Faculty of Electronic & Computer Technology and Engineering

DEVELOPMENT OF AN IOT BASED SOLAR-POWERED ELECTRONIC NOTICE BOARD BY USING ESP32 MICROCONTROLLER

DENASVARAN KANASAN

Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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DEVELOPMENT OF AN IOT BASED SOLAR-POWERED ELECTRONIC NOTICE BOARD BY USING ESP32 MICROCONTROLLER

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A project report submitted
in partial fulfillment of the requirements for the degree of
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FAKULTI TEKNOLOGI DAN KEJURUTERAAN ELEKTRONIK DAN KOMPUTER

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Sesi Pengajian : 2023/2024

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DEDICATION

To my beloved supervisor,
Ts. TG MOHD FAISAL BIN TENGKU WOOK,

To my beloved father,
KANASAN A/L NADASAN,

To all those who support me morally and physically,
I would like to address my sincere appreciation and deepest thankful to you people,
Without whom my work would not possible and success.

ABSTRACT

Smart electronic notice board display the information on LCD. A solar powered notice board is a form of electronic display board that is powered by solar energy. This technology is gaining popularity due to its capacity to give an efficient and cost-effective method of displaying information. Solar-powered notice boards are typically outfitted with LCD panels that may be set to display a variety of information, such as text, photos, videos, and more. They are commonly found in public places such as parks, bus stops, and other outdoor areas. They are also utilized to broadcast announcements and other essential information at educational institutions and commercial establishments. The solar powered notice boards are typically connected to a solar panel, which collects energy from the sun and transfers it to the board. This energy is then used to power the LCD screens and other component of the notice board. In our project, the user will be able to wireless send information or notices to a notice board utilizing ESP32 with Wi-Fi Module with a smart phone via an application that interacts with the notice board.

ABSTRAK

Papan kenyataan elektronik pintar memaparkan maklumat pada LCD. Papan kenyataan berkuasa solar ialah satu bentuk papan paparan elektronik yang dikuasakan oleh tenaga suria. Teknologi ini semakin popular kerana keupayaannya untuk memberikan kaedah yang cekap dan kos efektif untuk memaparkan maklumat. Papan kenyataan berkuasa solar biasanya dilengkapi dengan panel LCD yang mungkin ditetapkan untuk memaparkan pelbagai maklumat, seperti teks, foto, video dan banyak lagi. Ia biasanya ditemui di tempat awam seperti taman, perhentian bas dan kawasan luar yang lain. Mereka juga digunakan untuk menyiarkan pengumuman dan maklumat penting lain di institusi pendidikan dan pertubuhan komersial. Papan kenyataan berkuasa solar biasanya disambungkan ke panel solar, yang mengumpul tenaga daripada matahari dan memindahkannya ke papan. Tenaga ini kemudiannya digunakan untuk menghidupkan skrin LCD dan komponen lain pada papan kenyataan. Dalam projek kami, pengguna akan dapat menghantar maklumat atau notis tanpa wayar ke papan kenyataan menggunakan ESP32 dengan Modul Wi-Fi dengan telefon pintar melalui aplikasi yang berinteraksi dengan papan kenyataan.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Ts Tengku Mohd Faisal Bin Tengku Wook for their precious guidance, words of wisdom and patient throughout this project.

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LIST OF SYMBOLS AND ABBREVIATIONS

GUI	-	Graphical User Interface
APC	-	Advanced Process Control
TTS	-	Text-To-Speech
IoT	-	Internet of Thing
IDE	-	Integrated Development Environment
NodeMCU	-	Node MicroController Unit
Wi-Fi	-	Wireless Fidelity
I2C	-	Inter-Integrated Circuit
LCD	-	Liquid-Crystal Display
GSM	-	Global System for Mobile
SMS	-	Short Message Service
LED	-	Light-Emitting Diode
SIM	-	Subscriber Identify Module
IC	-	Integrated Circuit
DC	-	Direct Current
V	-	Voltage
W	-	Watt

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter examines the fundamental knowledge associated with the project, including a review of the research and current information in the study's background. The objective and scope of the study determine the problem statement for the project. Based on Wi-Fi technology and solar energy, a smart electronic notice board is created and implemented.

1.2 Background study

A notice boards can be seen in a different of places, including retail malls, educational institutions, traffic control, banks, stock markets, and so many places. In modern times, advertisements are going digital in trains and buses, information such as platform numbers and details about tickets are displayed on digital boards. People are increasingly drawn to the thought of having the technology world at their fingertips. These electronic notice boards are created to according to the needs of the customer. The displayed messages in all of these electronic notice boards are fixed and programmed in the controller. Little innovative judgement in employing innovation for everyday purposes would have a positive impact on the world's difficulties that we are concerned about. Wireless communication has made its grand entrance, and the entire globe is currently becoming mobile. We want to be able to control everything without going anywhere. This electronic notice board is made simple by embedded technologies. The implementation of embedded system in

communication has given rise to a lot of new application that ensure human safety and well-being.

