (IoT) will be the next big thing in the field of information technology

2.2.1 Genesis of IoT

The development and expansion of the Internet of Things (IoT) were dependent on the development of new technologies and the enhancement of current ones. Wired networks, wireless networks, sensor networks, Radio-Frequency Identification (RFID), embedded software, communication protocols and others are all examples of these technologies. IoT connects every object transforming it into a smart device. By incorporating sensing, transmitting, and processing capabilities inside things, a thing can become a smart thing, an object may become a smart object, and an appliance can become a smart appliance. Due to the availability of all of these technologies as well as electronic equipment such as sensors and actuators, technological phase had came in which every object is considered to be sensed and to have some computer capabilities leading in the IoT era. Figure 2.1 shown the genesis of IoT.

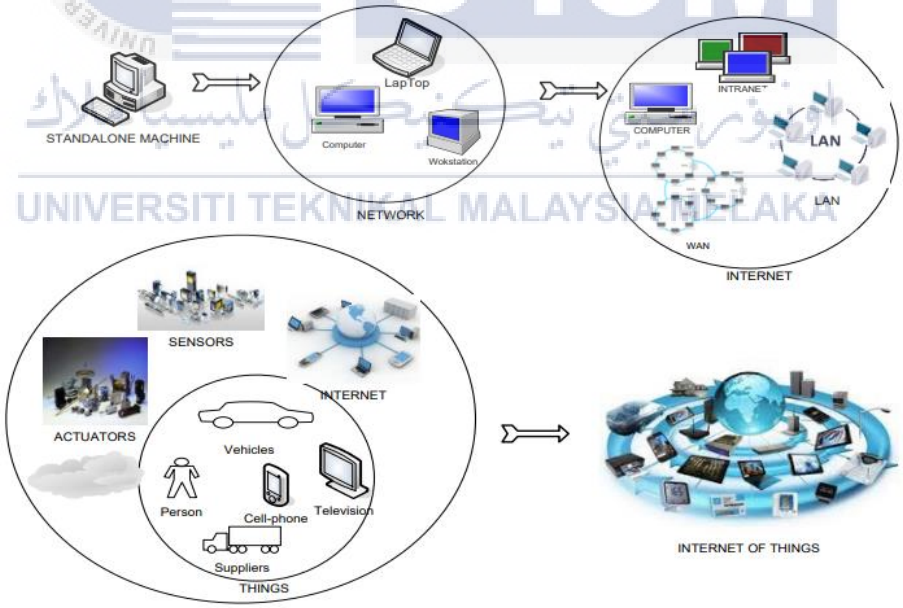


Figure 2.1 Genesis of IoT [2]

2.2.2 Application Domains of IoT

Internet of Things (IoT) had established as a platform whose implementation can encompass a wide variety of application areas due to its presence in every sector of the physical world. As a result of the ability to connect embedded devices with limited CPU, memory, and power resources, the Internet of Things can now find applications in practically every field. The smart door opens and closes in response to the arrival of an authenticated person. It can be programmed to operate in a variety of ways such as sending a message to a selected person's mobile phone if the time is after midnight. The term "smart elderly support" refers to specific care for the elderly. Elderly people as well as youngsters living in the home required extra attention. If the house was smart home, they can also be monitored and given support.

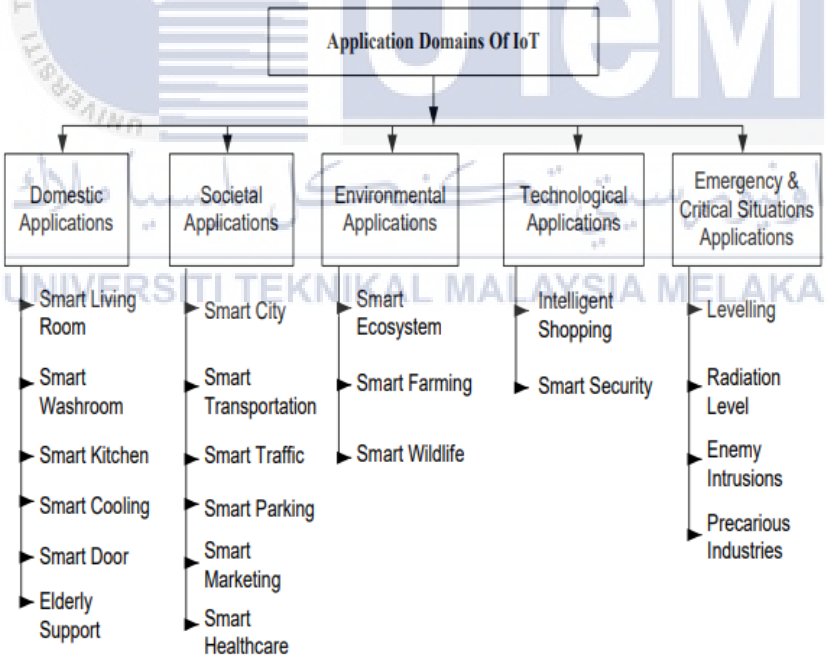


Figure 2.2 Application domains of IoT [2]

2.3 IoT Smart Doorbell Surveillance

The Internet of Things (IoT) was a collection of networked objects, systems, and sensors that take advantage of developments in processing power, electronic miniaturisation, and network connections to provide previously impossible capabilities. The objective of the project was to use Internet of Things (Iot) to improve home security[3]. When a visitor touched the switch bell of the house usually the current doorbell system used the old methodology. When there was someone in the house, they opened the door otherwise the visitor waits for a specific amount of time and then goes without leaving a trace. Technology is important in today's world because it simplifies everything

2.3.1 Literature Survey

The project titled Home security yystem for alone elderly people was developed in Thailand. The main reason to develop the project was to help elderly people feel more secure at home because there were many older persons were forced to live alone. The system was a smart doorbell that allows elderly people to see, hear, and speak to guests at the front door via their smartphones, rather than having to face them face to face. Then, Automatic safety home bell system with message enabled features focused on IoT-related automatic doorbell systems. If the visitor remains outside for longer than a specific duration without any clue, an SMS will be sent to the house member's registered mobile number, and the house member's response in the form of an SMS will be displayed on an LCD screen next to the door so that the visitor can read the SMS and take appropriate action.

2.3.2 System Architecture

Figure 2.3 shown system architecture that contains doorbell, smart doorbellsystem, wireless transmitter-receiver module and lcd response. The doorbell built by using Arduino and webcam where SMS notification sent to the owner with the visitor's picture at the door.

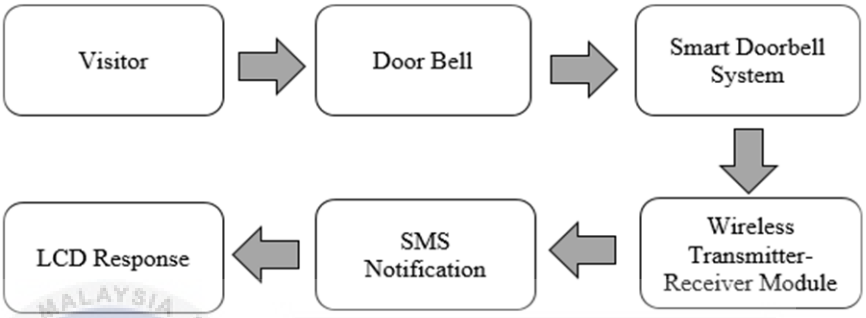


Figure 2.3 System architecture [3]

PushingBox service used for programming part. The Arduino sent HTTP GET request when the doorbell was pushed and sent to PushingBox API. HTTP GET function to get information from a given server by using the given URL. While receive the request, PushingBox starts the user's scenario and takes a picture with the web camera which is then transmitted back to the API. Therefore, the PushingBox API act as connector communication between the user and visitor. The device ID was the only argument required with the request. Visitors receive an LCD Response as a response from the owner. Moreover, there were many hardware used to build the system such as Arduino Mega, ethernet shield, doorbell or switch, jumper cables and ethernet cable while at the same time, two software required to run the program which is Arduino IDE and Pushing API. Figure 2.4 shown the flow diagram when the doorbell is pressed, it presented the process and flow of data as well as how the visitor receives an LCD response.

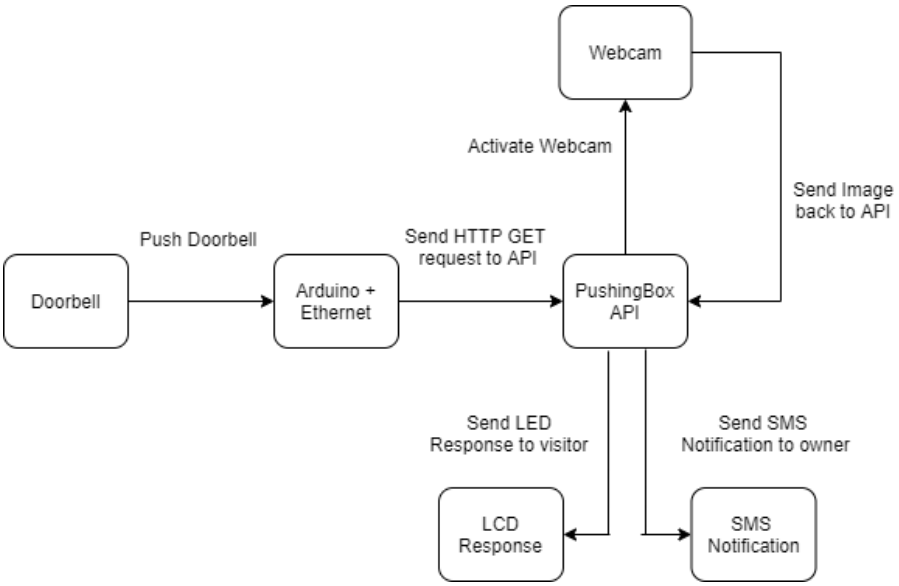


Figure 2.4 Flow diagram [3]

2.3.3 Result

Table 2.1 shown the testing and outcomes by using various cases. The doorbell was connected to arduino by using cable where it act as push button. Then, the device checked by arduino function and every scenario added to the push box services. The scenarios assisted in the delivery of the SMS notice to the device. Once the scenarios were submitted, an SMS notice delivered. When a user receives an SMS notice, he examines it and becomes aware of the situation.

Table 2.1 Testing Result [3]

SCENARIO	TEST TYPE	OUTCOME
Under different weather conditions	Sensor test	Works perfectly in all weather conditions
When visitor rings the bell	Visitor Arrival Test	Bell rings, SMS is received by owner after 3 minutes
Waiting time	Message transmissiom reception test	Acknowledgement by owner was displayed on the LCD screen

2.4 Smart Home Automation & Security System Using Arduino and IoT

The internet of things (IOT) has sparked a global revolution and has become an essential part of modern life. As a result, this project focuses about Arduino principles and several sensors to make controlling house appliances easier. [4]. The project presented about home automation and home security ways. Arduino was normally utilized by a wide range of creators around the world. Fame has been driven by Arduino's effortlessness of utilization and the huge number of sensors and libraries accessible to expand the essential capacities of these controllers [5]. The system use sensors and Arduino to sense and control the environment around and IOT deals with embedded technologies and the internet of things (IOT).

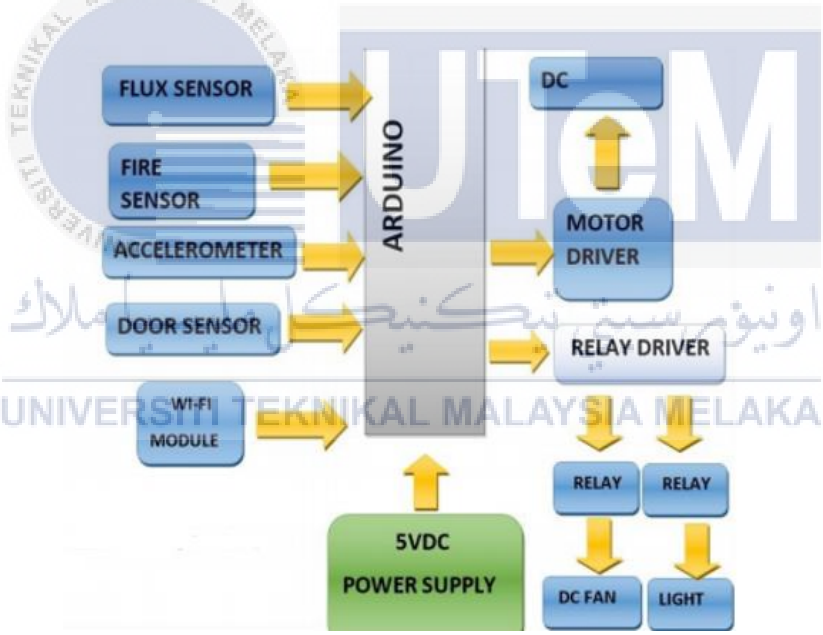


Figure 2.5 Block diagram [4]

The Figure 2.5 shown the overview of the sytem by using block diagram. There are three main parts which is sensing, monitoring and controlling system. Sensing was created by using many sensors which is flex sensor to control appliances by the gestures of fingers. Then, magnetic sensor to give a alert if the lock wan breaks and last sensor is flame sensor where a give alert if happen any fire inside the house. Monitoring was created by by the

cloud patform so user can know the house by using laptop and smartphone. Lastly, controlling was handle by the microcontroller which is Arduino Uno to control the appliance on the house.

2.4.1 Arduino UNO Board

The main component of the system was Arduino UNO board. It was appeared in Italy where this hardware was the low cost component for communicating device. The Arduino was one of the great main component that can select to do any IOT applications project, produced and form program. Therefore the Arduino UNO board can plays a role as head or cpu on the project.

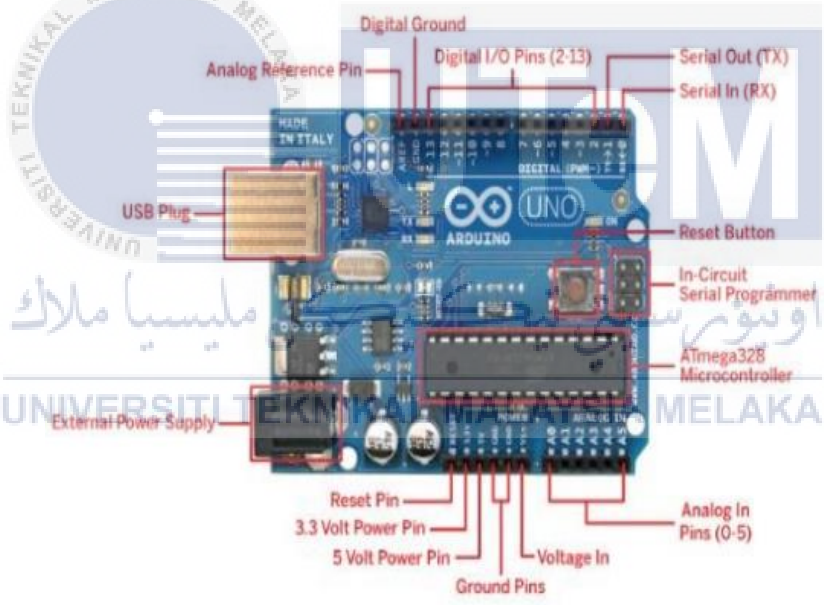


Figure 2.6 Arduino Uno Board [4]

2.4.2 5V Relays

The relay was used to control the circuit by control the high current to lower current otherwise some circuits should be controlled by one signal. Mostly, A relay module is an electronic device that uses electrical energy to change a contactor from ON to OFF.

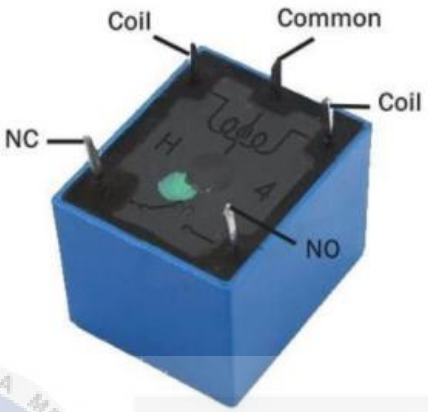


Figure 2.7 5V Relay [4]

2.4.3 Wi – Fi Module

The author used ESP8266 Wi-Fi module that serves as an additional device for a microcontroller such as an Arduino to connect directly to wifi and make a TCP/IP connection. It was capable of either hosting a programme or delegating all Wifi network tasks to another processor.

Figure 2.8 WI-FI module [4]

2.4.4 Arduino IDE

The function of the integrated development environment or Arduino IDE was as software used to write, verify, debug, compile, and upload programs (sketches) from a computer to the Arduino board.. It an use in any operating system such as Windows, Linux and other operating system.

Figure 2.9 Arduino IDE

2.5 Smart Doorbell Security System Using IoT

The paper was about security that combines the function of smartphone and home network system. The system consists of a camera connected to a Raspberry Pi that was triggered anytime the doorbell was pressed, capturing their face and comparing it to a database of previously registered faces. [6]. This system enhances security by automatically capturing images and processing images for facial recognition, then using mail communication with the server to validate if the intruder is known or unknown. The main security feature of the system was face recognition.

2.5.1 Literature Survey

The Smart doorbell system based on face recognition where introduced how to recognise a face. OpenCv library was used to to Eigen Faces algorithm to perform face recognition.. The first part requires face detection using hair-like filters followed by a search

for similarity within the database entries. The mechanism can assist persons who had hearing loss or were entirely deaf in informing others about someone at the door. The OpenCV library was ported to the Raspberry Pi for this project which focuses on image processing. The suggested system is divided into two parts which is pre-processing and picture recognition. The user-friendly, easy-to-build, low-cost, and successful face recognition approach has a number of advantages.

Then, Smart bell notification system using IoT used microcomputer, Raspberry pi, camera PIR sensor and Buzzer. The idea to implement the project was came from the trend of when the delivery person want to meet the recepient and the recipient was not at home. This smart doorbell notifies user when the doorbell rings and allows user can see and speak with visitors from smartphone at any time. The doorbell system built in with "Face Recognition" module so can detect the known and unknown persons in front the door. The system's limitation was the internet connection because user will not get notification from the smartphone if the internet was not stable. Therefore, SMS system will be provided as the backup plan of notification's alert to user to overcome the unstable network connection.

Lastly, the IoT Smart bell notification system design and implementation purpsosed when a guest rings the doorbell, the device records and sends the visitor's CCTV to the user. System provides a simple user interface through which the user may view the CCTV and take relevant action. The system accomplished by connecting to a real-time SMS service, which sends a reminder message to the user whenever the doorbell is pressed. Alternatively, if an intruder breaks into the home, the system can help in identifying the intruder by collecting CCTV footage. This method can also be used to promptly notify the authorities or a home security service provider when a trespass occurs. Video, image storage, warning

notice, and GUI functions all supported by the smart bell system provided in this project. In future, to improve the security system, voice recognition and face recognition can be included. The system's drawback was the time takes for data to move from the doorbell unit to your phone.

2.5.2 Proposed System

Figure 2.10 shown the proposed system of this project. The system provided with database of approved person list on that system and registered their faces with by entering OTP otherwise non-approved people cannot enter the house until they enter the OTP. The camera triggered, captured the image of the visitor and cheked with database. When the face was not matching with the database, system will sends an email that consist the unknown person image and OTP otherwise the known person allows to enter the house. The sytem also use voice recognition method to detect voice and speech. In addition, motion detection system also had on the system. There were three methods to develop the system which image processing, digital signal processing and speech to text processing.

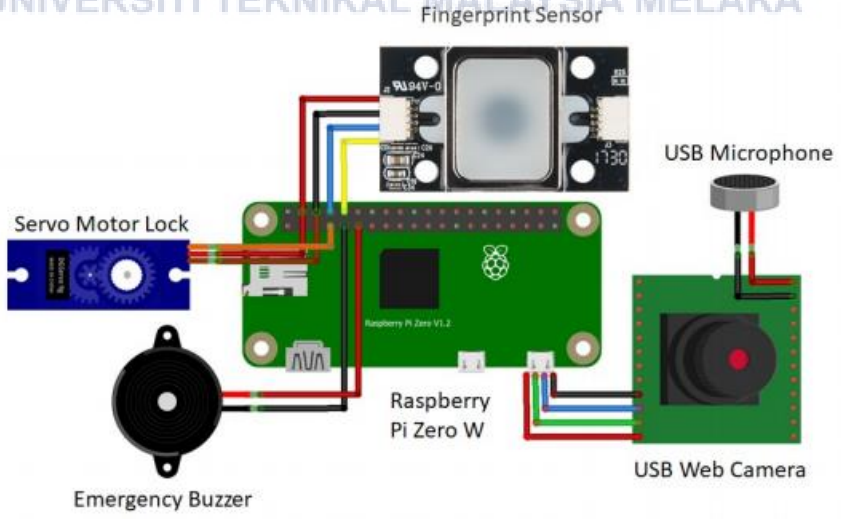


Figure 2.10 Proposed system [6]

2.6 Smart Doorbell System with Facial Recognition for People with Hearing Impairment

People with hearing problem face a lot of difficulties with doorbells. Existing doorbells are not very helpful in terms of alerting the person about the visitor at the door [7]. The system not essential for people with hearing impairment but provides the notification via a buzzer whenever the doorbell wass pressed. It gives a live feed on the application and the users have the privileges to add or reject the request for saving the data in the cloud. The system allows the home owner to add more security to their doorbell system It is costly because of such high end technologies involved and the connections are made through wifi and internet connections.