This inspired us to use mobile phone to receive messages and display them on an electronic board. The main purpose of designing this electronic notice board system is to connect it with user's mobile phones in order to display the most recent information. The Internet of Things (IoT) is a network of physical objects, automobiles, home appliances, and other electronic-enabled goods. Software that allows these things to communicate and exchange data. Each gadget is uniquely identifiable according to its Embedded computer system, but it can also communicate with other devices using the current Internet infrastructure. We add a username and password type authentication system to provide security. As a result, only the rightful authority may deliver information. In other words, the user can effortlessly submit a message or information from a remote location for display. The application gains advantages from being simple to use, collaborating with others, and having more efficient data transfer options. Other studies on a similar system that employs Zigbee and other nonlinear short-range forms of communication have been conducted. There is a complete study of various short-range wireless protocols that must be examined in order to choose the one that would best suit the objective, and it was clear that the system's benefits are fewer than the advantages. Although Zigbee can be utilized to construct similar technologies, it cannot be cost-effective. Using the recommended strategy, we can strengthen security wherever possible, pay attention to crisis situations, and maintain an effective distance from any potential risk. The sound gadget is a speaker that is operated by a microcontroller via a TTS converter; nevertheless, this increases the system's power usage, which is more of an issue.

1.3 Problem Statement

In this environmentally aware day, the idea of printing paper and posting it on noticeboard is not especially green. Consider alternative means of delivering information that do not necessitate the use of as much paper and ink. However, the project that is suggested acknowledges that it exists, but without IoT, it may be impossible for the representative to transmit emergency information on time. The deployment of our electronic notice board solves the challenges associated with ordinary notice boards. It will deliver a more advanced method of spreading alerts throughout the world in a much simpler and more effective manner. We choose the internet as a channel for deliver information because of its popularity.

1.4 Project Objective

The following are the project's objectives;

a) To create a wireless notice board that display messages transmitted from the smartphone.

b) To create a portable notice board worked by solar energy.

c) To create an app that allows users to communicate with a smart electronic notice board.

1.5 Scope of Project

The scope of this project are:

a) Creating IoT based smart electronic notice board projects with the MIT app inventor, which includes a text editor, a message area, a textual console, a toolbar with basic functionality buttons, and a series of menus for writing code.

b) Creating a portable Internet of Things based smart electronic notice board that can be placed anywhere and its supplied with power by a Polycrystalline Silicon Solar Panel and a 12V rechargeable battery.

c) Creating an Io based smart electronic notice board powered by solar energy consuming a ESP32 to link devices and use Wi-Fi technology to communicate data and a I2C LCD to show information.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter summarizes previous research to the electronic notice board. It also component the hardware and software utilized in each study to model the design. A comparison of several electronic notice board research techniques is being conducted in order to determine the best and most suitable methods for this project. The literature study will conclude with a summary of the project's overall research.

2.2 Notice board

A notice board, also known as a bulletin board, is a board used to communicate in writing to a large group of people. Notice board are commonly found in public locations such as educational institutions, religious, offices and retail establishments. Notice board can also be used to deliver information to a specific audience, such as the members of an organization. A notice board goal is to make it easy for people to learn about forthcoming events, activities or announcements. A notice board is a surface on which public posts, such as wanted or for sale ads, event notices, or information, are posted shown in the figure 2.1. A notice board may also be used to post safety notification, health suggestions, and public service messages. Notice boards are frequently used in conjunction with other modes of communication such as email, text messaging, and social media. However, they continue to be a popular means of conveying information to a huge number of individuals. Online notice board have overtaken traditional notice boards. Although a notice board may contain multiple internet forums, the term notice board and even internet forum are all synonymous.

Figure 2.1 Notice board

2.2.1 Digital Notice Board

A notice board is an important part of any business or university. This project is about creating a digital notice board using a Raspberry Pi and Android operating system software connected to an LCD monitor, as stated in Figure 2.2. The capability to build up notices based on of importance and backup is a crucial feature of this software. The wireless notice board is built with a Raspberry Pi attached, which displays the message via a mobile device. Raspberry Pi operates to add, update, delete and send messages according on the time and date specified by the user, as well as how the message appears on the notice board based on the scheduling.

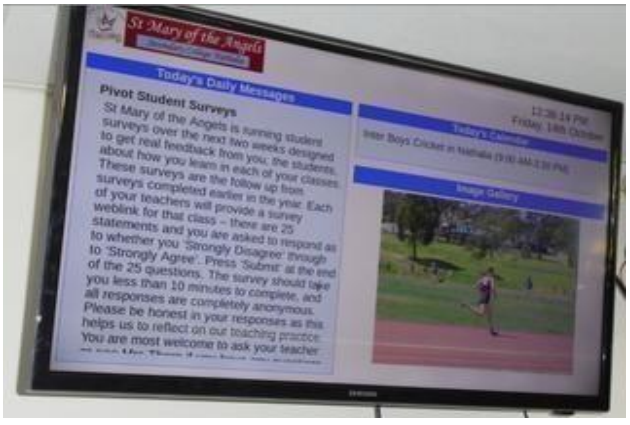


Figure 2.2 : Digital notice board

2.3 Internet of Things

The Internet of Things (IoT) is a network of linked devices and sensors capable of data collection, transmission and exchange. It is a network of physical devices embedded with software, sensors and other technologies to collect and exchange data. Physical things can be connected to the internet and remotely monitored and controlled using the IoT. IoT has enabled users to have more efficient and safe access to the information they require due to the rapid evolution of technology. People may monitor, control and analyze their data in real-time by connecting things to the internet. The IoT has also allowed businesses to create more efficient and cost-effective services and products. IoT is growing increasingly popular and is being used in a range of industries as the demand for better and smarter technology grows. Almost every industry uses IoT to boost productivity. In combination with the growth of fundamental technology in the past, the expansion of the use of IoT system from the standpoint of every sector in a country has undoubtedly led to the development of IoT system. As a result of this growth, advanced appliances based on IoT application have appeared, broadening the scope of more complex and innovative technologies.