Meanwhile, the smart doorbell system was used IoT smart bell notification system design and implementation where the function to combine the services of smart phones and home network systems. The main method was to remotely access the IoT based doorbell to monitor the visitors in real-time. By using CCTV evidence the system, it will help to detect if have any intruder attempted to break-in in the house. This system would be helpful to get the necessary evidence for the police's report or home security provider immediately if any trespass occurs. The authors have proposed that this system can be further improved by adding voice recognition and facial recognition functionalities as this would only strengthen the system.

2.6.1 Proposed Work

The system focus to overcome the problem of person which had physical challenged especially hearing impaired where had some difficulties about doorbells. Therefore, the system will assist with give notification by vibration on the wrist when the doorbell pressed by someone. In addition, the system add seurity features by built in face recognation system

to detect known faces. The system used Wi-Fi module to interact between the wearable device and the doorbell hub without internet.

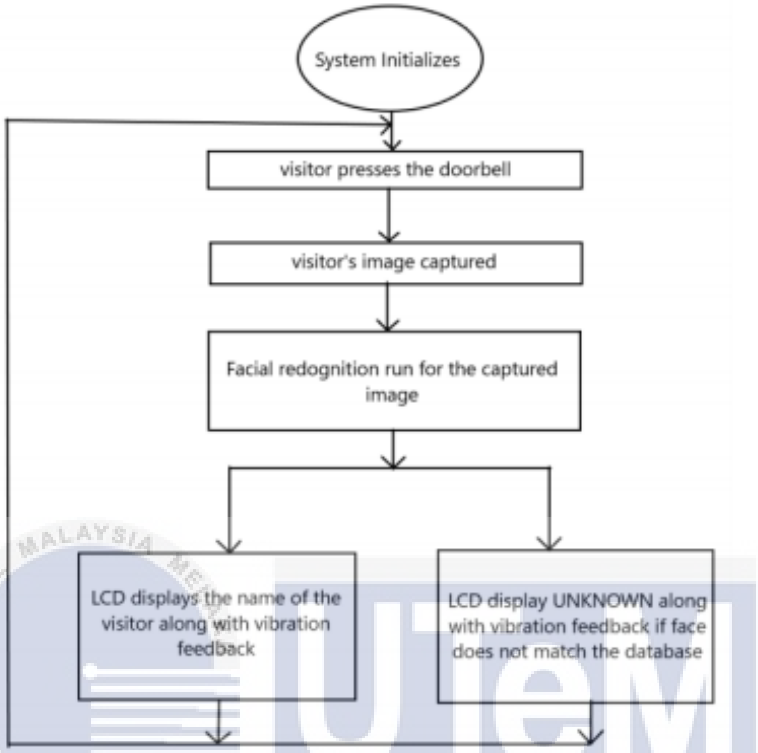


Figure 2.11 Flowchart of proposed work [7]

Figure 2.11 shown the flowchart of the proposed work. The flow of the system system started when visitor pressed the home dorrbell, the respberry-pi in the doorbell hub will capture the visitor's face by using pi-cam attached to the hub and provide image to the face recognition system. The Haar-cascading algorithm was used for facial recognition since its approach is based on a machine learning a cascading feature that learned from a collection of pleasant positive and negative images. In order to run facial recognition, the machine learning algorithm recognises objects, faces, and figures in other images. After the pi-cam has finished taking pictures of the person on the door, the Haar cascading algorithm sets in and begins extracting features from the images in preparation for further comparisonial recognition.

2.6.2 Development

Figure 2.12 shown the wearable device was controlled by a Raspberry Pi version B board and an ESP8266 module. The Raspberry pi based door bell system was helpful for every types of user [8]. The Raspbian buster operating system imounted on the micro SD card. The Pi Camera Module was connected to the Raspberry Pi board via CSI connector in the doorbell device. The Raspberry Pi's GPIO pins were connected to the push-button amd must connected to the power supply. Pyton3 and OpenCV must be installed on the Raspberry Pi in order to run the facial recognition script. After all is set up, project files containing the required script were imported to run the facial recognition.

Then, the pictures of the identifed faces also need to be import to link faces to the databases. The facial recognition script was able to detect faces from a live picture taken with the Pi Camera module after train the datasets. The required connections between the ESP8266, LCD monitor, and vibration module are made in the wearable system while Arduino was used to set up the ESP8266. Next, installing the IDE on the desktop and the required packages After the packages were loaded, the script for connecting the Raspberry Pi to the ESP8266 was installed. The script that receives the data sent from the Raspberry Pi and processes it before producing the output must then be added.

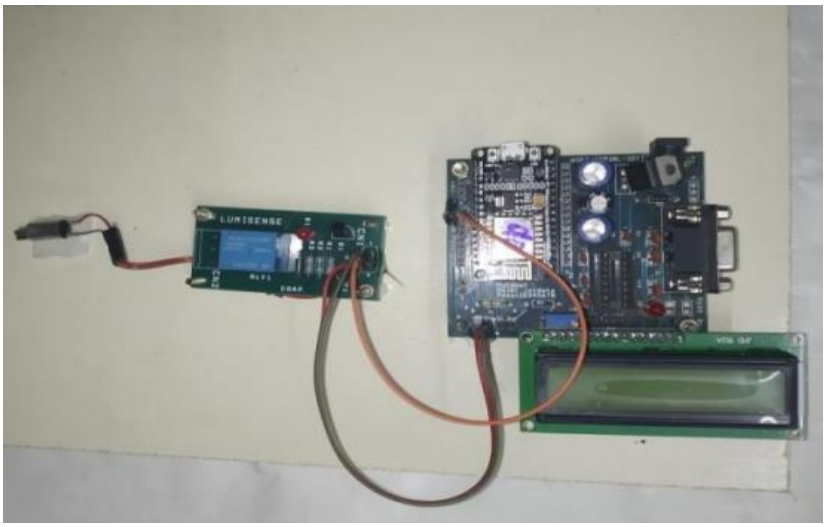


Figure 2.12 Prototype of wearable device [7]

2.7 A Smart Visitor's Notification System with Automatic Secure Door Lock Using Mobile Communication Technology

The project was using Global System for Mobile communication (GSM) technology to develop the system. The GSM was used to communicate with the smartphone by sending or receiving SMS [9]. The implementation to provide more flexibility in managing their records and security of the place. This technology uses face recognition to verify visitors' identities. A low-cost SMS-based door security module has been designed and linked with the GSM network to allow communication between the system and the owner. Figure 2.13 shown the block diagram of the system. The microcontroller connects with laptop or PC by using RS-232 USB to serial converter. The receiver pin (RX) connected to the transmit pin (TX). The laptop can connect with phone by web to send visitor's image. A laptop or PC is also connected to a phone over the internet to send photos of visits. Real-time picture input provided through computer webcams. The speaker and microphone were to record and listen the visitor's voice message.

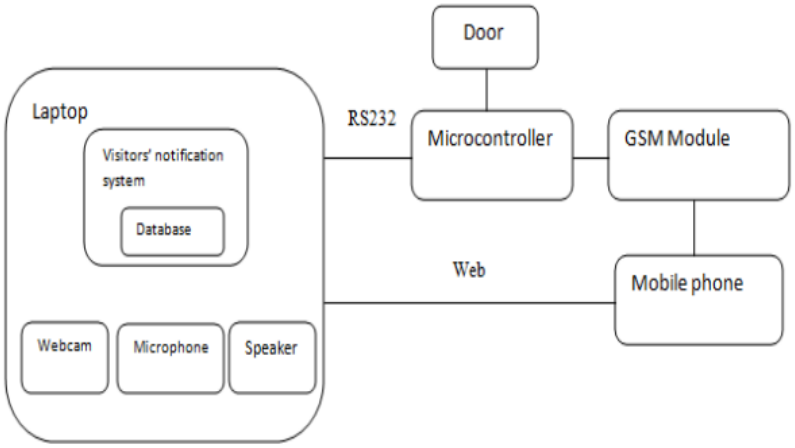


Figure 2.13 Block diagram [9]

GSM was controlled by the microcontroller to interfaced with the system. If the face of a visitor matches that of an existing database, the system will send an instruction to the microcontroller. The door will automatically open after processing the command and closed automatically after few seconds. If the visitor's face was not recognized, the system sends an image of the visitor to the owner's email address over the web and a command was formed and sent to the microcontroller at the same time. The microcontroller will activate the GSM Modem in response to the given command. When the GSM turned on, an SMS sent to the owner's phone to be alerting the arrival of an unauthorized guest. There are many main components used for this system such AT89C55 microcontroller, LCD, GSM modem, RS-232 USB and other components

2.8 Dash-bell: A Low – Cost Smart Doorbell System for Home Use

A smart doorbell was an essential component of a smart home since it serves to maintain the home security by preventing unauthorized entry like robbery or invasion. Through adaptive learning and other technologies, the smart home's controller may be able to answer the doorbell and decide whether or not to accept a visitor outside the door [10].

The project implemented the dash bell system as shown in Figure 2.14 where the components that the system used were dash button as the doorbell, webcam, Raspberry Pi, Wi-Fi router, buzzer, and Amazon Web Service as cloud computing service. The system starts when the dash button was pressed by visitor to request for entry the house. The Raspberry Pi receives a signal from the Dash button to the Wi-Fi router. Then, the webcam is activated, and an image of the visitor is taken and at the same time, the buzzer for the alarm sound is activated and image obtained along with the timing posted to the cloud. The images that have been captured sent to the cloud database service by using Amazon Web Services. The user notified via a mobile application that develop by the author. The visitor's access is granted or denied by the homeowner. The server updates the decision, and the Raspberry Pi receives the notification as well. The door opens automatically using a servomotor if the visitor is granted admission by the homeowner. Homeowner had many options whether accept or reject the call and ignore the call if the "Do Not Disturb" feature is turned on. The updated details for database, homeowner can view the historical record of the request. The interfaces that the system used had three types which is Email, text message and ringer as shown in Figure 2.15.