2.3.1 IoT Based Electronic Notice Board

An electronic notice board powered by IoT is a productive and efficient means to deliver information to students, faculty, and visitors. It can be used to conveniently convey notifications, announcements, and other messages. It is a less expensive alternative to traditional paper-based notice boards and may be used both indoors and outdoors. The board is network-connected and may be easily monitored and managed. Users can also engage with it via their cellphones or tablets. The board may display a variety of information, including upcoming events, weather forecasts, emergency notifications, and more. It is secure and may be modified to the needs of the organization.

2.4 Related previous project study

2.4.1 Previous project 1

Based on research of Keshav Kumar, Kumari Ritu, Mrigangna Singh and Mangal V.Patil, wireless display using GSM and Arduino, where modern technology such as wireless transmission and automation were unavailable, the most popular form of display in public settings was pen and paper[6]. The implementation of wireless communication between a mobile phone and a microcontroller inspired this project. Even if an authorized individual is not present, any message can be displayed anywhere by sending an SMS from mobile phone's registered SIM as shown in figure 2.3 circuit design of the project. The system operates in real time and enables a more convenient and automatic technique for display as shown in figure 2.4 developed module of the project.

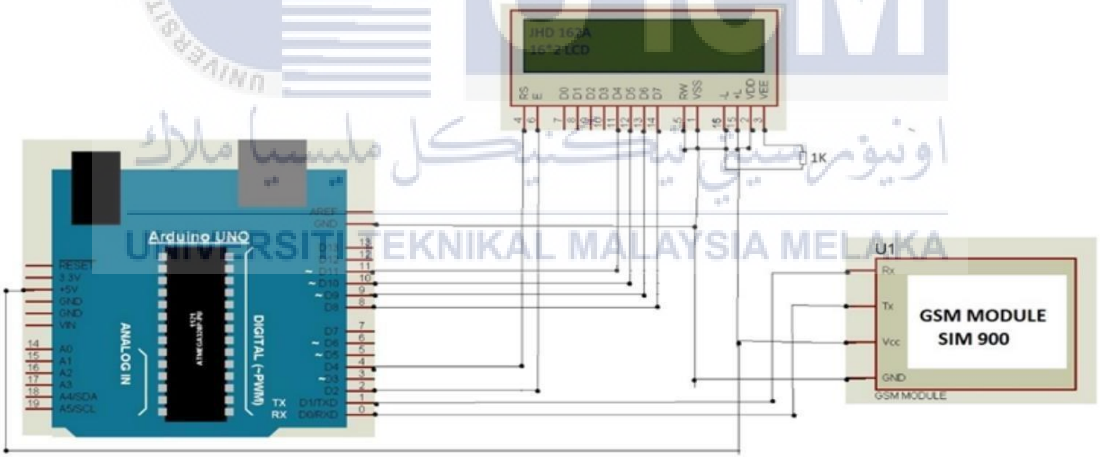


Figure 2.3 : Circuit design of the project

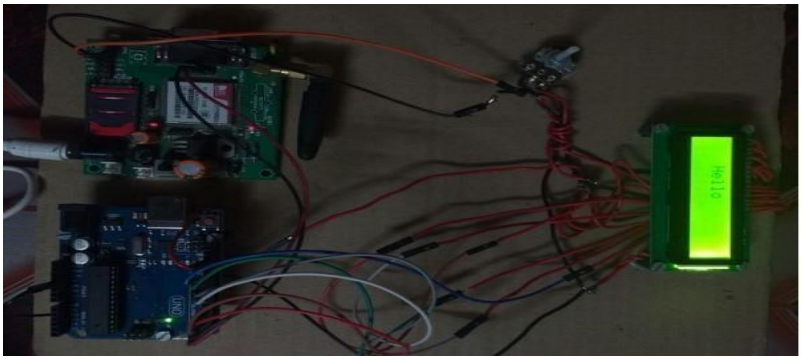


Figure 2.4 : Developed module of the project

2.4.2 Previous Project 2

Based on the research “GSM Based Prototype Implementation of Digital Notice Board”, author by R.Gayathri, P.Indhumathi, P.Janani and S.Rajan. The project’s goal is to show the message on the notice board form anywhere and at any time, as well as offer broadcast alerts to the target users [7]. As a result, as shown in Figure 2.5, through this GSM module for transferring and receiving messages is easier. In this proposed system, the message is sent from the authorized user to the GSM Module. This study focuses on the creation of an GSM based Display Board that can replace current programmable electronic displays and traditional notice boards, as shown in Figure 2.6.