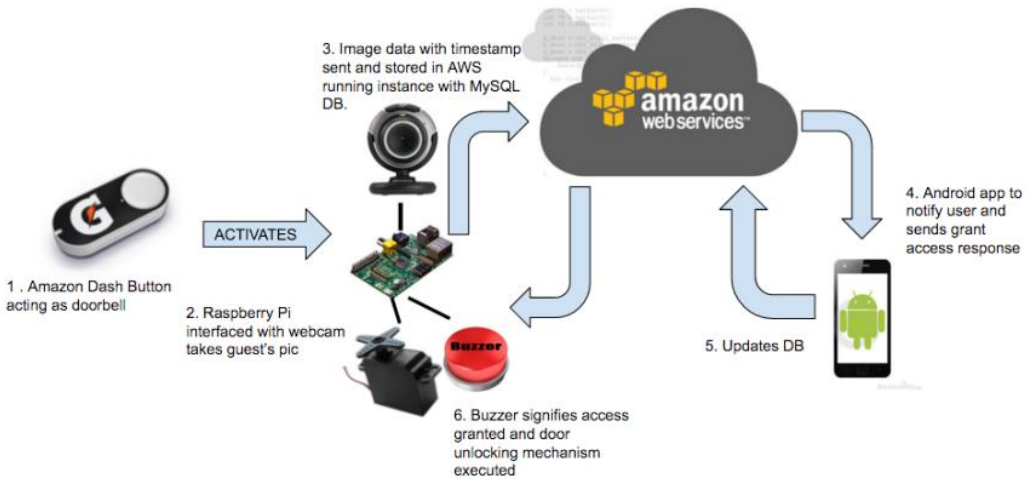
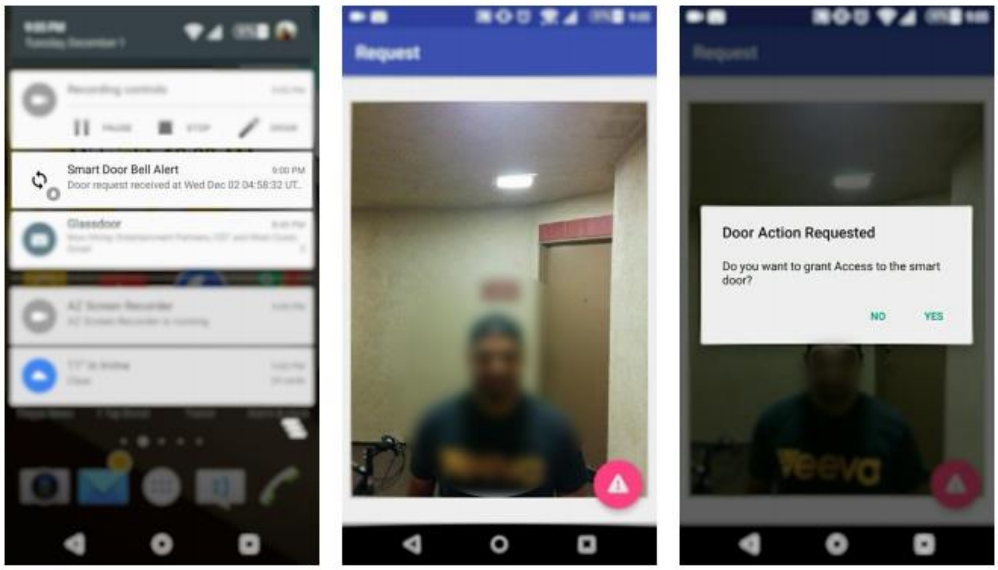


Figure 2.14 Architecture of dashbell [10]



(a) Notification (b) Visitor Picture (c) Grant Access

Figure 2.15 Interfaces alert [10]

2.9 Table of Comparisons

Table 2.2 Comparison of the literature review for Doorbell system

No	Author/Year	Component Used	Method	Pros/Cons
1	C. El Fiorenza et al. (2018)	-Arduino Mega Ethernet -Doorbell/Switch -Jumper cables -Ethernet cable -Arduino IDE -Pushinbox API	-Wireless Transmitter-Receiver Module -LCD Response -SMS notification	- Provide security system. - Assist the elderly people in the house. - Reduce time because visitor can get information and act accordingly.
2	Siddharth Wadhwani1 et al. (2018)	-Arduino UNO Board -5V Relays -DC Motor -Flex Sensor -Wi-Fi Module -Reed Relay Sensor -Flame Sensor -Acclerometer	-Sensing to control appliances by the gestures of fingers. -The cloud platform built to allow users to monitor their homes. -Controlling to control the appliance on the house.	- The system provides a moderately priced and low cost. - Sensing, monitoring and controlling as the security features by using IoT.

No	Author/Year	Component Used	Method	Pros/Cons
3	P. K. Singh et al. (2020)	-Respberry Pi -USB Web Camera -USB Microphone -Figerprint Sensor -Emergency Buzzer -Servo Motor Lock	-Image processing computational techniques. -Digital signal processing (DSP). -Speech-to-text technology.	-System has one time password (OTP) for security features. -Provide fingering sensor. -Face recognition, voice recognition and motion detection as additional security features.
4	R. Subash et al. (2020)	-Raspberry Pi 3 Model B -Pi Camera Module v2 -ESP8266 -Vibrating Motor -LCD1602 module	-Face image capture using a pi-cam linked to the doorbell hub -Comparing the features with the database that already exists. -Alerting the user to the presence of a visitor at the door.	-System for people with hearing problem . -Alert through their wrist. -Face recognition features make the system more secure.

No	Author/Year	Component Used	Method	Pros/Cons
5	R. S. Satti et al. (2015)	-AT89C55 microcontroller -SIM900 GSM modem -RS-232 USB -LM317 -LCD -7805 IC -Transformer	-Face recognition -GSM Modem	-Generate face recognition -Generate SMS and email message. -Low-cost effectively
6	B. Quadros et al. (2017)	-Amazon Dash button -Respberry Pi -Webcam -Buzzer	-Amazon Web Service (AWS) cloud services. -Three interfaces alert which is email, text message, and ringer.	-Provide usefull features and enhanced security. -Secure communication channels and encrypting user data.

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2.10 Summary

There are several techniques for development smart doorbell using IoT in previous researchers have devised in their projects. Several researchers continue to use the same approach before, but they are using different software and method to develop smart doorbell system. The Internet of Things (IoT) will be extremely useful in improving the interface between physical equipment and virtual software so allowing everything to be done remotely. However, for this system to work, it requires a constant Wi-Fi internet connection. Therefore, ESP32-CAM module can be the main microcontroller for this smart doorbell to monitor and control the input and output data of devices.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Normally, every house are using the normal doorbell by their owner to make them know that there are someone come infront their house when the doorbell pressed. This is the old concept or version of doorbell where simple to use and connect and has poor security features. Meanwhile, in this era of digital technology and communication, everything have been change to IoT which is can be control, manage and connect via internet and device like smartphone and more secure. Therefore, this project is to develop from normal concept of doorbell to the smart doorbell by using internet of things (IoT) and camera ready view. The main component of this smart doorbell is ESP32-CAM.

3.2 Workflow

The system starts when someone press the home's doorbell, it will send a notification and vibration to the disabled people inside the house by their smartphone. The application that is use to connect with the smartphone is Blynk application which is it had been developed and free to install on the smartphone. The disable people can open the notification on the smartphone and it will automatic view the person outside the house. The application can be setup their interface with any button and function. Meanwhile, the Blynk app can take a picture of the person who is standing outside. After seeing the person, the disable people can open the door by tapping or control on the Blynk application.

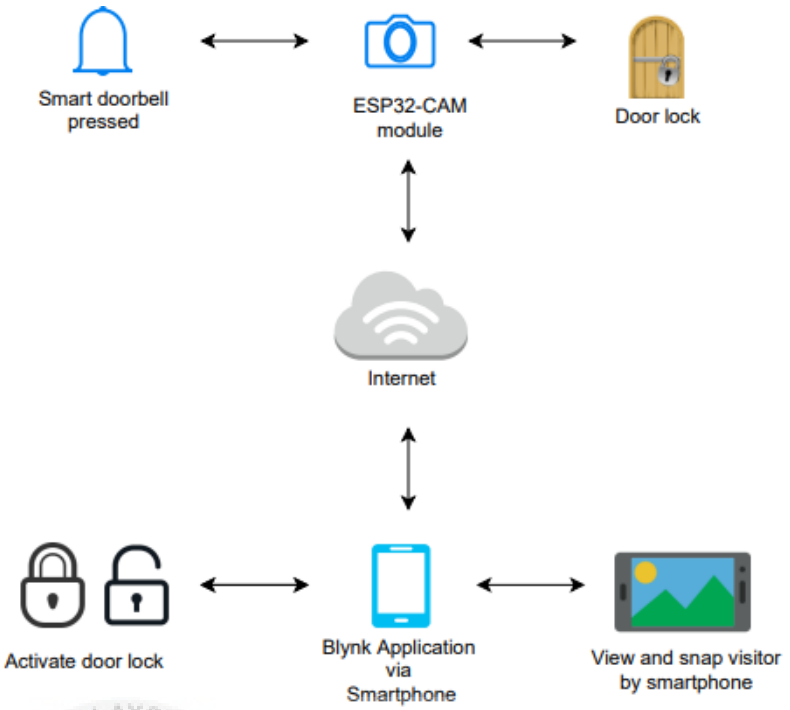

Figure 3.1 Structure flow

3.3 Block Diagram

The block diagram of Smart doorbell monitoring using IoT and camera ready view system is shown in Figure 3.2. The main component of the system is ESP32-CAM as it acts as the central figure to process the input and output signal. The system use 12V of power supply because to control the solenoid lock capabilities which is around 12V to function. The push button will act as the device to trigger the action of the system. The OV2640 camera module will view and capture the image of the person in front the house and the buzzer will activate along with camera when the push button is pressed.

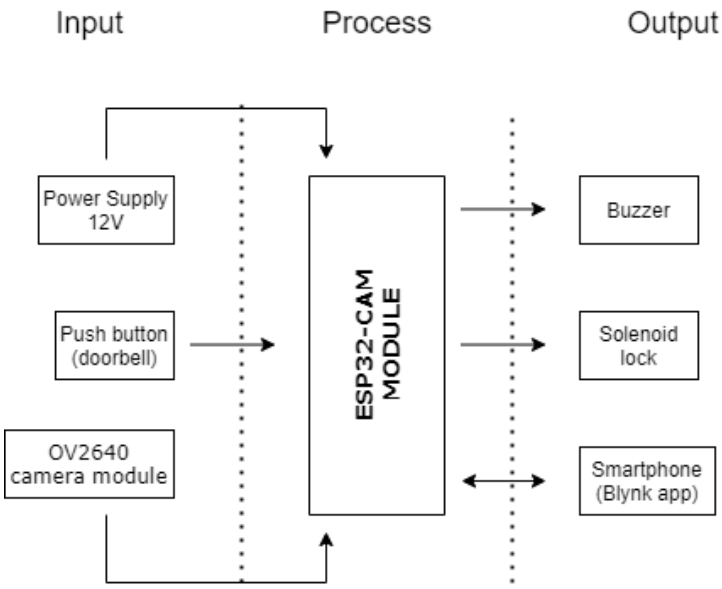

Figure 3.2 Block diagram

3.4 Hardware Requirement

This part will list out the physical components that is used to complete the project as ESP32-CAM module and Arduino UNO board are the main hardware requirement for this smart doorbell monitoring using IoT system. Therefore, there are other components need in this project such as delay, solenoid lock, buzzer and button.

3.4.1 ESP32-CAM Module

Figure 3.3 shows the ESP32-CAM which is a little version of the ESP32 Wireless Vision Development Board which developed for use in IoT projects such as smart home devices, industrial wireless control, wireless monitoring, QR wireless identification and others. This module is quite affordable and can be use in a variety of ways from some simple IoT, advanced for image monitoring and recognition using AI-Thinker module and even as a surveillance system to check what is going on in the place from wherever we are.

Figure 3.3 ESP32-CAM module

Table 3.1 Specifications of ESP32-CAM module

SPECIFICATION	ESP32-CAM
Wi-Fi	802.11 b/g/n
RAM	520KB SRAM + 4M PSRAM
SPI Flash	Default 32Mbit
Bluetooth	Bluetooth 4.2 BR/EDR and BLE standards
Support Interface	UART, SPI, 12C, PWM
IO Port	9
UART Baudrate	Default 115200 bps
Image Output Format	JPEG(OV2640 support only), BMP, Grayscale
Spectrum Range	2412 – 2484Mhz
Transmit Power	802.11b: 17 +- 2 dBm@11Mbps 802.11g: 14 +- 2 dBm@54Mbps 802.11n: 13 +- 2 dBm@MCS7
Security	WPA, WPA2, WPA2-Enterprise, WPS
Power Range	5V

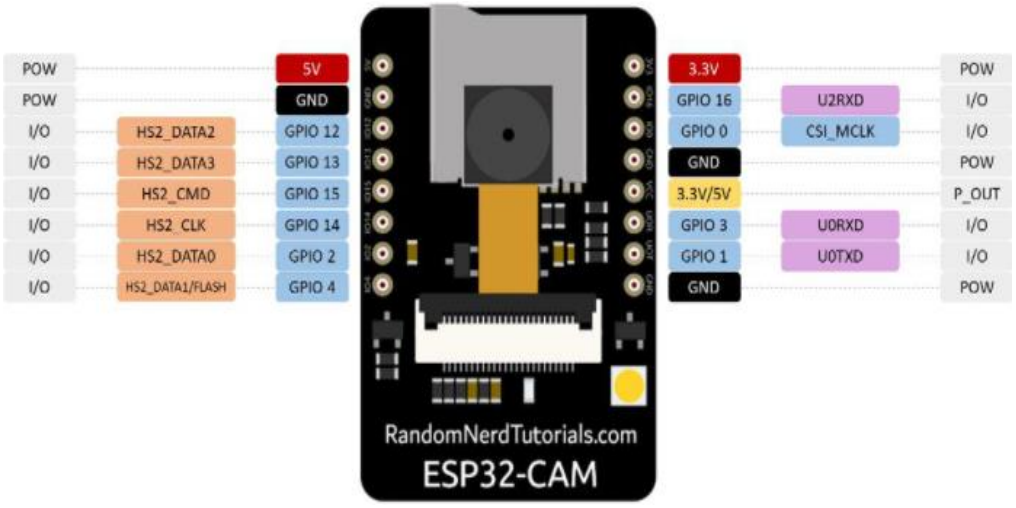

Figure 3.4 Pinout diagram of ESP32–CAM

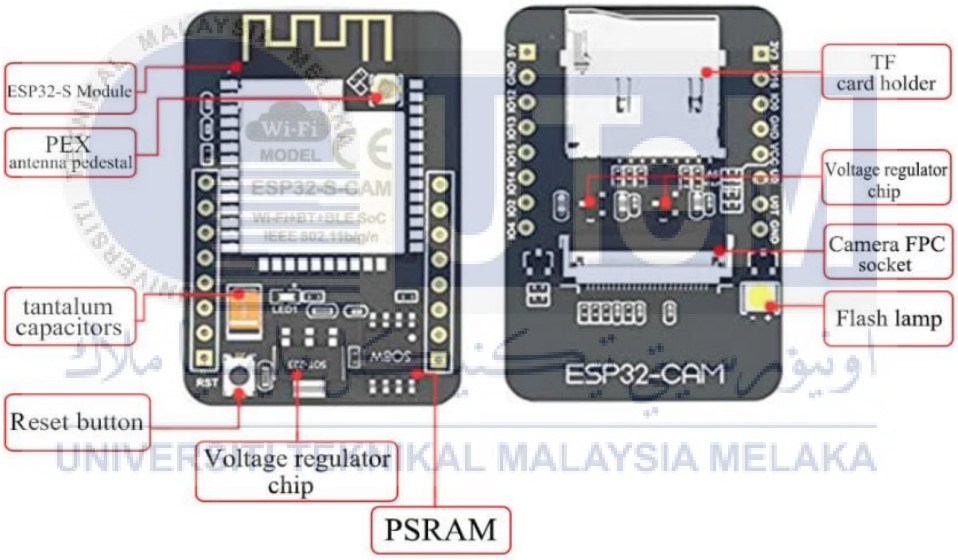

Figure 3.5 Parts of ESP32-CAM module

3.4.2 OV2640

Figure 3.6 shows the OV2640 Camera module that come with ESP32-CAM when purchased the component. The camera need to be put and insert into the ESP32-CAM board to connect the camera. Open the camera connector on the board then put the camera in place and close the camera connector properly because the loose of the connector will give some issues

when we run the program. The OV2640 camera module 2MP appears to be a very competitive small-size camera module that can run as a basic system on its own.

Figure 3.6 OV2640 camera module

3.4.3 Arduino UNO Board

The function of the Arduino Board is to allow users to control a variety of electronic equipment. Arduino boards can read inputs and convert to outputs. Arduino Uno shows on Figure 3.7 will be the connector for ESP32-CAM. It will act as TTL converter to program the ESP32-CAM module.

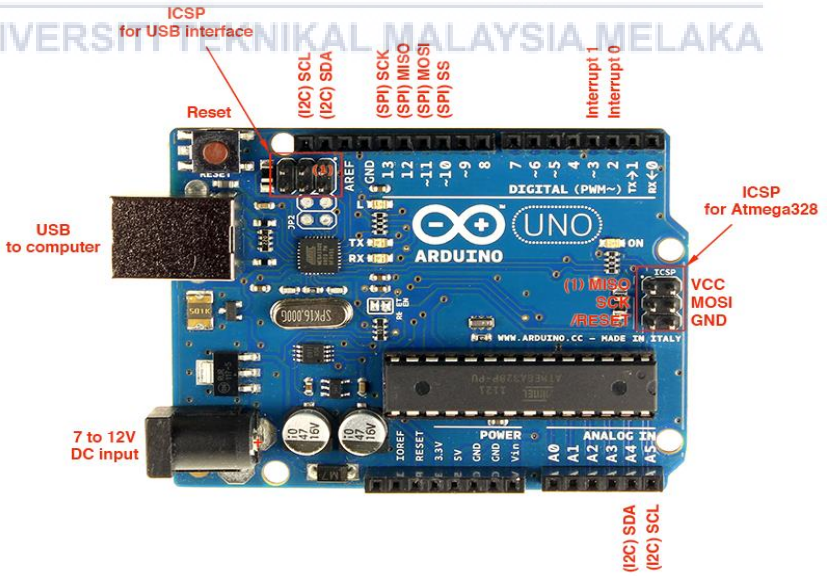

Figure 3.7 Arduino UNO board

3.4.4 Piezo Buzzer

Piezo buzzer also known as passive buzzer. It terminated with color-coded wire which is red and black to connect with the project. It can be ue in any Arduino board or any microcontroller that to produce tone signal. The buzzer operates on 3.5V-5V with a mean current of 35mA at maximum. It can produce sound indicator when the doorbell button is pressed.

Figure 3.8 Piezo buzzer

3.4.5 Push Button

The push buton function as the doorbell button. When visitor push the button, buzzer will respond by emitting sound and camera will view the person outside the house.

Figure 3.9 Push button

3.4.6 12V Solenoid Lock

Solenoid lock use as the door or gate lock of the house. The slug pulls in and the door opens when 9-12VDC is applied. This solenoid lock can be control by using Blynk application to open or close the door or gate.

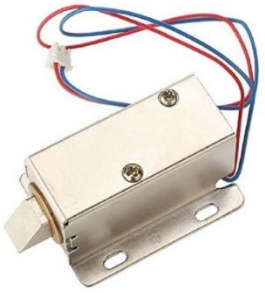

Figure 3.10 Solenoid lock

3.4.7 Relay Module

Relay is important to have when do the electronic projects. It will isolate the low voltage against high voltage like 5V DC and 240V AC. The relay can be set to activate at 5 volts (high) or 0 volts (low). This is a Relay Breakout Board that may be used by anyone.

Figure 3.11 Relay module

3.5 Software Requirement

Software involved in developing the system and assisting the hardware component by controlling the input and output of hardware components.

3.5.1 Arduino IDE

The Arduino IDE also known as the integrated development environment is a software that allows to write, check, debug, build, and upload programmes from computer to the Arduino board. The Arduino software contains its own programming language, which is a simplified version of the C language with a library to make programming easier for users.

Figure 3.12 Arduino IDE

3.5.2 Blynk Application

Blynk is a smartphone application that lets user control and monitor a project. Blynk is the open source application where it is availablle for Android and iOS. Blynk is using just to drag and drop widget interface. Blynk can alwork via the internet, Bluetooth and USB. It is also can connect with any components such as the ESP32 CAM, NodeMCU ESP8266 and others that has a WiFi chip. Figure 3.14 shows the structure of the Blynk application on the smartphone link with the any microcontroller board like Arduino board.

Figure 3.13 Blynk application structure

3.6 Flowchart

The Figure 3.14 below shows the flowchart of the smart doorbell with IoT system where demonstrate the way of the system function. The input device that to be use is push button where respond as doorbell button. The system begins when someone outside the house's gate as the visitor want to enter the house. When the visitor pushes the doorbell, the buzzer will activate sound and the camera module will view the visitor in front the house.

Meanwhile, at the same time the user will receive notification that vibrates through the smartphone by use the Blynk application. Therefore, the user can see the visitor's image in front the house that display on the smartphone via Blynk application. After identifying the visitor, user can unlock the door by using the Blynk application if the visitor is the known person where in a normal situation the user must open the door manually and take times to reach at the house's gate. Otherwise, the user can maintain to lock the door if the visitor is unknown person.

Therefore, the disabled person will be able to see the visitor's image through the display part on the Blynk application interface and control the home door lock to reduce time and energy. In addition, this smart doorbell offers a method that is user friendly, secure, easy, saves time energy and budget.