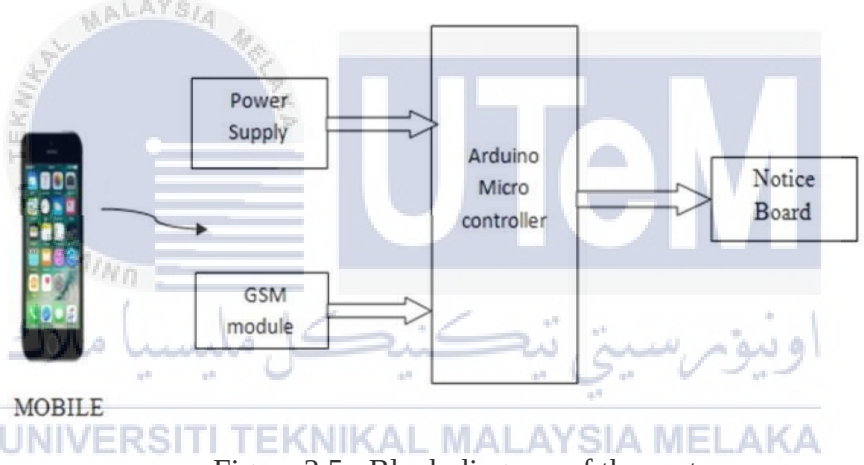


Figure 2.5 : Block diagram of the system

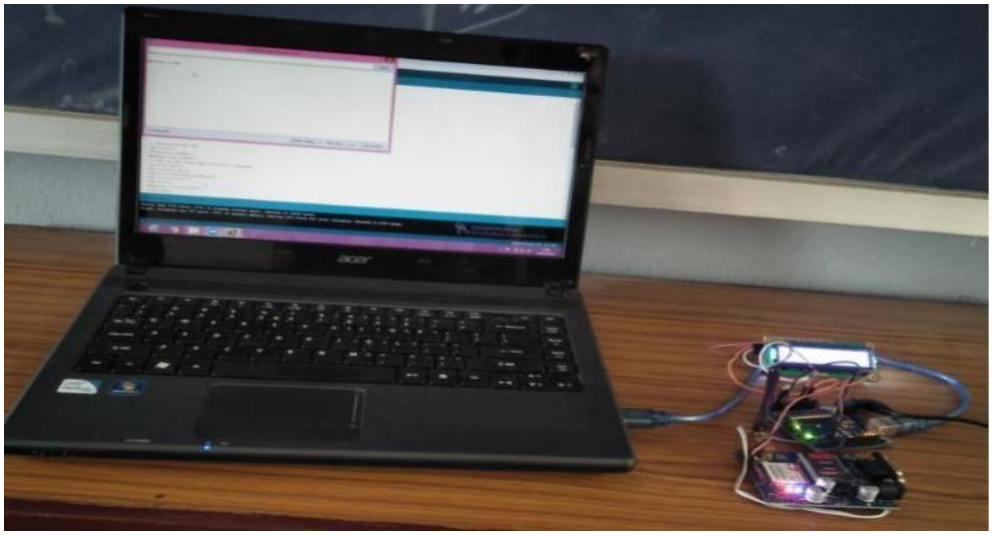


Figure 2.6 : Hardware assembly of the system

2.4.3 Previous Project 3

A research by Rahul Banka, Amankumar Patel, Jyoti Chandode and Switi Pathade shows that a notice board are essential at any organization or public utility location such as hospital, airports, bus stops, railway stations, retail malls, and parks [8]. The goal of this project is to create a notice board that receives and display messages from real users anywhere in the world via GSM technology. So, if the user wanted to display a message, he can submit the information by SMS and the LCD display would update accordingly. This study investigates the functioning of a notice board created using Arduino Uno programmed. The microcontroller's ports are linked to a GSM modem with a SIM card. The GSM at the receiver's end receives an SMS sent by an authorized phone number. The Arduino Uno is used to control the entire process, the GSM module is used to receive messages transmitted from the registered mobile and the LED display used to show the received SMS. The figure 2.7 block diagram of the wireless notice board using GSM technology is shown below.

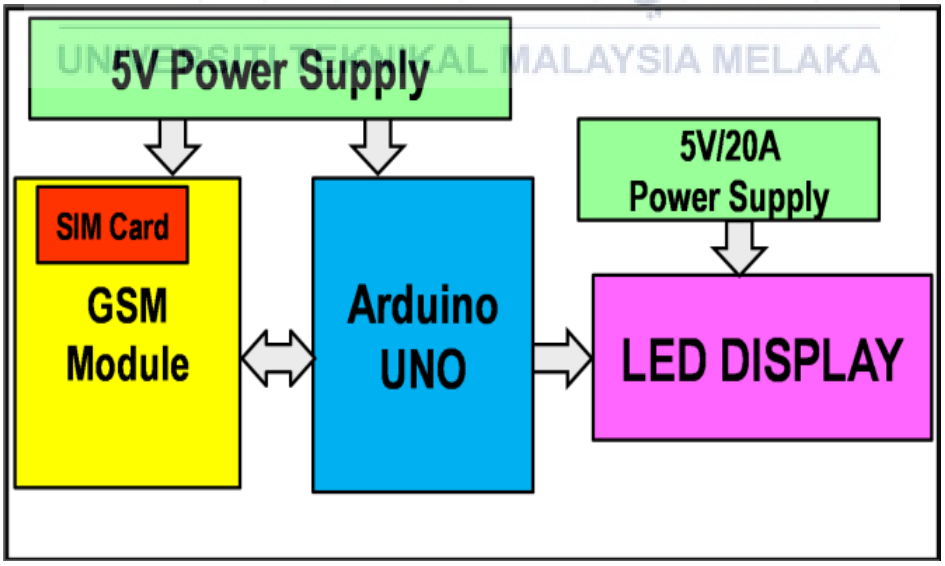


Figure 2.7 : Block diagram of wireless notice board using GSM technology

2.4.4 Previous Project 4

Furthermore, a research by S.P.Manikanta and Dr.P.Santosh Kumar Patra found that main disadvantage of developing these boards is that they are not flexible and cannot be located anyplace owing to tangled wire. To address this issue, a wireless board is intended to display the most recent information [9]. The project is run by providing power directly to the GSM module, and so all of the components receive power supply. The GSM module receive a message from an external mobile phone and transfer it to the Arduino. The Arduino analyses this data and delivers it to the LCD display, which displays the message.

Figure 2.8 : Block diagram of the system

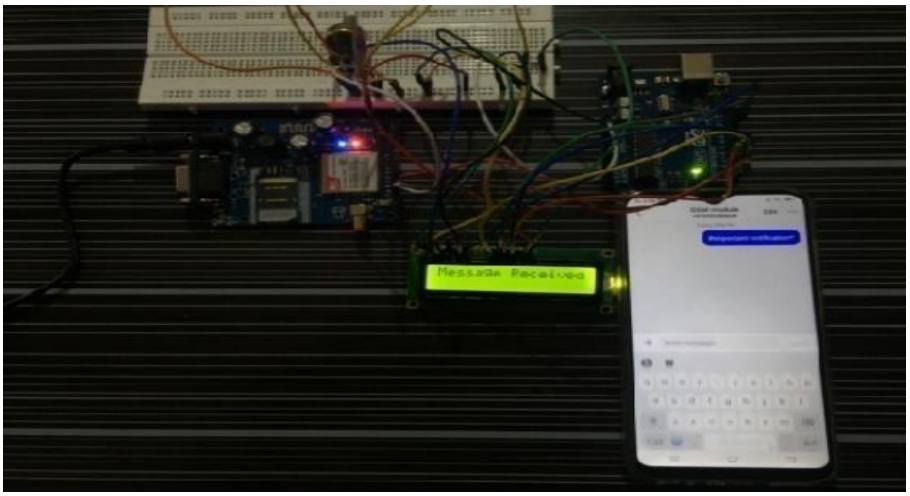


Figure 2.9 : Hardware setup of the system

2.4.5 Previous Project 5

On the other hand, the research by Arun Kumar R, A H Harshita, Deepa S Chavadi and Harshita Y Gorawar explains that GSM based technology that allows it to display flash news or announcement faster than a programmed system to the LCD display the notice[10]. A GSM modem linked to the LED display hardware is used to receive SMS and send it to the LED display controller circuit. The controller circuit of the LED display then filters the message content in SMS and dynamically adjusts the display text on the LED display.

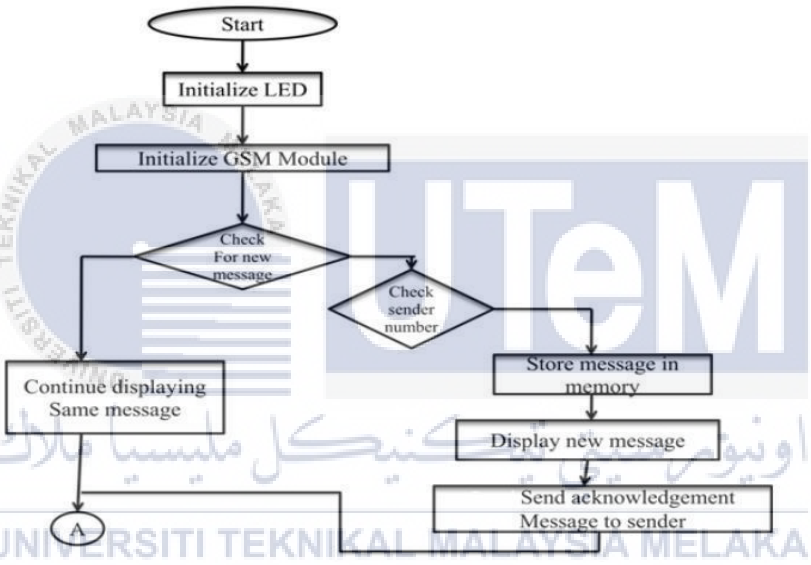


Figure 2.10 : Flowchart of the project

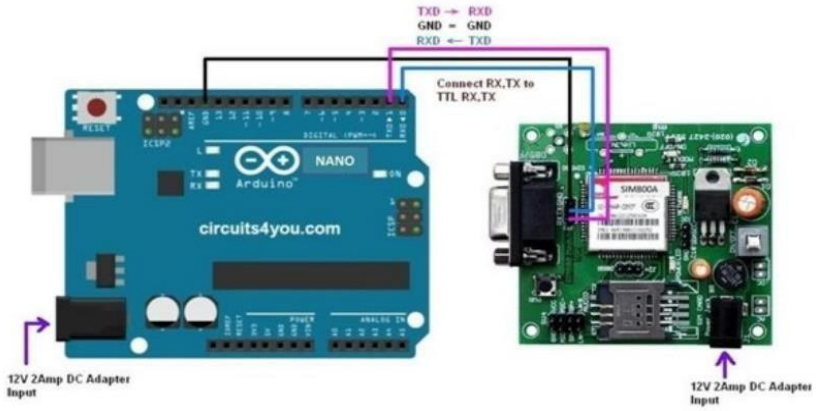


Figure 2.11 : Interfacing between GSM and Arduino

2.4.6 Previous Project 6

A research by Priya.C, Ramya.C, Dhanasekar.S, Kavipriya K, Madhushree A and Subhashini B about “GSM Based Wireless Notice Board Using Graphical Lcd”. The well-developed schools and Universities use wireless notice boards to display information, which saves much times [11]. A wireless notice board on GSM is being developed, the contents of which can be modified on a regular basis using a SMS. This project work is created to be a simpler, trouble-free, and convenient system for receiving and finally displaying content in as pecific way. This board, which includes the widely used GSM, facilitates the transfer of displaying the content on the board via the user’s handphone.