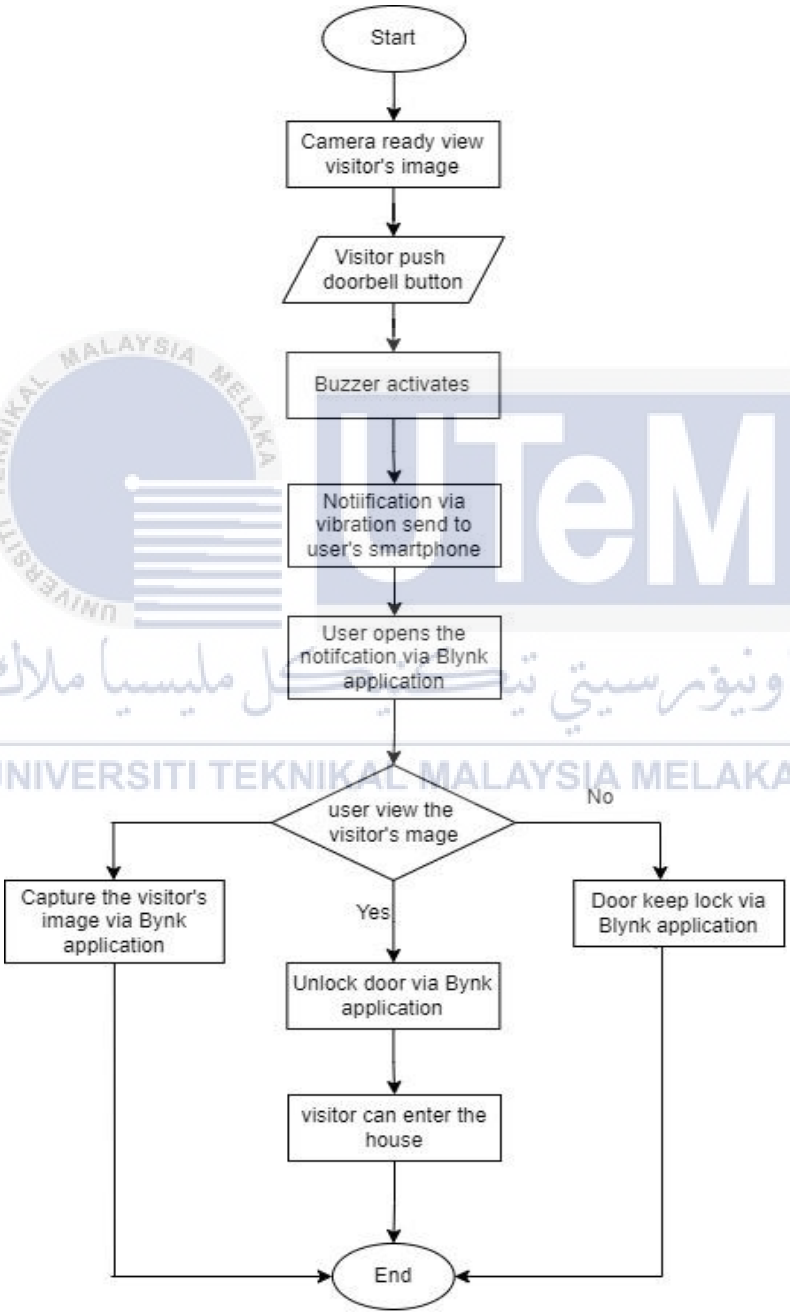

Figure 3.14 Flowchart

3.7 Project Costing

The project involves hardware implementation, thus there were some costings involved to complete the project. All the cost for items is listed in Table 3.2 which will be used to show whether the project is expensive or inexpensive based on the function or availability in market. Table 4.1 highlights the overall costing of hardware involved for this project. The most expensive component is the ESP32-CAM module and others item cost less than RM40.00. Therefore, from the table above, the cost of the project is very reasonable.

Table 3.2 List of hardware and price

No	Hardware	Units	Cost (RM)
1	ESP32-CAM module	1	40.00
2	Arduino UNO Board	1	26.00
3	Solenoid Lock	1	18.00
4	Relay Module 5V	1	5.00
5	Piezo Buzzer	1	1.00
6	Button	1	0.50
TOTAL			90.50

3.8 Summary

This chapter presents the proposed methodology in order to develop Smart doorbell monitoring using IoT and camera ready view. This part explained about the process and method on how the project will be design and develop. Therefore, this section will discuss about the structure of the project, block diagram, hardware and software needed, simple circuit programming and the flowchart of the project.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents to preview the result and provide discussion from the data collection while undergoing the project process. This includes testing and analysis to measure the accuracy and preciseness of the data. This chapter is to ensure that every objectives of the project are fulfilled.

4.2 Overall Project and Operation

To run this project, the main software is needed to be use as the programming part. This project was using Arduino IDE as the main software to program and compile the main component of this project which is ESP32-CAM module. Therefore, there are no errors during the execution process while run this project.

4.3 Software Implementation

Software is one of the main components for this project. This part tells the detail about how the software involved in the project.

4.3.1 ESP32-CAM Board Installation

To function the ESP32 board in the Arduino IDE, library of the ESP32 board by using URL “https://dl.espressif.com/dl/package_esp32_index.json” needs to be install first to make the board is available in Arduino IDE. As shown in Figure 4.1, on the preferences

part, the URL needs to fill in the additional boards manger URLs before we can find and install the ESP32 on the board manager as shown on the Figure 4.2.

Figure 4.1 ESP32 URL library

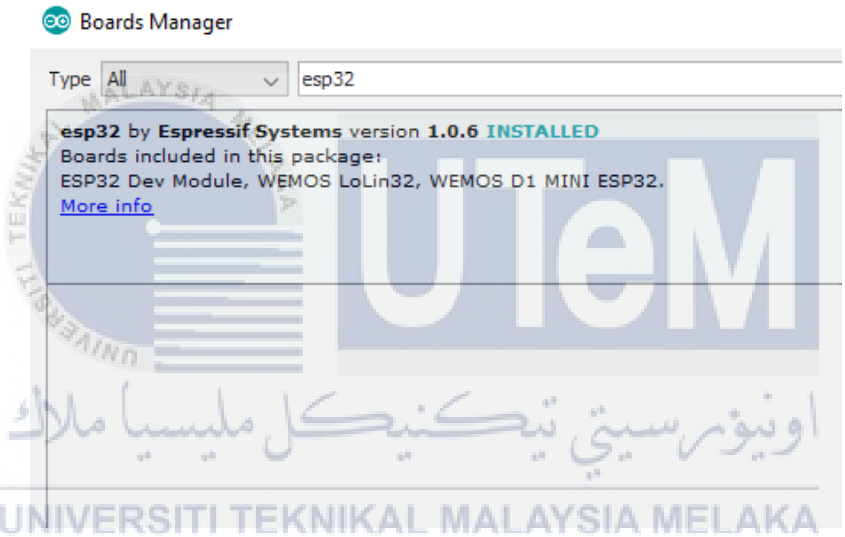

Figure 4.2 ESP32 board installed

4.3.2 Testing Part

The testing phase is used to confirm that the ESP32-CAM components are working properly by test the OV2640 camera. Arduino Ide provided the example program to test the function the camera as shown in Figure 4.3. The camera module for ESP32-CAM is AI-Thinker. Then, by using any selected internet connection, fill in the SSID and password on the program. After done uploading the code, disconnect the GPIO-0 pin from GND pin on ESP32-CAM module and press the reset button. Figure 4.4 shows the serial monitor Baud

rate is 115200 to get the IP address result on serial monitor to test the camera on browser as shown in Figure 4.5

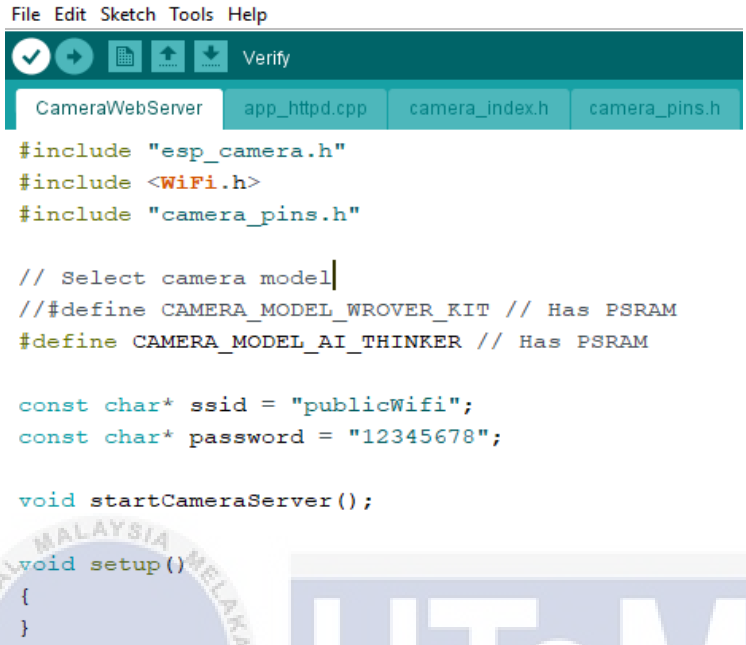

Figure 4.3 Arduino IDE programmed

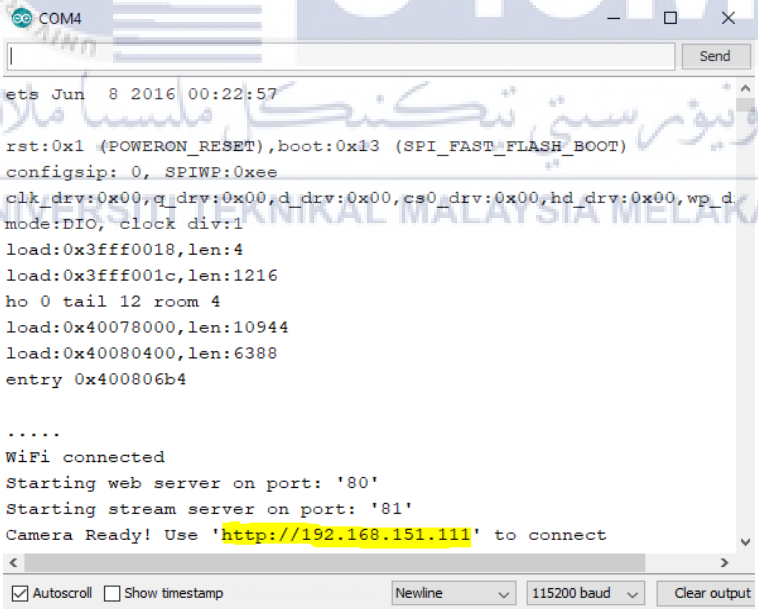

Figure 4.4 IP address of ESP32-CAM

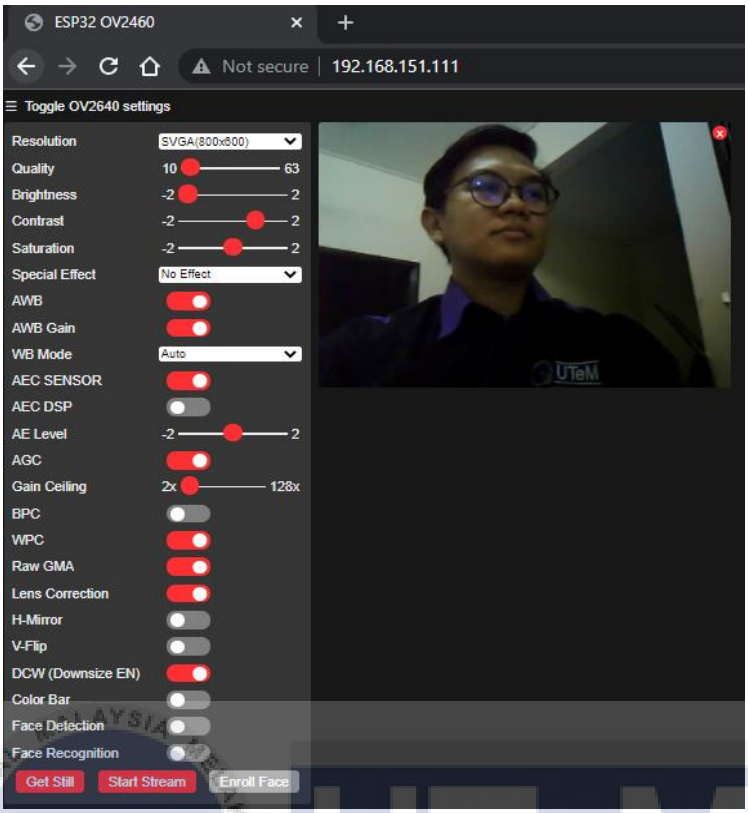

Figure 4.5 Camera testing for ESP32-CAM

4.3.3 Blynk Application Setup

The smart doorbell is controlled through the Blynk application. Figure 4.6 shows the Blynk application's setup interface. The first step in setting up this application is to launch a new project in the application and click the plus symbol at the top. Then, from the widget box, select the image gallery widget and set it to pin-V1, with the function of displaying the visitor image. Then, from the widget box, select the styled button and configure it as pin-GP14 with mode-push. The purpose of this function is to capture an image. To set the solenoid lock button as pin-GP12 with mode-switch, select the styled button from the widget box. Finally, from the widget box, choose notification, which has the purpose of receiving a notification when the push button is pressed.

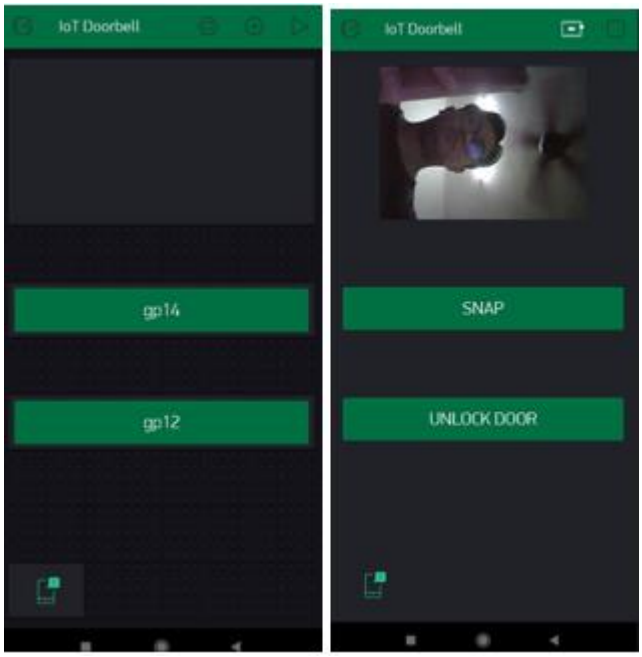

Figure 4.6 Interface Blynk application

4.4 Hardware Implementation

Hardware is one of the main components for this project. This part tells the detail about the hardware involved in the project

4.4.1 Circuit Connection

Figure 4.7 shows the illustration circuit connection between ESP32-CAM module and Arduino UNO to upload code from Arduino IDE. The ESP32 camera connected to Arduino UNO through four wire connections because this camera module does not have a USB connector. The UOR and UOT pins on the Arduino UNO are used to convert TTL serial transmission to USB signals as well as to upload source code from a PC (serial pins). Table 4.8 shows the connection pins of ESP32-CAM and Arduino UNO. After uploading the code, disconnect GPIO 0 with the GND pin of ESP32 CAM.

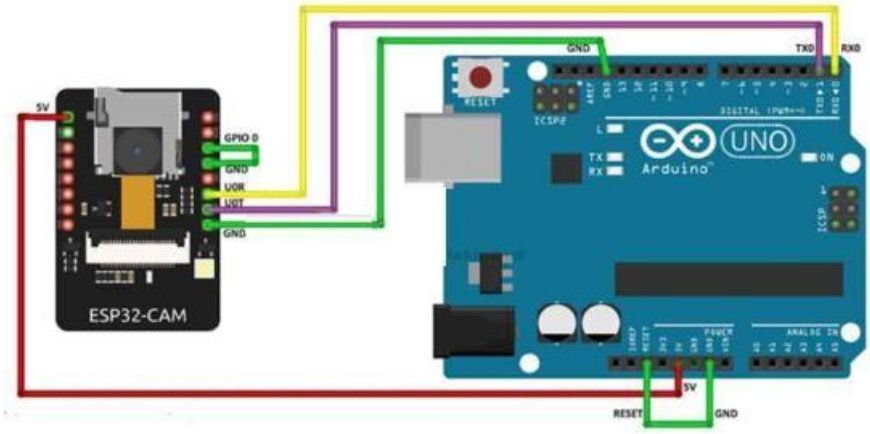

Figure 4.7 Circuit connection for ESP32-CAM module

Table 4.1 Connection pins of ESP32-CAM and Arduino UNO

ESP32- CAM	**Arduino UNO**
5V	5V
UOR	RX
UOT	TX
GND	GND
GPIO 0 to GND	Reset to GND

Figure 4.8 shows the Arduino UNO is connected to the ESP32-CAM. By using jumper, the connection pin for component must same as shown on Figure 4.3. The Arduino UNO is powered by a 5V power source and connect with 5V pin of the ESP32- CAM. The UOR and UOT from ESP32-CAM connect with the RX and TX pin of the Arduino UNO board. Then, GPIO 0 must be connected to GND pin on the ESP32-CAM module while reset pin connect to ground in the same Arduino UNO board. Lastly, the ground pin from ESP32-CAM connect with the ground pin of Arduino UNO board. After that, connect the Arduino UNO to the PC to create program.

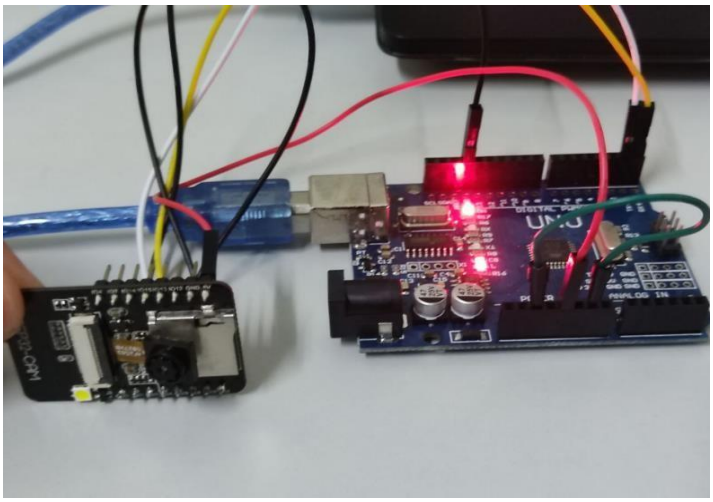

Figure 4.8 Connection ESP32-CAM and Arduino UNO

4.4.2 Hardware Testing

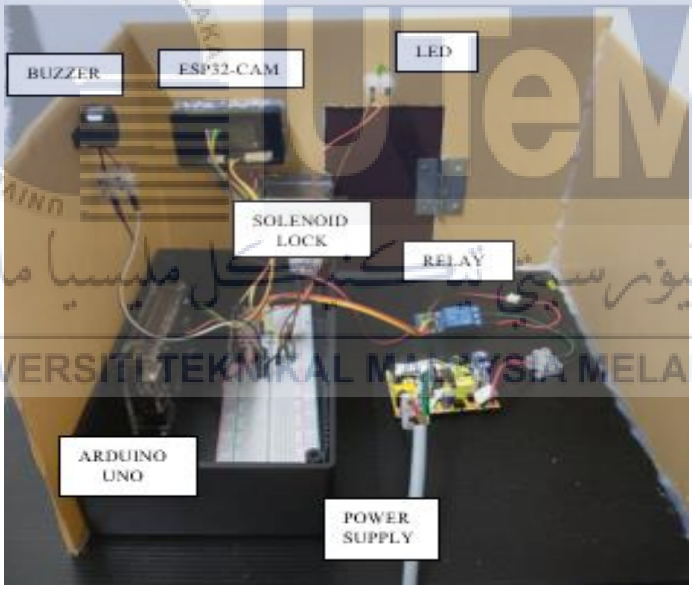

Figure 4.9 Project prototype

Figure 4.9 above shows the prototype of the smart doorbell project with inner (interior) view. All components listed on the project costing on chapter 3 is shown on the Figure 4.9 where everything had been in connection to be test and analyze their functionality. This inner view consist ESP32-CAM module, Arduino UNO, 12V solenoid lock, relay, buzzer, LED and 12 power supply.

Figure 4.10 Front view of prototype

The Figure 4.10 is showing the front view of this project prototype which is consist LED, OV2640 camera and doorbell. Figure 4.11 is showing the functionality of this smart doorbell project. When visitor press the button as known as doorbell, the bezzer will produce sound the OV2640 will direct capture the visitor image with the flashing light and send the notification to inform the homeowner that someone infront the house . Basically, the OV2640 already be camera with ready view the visitor image infront the door. When the visitor is known person, homeowner can unlock the door lock and the LED will be turn on to give the known visitor enter the house and keep unlock the door if the visitor is unknown person.

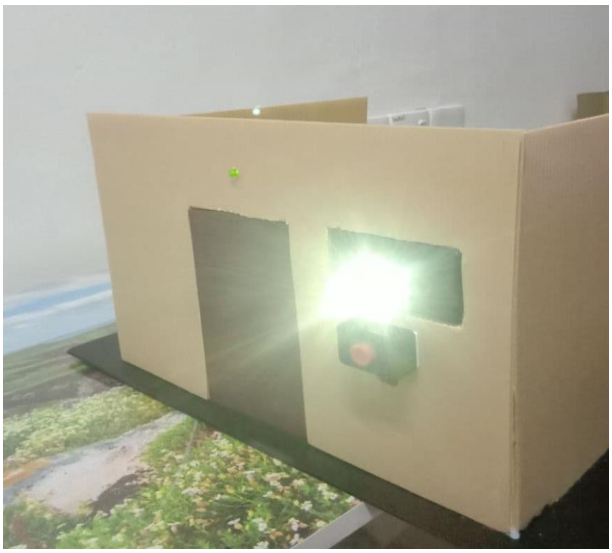

Figure 4.11 Functionality of smart doorbell

4.5 Results and Analysis

The result and data were recorded and shown in Table 4.2. This data was recorded based on the number of notication and image captured with time. The scenario of this project is where when the doorbell is pressed by a visitor, the user can directly get notification and picture of visitors on their phone. From the results, it is inequality of time in notification and image capture after the doorbell is pressed. Initially, both notification and image captured in the same state where the user can receive notification and image visitors at the same time. When the doorbell is pressed for the second time and so on, the image capture is occurred along the button, but the notification is slow to come out on the user's smartphone.