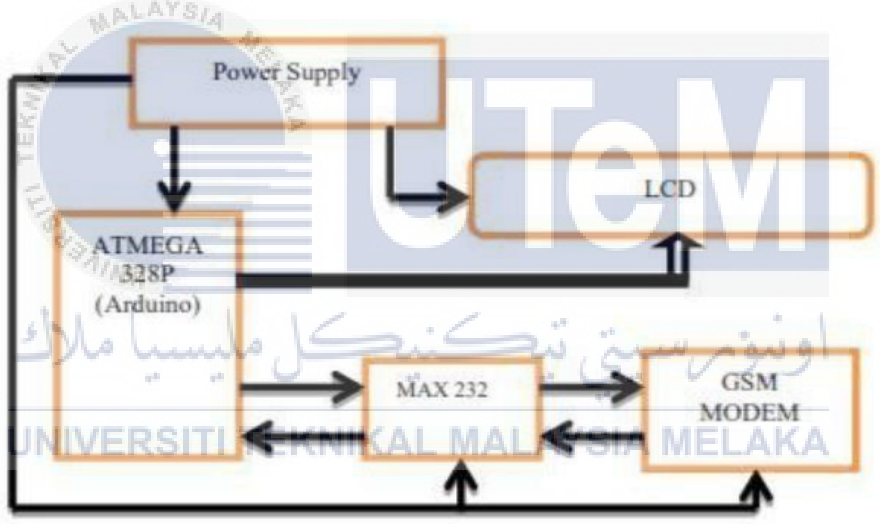


Figure 2.12 : Block diagram of project

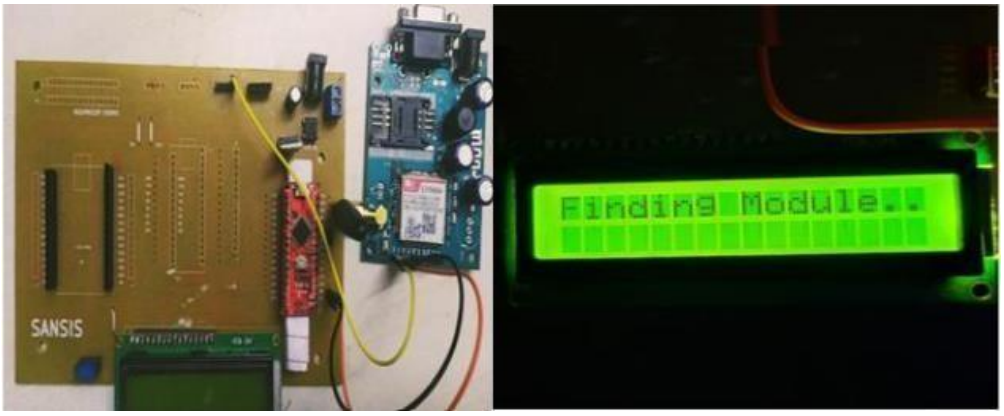


Figure 2.13 : Hardware assembly

2.4.7 Previous Project 7

Based on the research “Digital Notice Board System”, author by Kajal Nandgaonkar, Komal Kumbhare, Abhishek Wadatkar and Nikita Mendhe. A digital notice board system allows for any type of message or notification, such as advertising, announcing events or providing information[12]. This project deals with SMS based notice board that incorporates the commonly used GSM to ease communication of message display on noticeboard via user’s mobile phone. It operation is based on an ATMEGA32 microcontroller coded in assembly language. When user sends an SMS from his mobile phone from a registered number, it is received by the GSM modem.

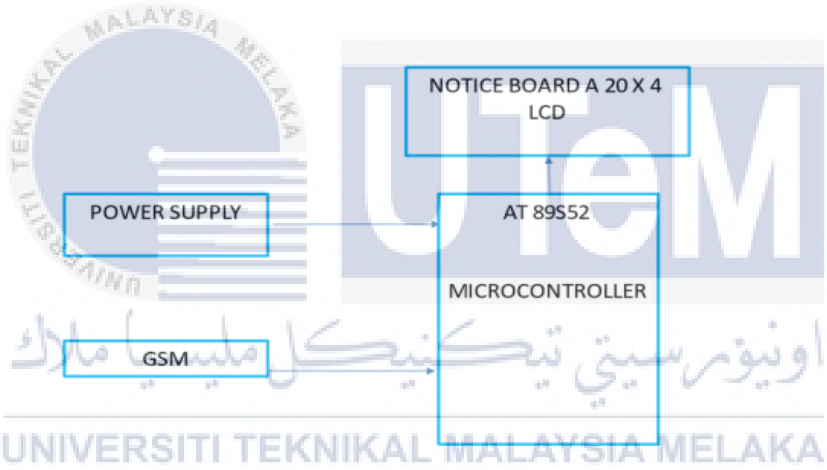


Figure 2.14 : Block diagram of system

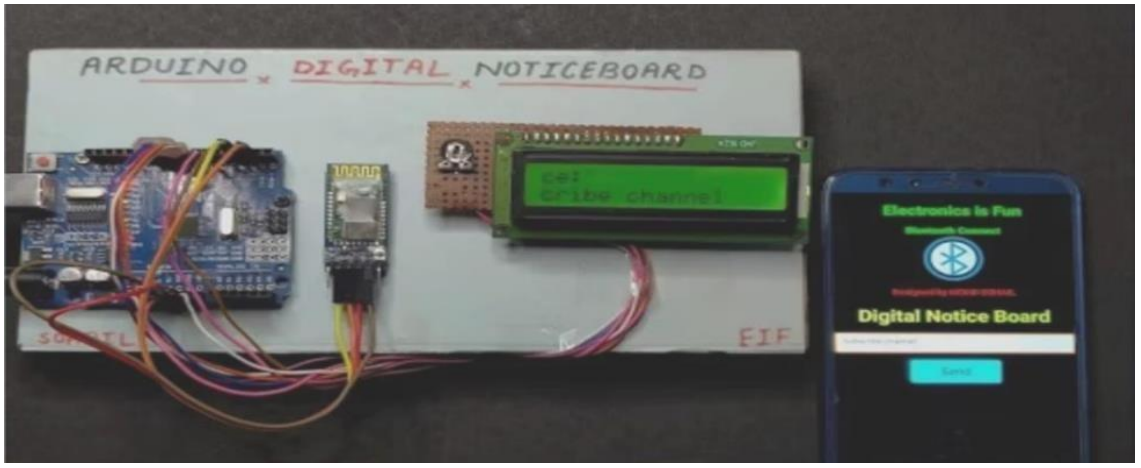


Figure 2.15 : Hardware assembly

2.5 Compare of related Previous Projects study

Multiple articles were analyzed, and the prototype of the GSM-based notice board was thoroughly examined. It is a cellular network that allows mobile gadgets to receive voice and data services. GSM is the most extensively used wireless communication technology in the world, including high-speed data transport. It is utilized in almost every country and is the primary technology used by the majority of mobile phone providers. Most mobile phone applications and services, such as SMS, MMS, and other internet services, employ GSM technology. GSM is a dependable and secure technology that allows individuals to communicate all over the world. It lets people stay connected no matter where they are. GSM is an excellent way to remain in touch with friends and family, conduct business, and access the internet. GSM allows you to stay connected at all times and from any location. The summary of the existing project is shown in table 2.1.

Table 2.1 : Summary of comparison of related Previous Projects study

Name	Year	Author	Drawbacks
Wireless Display using GSM and Arduino [6]	2018	Keshav Kumar, Kumari Ritu, Mrigangna Singh, Mangal V.Patil.	Limited coverage: Limitation may effect on the functionality of GSM modules in certain place.
GSM Based Prototype Implementation of Digital Notice Board [7]	2018	R.Gayathri, P.Indhumathi, P.Janani, S.Rajan.	Power consumption: Transmitting and receiving data via the GSM network uses energy, which can drain the battery more quickly.
Smart Wireless Notice Board [8]	2020	Rahul Banka, Amankumar Patel, Jyoti Chandode, Switi Pathade.	Data transfer speed: Disadvantage when dealing with application that require high-speed data communication.

Table 2.1 : (Continue)

Message Display on Notice Board using GSM and Arduino [9]	2021	S.P. Manikanta, Dr.P.Santhosh Kumar Patra.	Limited data capacity: Can handle small amount of data for messaging or basic communication.
GSM Based Wireless E-Notice Board [10]	2021	Arun Kumar R, A H Harshita, Deepa S Chavadi, Harshita Y Gorawar.	Security concerns: Can be susceptible to security vulnerabilities.
GSM Based Wireless Notice Board Using Graphical Lcd [11]	2021	Priya C, Ramya C, Dhanasekar.S, Kavipriya K, Madhushree A, Subhashini B.	Low bandwidth: Limited bandwidth which affects the amount of data that can be transmitted simultaneously.
Digital Notice Board System [12]	2023	Kajal Nandgaonkar, Komal Kumbhare, Abhishek Wadatkar, Nikita Mendhe.	Limited flexibility: Modules are designed for specific communication protocols and may not be easily upgradeable to new technologies.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In today's world of technology, IoT is one of the most widely used and well-regarded communication platforms. It has become extremely widespread and wireless communication via the internet style. Furthermore, it is open to anyone and user-friendly in terms of modern technology. A smart electronic notice board is a cutting-edge equipment for any business. The smart electronic notice board in our suggested system allows the user to show notices wirelessly. For communication, the system employs an ESP32, which is coupled with a Wi-Fi module and a LCD display. A basic buzzer serves as an alarm signal when a new notice is received in the system. To display the notification, a mobile application will be created. The application is generated only when the login details, such as network name and password, are equivalent and the user is able to access the application before the warning is delivered. The embedded language had been utilized to program the entire system. The Notice Board delivers an acceptance message to the user by displaying the most recent existing notice on the application. For the first time, the programs are launched. The application includes a text box in which we can enter our message and make modifications. Extra choices include changing the brightness levels and the delay period of the scrolling text. The Wi-Fi module receives the sent message and sends it to the LCD display. Finally, the message appears on the LCD Display. Furthermore, the smart electronic notice board has a solar panel that will power the device. In addition, the system has a battery that extends the system's lifespan.