Table 4.2 Data of number of notification and image captured versus time

NOTIFICATION	TIME (s)	IMAGE CAPTURED	TIME (s)
1st	0.0 (+6.8)	1st	0.0 (+1.6)
2nd	6.8 (+6.6)	2nd	1.6 (+1.3)
3th	13.4 (+6.3)	3rd	2.9 (+1.2)
4th	19.7 (+5.6)	4th	4.1 (+1.4)
5th	25.3 (+5.3)	5th	5.5 (+1.2)
6th	30.6 (+5.6)	6th	6.7 (+1.3)
7th	36.1 (+5.1)	7th	8.0 (+1.2)
8th	41.3 (+5.3)	8th	9.2 (+1.4)
9th	46.6 (+5.9)	9th	10.6 (+1.2)
10th	52.5	10th	11.80

User’s smartphone can receive 10 notifications in 60 seconds and 10 visitor’s images can be captured in 12 seconds. Figure 4.12 shows around one minute, the smartphone only can get the 10 notifications pop up while Figure 4.13 shows around 12 second, the smartphone can get the 10 visitor image. Therefore the ratio is 1:5 which mean one for notification and five for image capture although the notification and image captured should

be along each other. This is because this system had a connection lagging to send the notification through the user's smartphone signal.

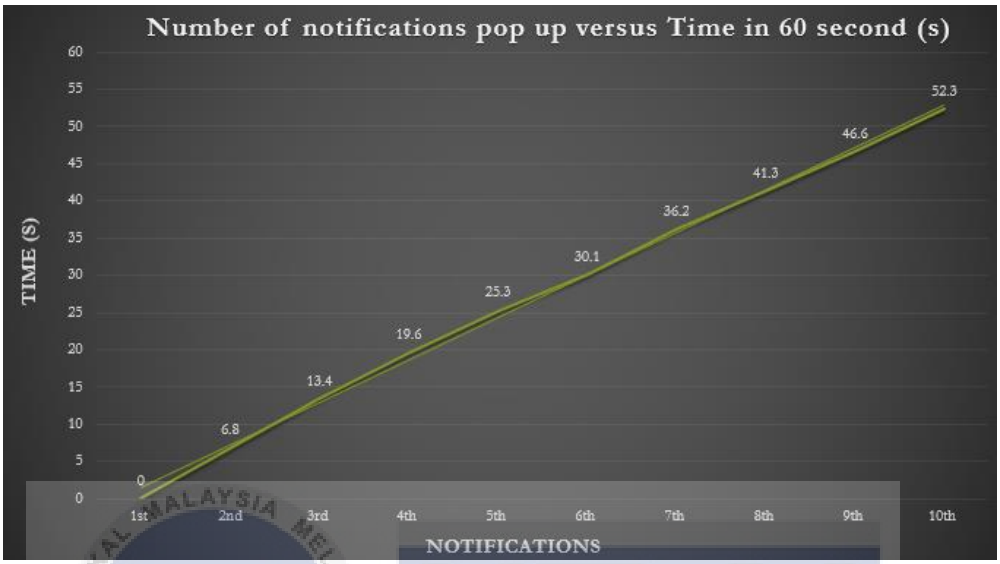

Figure 4.12 Graph of notifications

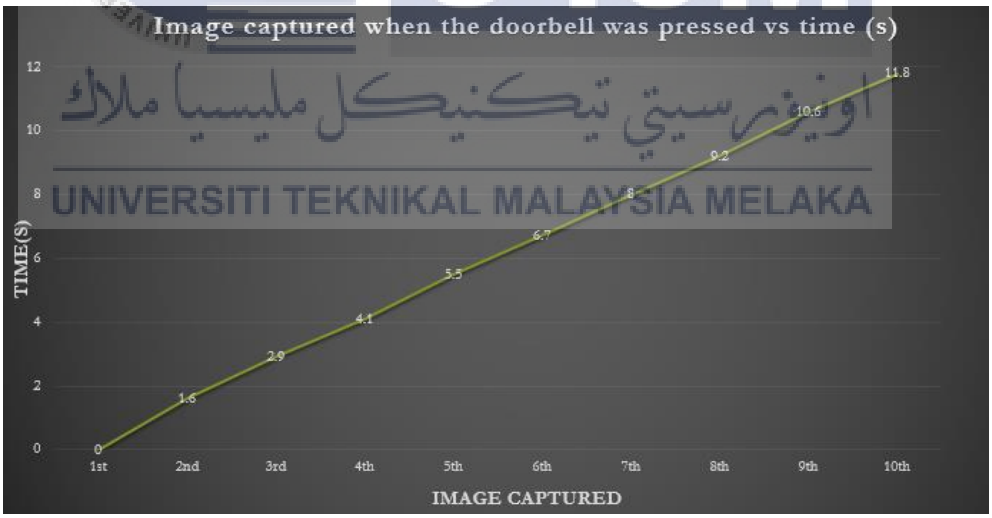

Figure 4.13 Graph of image captured

Table 4.3 Expected result of each component

No	Component	Expected Condition	Actual Result
1	ES32-Cam	View and campture visitor image	Good
2	Button	Capture and sent notification	Good
3	Buzzer	Produce sound when button pressed	Good
4	Solenoid Lock	Control lock and unlock door	Good
5	LED	Light on when the lock door unlock	Good

4.6 Summary

The ESP32-CAM is establishing an IP address after uploading the code is essential before viewing the test image. The camera can then be accessed through a local network byentering the IP address into a web browser and viewing the image. The ESP32 camera lookedimpressive in result where produce nice image view in a shorter amount of time. As previously stated, the OV7670 module is low-cost cameras so it can only create monochrome photos. Furthermore, the techniques for capturing photos have been discoveredto be easier and convenient then make it appropriate to use in this project. The disadvantage of this camera module is requiring a strong Wi-Fi connection to run smoothly. As a solution,the camera will be connected to a personal hotspot device for testing reasons to ensure that the entire system functions properly.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter will discuss about the ending of the project and future proposal planning for this project. Certainly, this part will clarify the true methodology and knowledge gain from the task. This also includes several suggestions that can be used or applied in the future for related project

5.2 Conclusion

This project is to design Smart doorbell monitoring using IoT and camera-ready view via vibration and notification through smartphone when thedoorbell is pressed. Homeowner can control and view the visitors from the smartphone. As of now, everything is in an age where every object is a smart object. Everything move to the Internet of Things (IoT) which can be control, monitor and connect via the internet and devices like doorbell and solenoid lock. Home doorbells are one of the things that can be upgraded to be smart, more innovative, and user friendly.

More specifically “Internet of Things” is utilized in this system for monitoring the person entering in a home using a smart phone. Smart doorbells allow people inside the house to receive alert and notice when the visitor press the doorbell, see who the guest is and control the home door lock via smartphone due to the lack of ability. This system is based on IoT, which uses ESP32 Cam Module, Arduino UNO, Buzzer, Relay, Push Button and Solenoid Lock.

The medium of IoT that is use on this system is Blynk Application. Therefore, the disabled person will be able to see the visitor's image through the display part on the Blynk application interface and control the home door lock to reduce time and energy. This system presents a developed solution to provide increased security for disabled people within their home. In conclusion, in the age of technology, it is necessary to update security systems around the house and to make living easier.

5.3 Future Works

For future improvements, the following recommendation to improve the study and experimental model of the process:

i) Improve the system limitation access for device and network connection to view the system camera which is provide more than one device can access same IP address of the camera to view the visitor outside the house.

ii) Include the higher-resolution camera with a night mode. Therefore, the camera view can function well and clear both during the day and at night.

iii) Provide audio and video communication between visitors and homeowners to communicate each other.

iv) Provide storage to save the all the capture or recorded visitor image for evident and safety.

5.4 Project Potential

This project has the potential to be commercialized on electronics companies or home appliances because it provides a system that facilitates users, especially people with disabilities to reduce their ability and energy when at home to see someone in front of the house and can open the door remotely using a smartphone where this method is not yet available on the market. In addition, this smart doorbell offers a method that is user friendly, secure, easy, saves time energy and budget.

5.5 Summary

The aim of this chapter is to conclude up the project and make recommendations for future projects. The purpose of this project is to provide ideas for effective ones, as well as to assist in the evaluation of papers and to provide advice on what to avoid. The recommendation above is meant to raise the project's quality.

REFERENCES

[1] A. Ennis *et al.*, "Doorstep: A doorbell security system for the prevention of doorstep crime," *Proc. Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. EMBS*, vol. 2016-Octob, pp. 5360–5363, 2016, doi: 10.1109/EMBC.2016.7591938.

[2] P. Matta and B. Pant, "INTERNET-OF-THINGS : GENESIS , CHALLENGES AND APPLICATIONS Definitions of IoT," vol. 14, no. 3, pp. 1717–1750, 2019.

[3] C. El Fiorenza, S. Bompelli, M. Sampath, and M. Ghogre, "Iot Smart Doorbell Surveillance," *Int. J. Adv. Res. Innov. Ideas Educ.*, vol. 4, no. 2, pp. 2701–2706, 2018.

[4] S. Wadhwani, U. Singh, P. Singh, and S. Dwivedi, "Smart Home Automation and Security System using Arduino and IOT," *Int. Res. J. Eng. Technol.*, vol. 5, no. 2, pp. 1357–1359, 2018.

[5] S. Rehaman, "Home automation for safety and security using arduino (iot)," *BBA Student, IFIM Coll. Bangalore*, vol. XII, no. Ii, pp. 679–693, 2020.

[6] P. K. Singh, R. Saxena, U. Dubey, A. Raj, B. M. Sahoo, and V. Bibhu, "Smart Security System Using IOT," *Proc. Int. Conf. Intell. Eng. Manag. ICIEM 2020*, pp. 392–395, 2020, doi: 10.1109/ICIEM48762.2020.9160144.

[7] R. Subash, Y. Kumawat, and V. Sivarajan, "Smart Doorbell System with Facial Recognition for People with Hearing Impairment," vol. 29, no. 6, pp. 2478–2486, 2020.

[8] M. Shimpi, K. Zikre, D. Latif, and D. Shrikhande, "Door Surveillance with Smart Bell," *Dep. Inf. Technol. VIT, Mumbai, India*, vol. 2, no. 2, pp. 2581–5792, 2019.

[9] R. S. Satti, “A Smart Visitors ’ Notification System with Automatic Secure Door Lock using Mobile Communication Technology,” *IJCSNS Int. J. Comput. Sci. Netw. Secur.*, vol. 2, no. 01, pp. 39–44, 2015.

[10] B. Quadros, R. Kadam, K. Saxena, W. Shen, and A. Kobsa, “Dashbell: A Low-cost Smart Doorbell System for Home Use,” 2017, [Online]. Available: http://arxiv.org/abs/1706.09269.

APPENDICES

Appendix A Gantt Chart of BDP 1&2