3.2 Project Methodology Flowchart

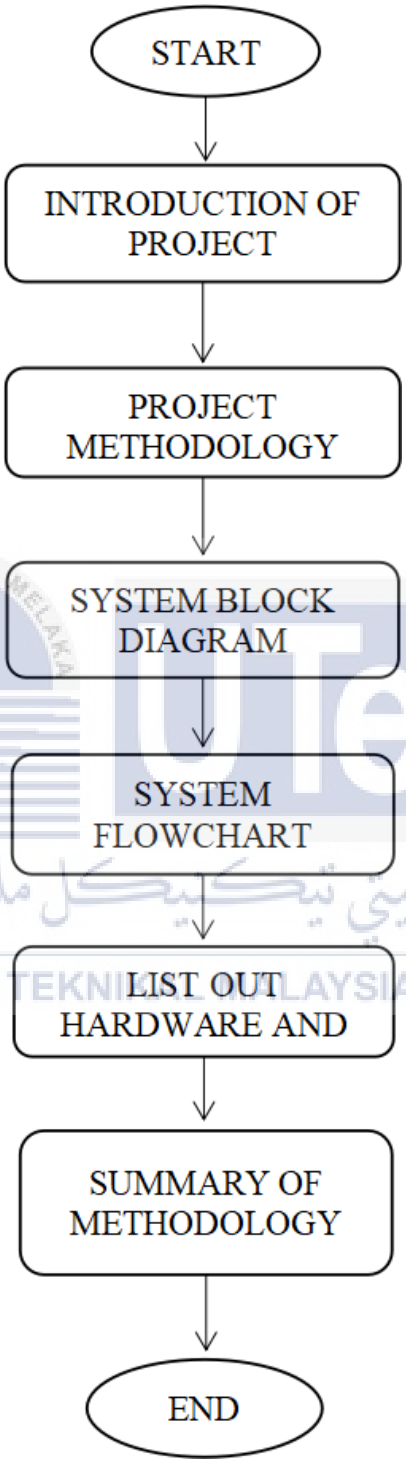


Figure 3.1 : Project Methodology Flowchart

Figure 3.1 displays the project methodology flowchart, which begins with an overview of the project. The introduction to the project methodology flowchart is guided by the project's plans and objective. Second, a project methodology flowchart. Creating a flowchart makes it simple to see the overall flow and method of the project. It can also be a systematic flow in which the progress and strategy for completing the project's objective and goals are monitored. Afterwards, the project was divided into two sections that are a system block diagram and a system flow chart. To design a system block diagram, first create a block diagram that contains input to the microcontroller, process in the microcontroller, and output or user interface. The diagram must be precise and comprehensive. For the system flow, a flowchart is also necessary. This system flow is intended to explain the Smart Electronic Notice Board's approach and functioning concept, as well as how it performs as a result of their condition or algorithm. Make a list of all the hardware and software that will be used. Finally, once all processes have been completed, develop a conclusion approach that summaries how the project's objectives and scopes were fulfilled.

3.3 System Block Diagram

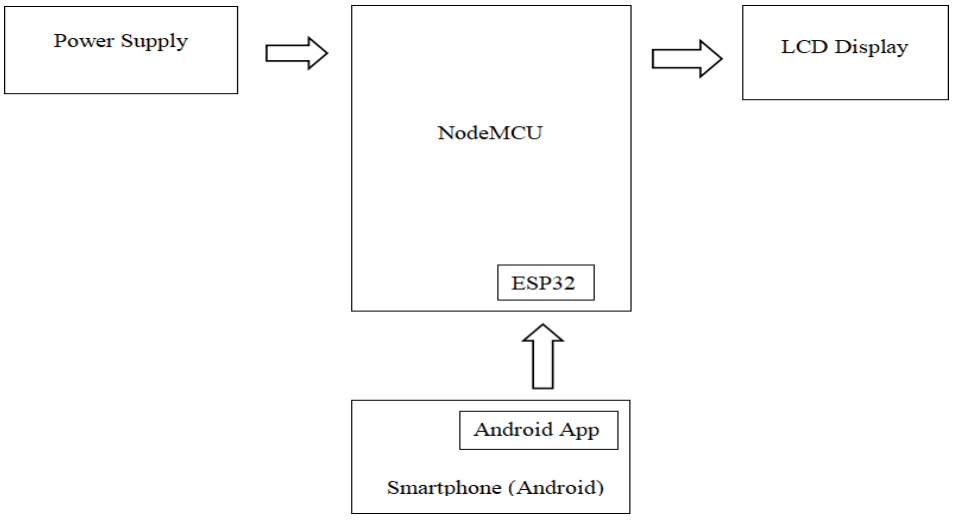


Figure 3.2 : System block diagram

The main advantage of this particular element of technology was that it would allow the NodeMCU to receive data from the built app on a smartphone. This system is a smart notice board that shows the message provided by the user, as well as a simple, user-friendly system that can receive and display notification in the LCD display that acts as a notice board. The information for the LCD has been entered into the application in the transmission area, as illustrated in figure 3.2. The software was built with MIT applications Inventor, and the C programming language was used to offer functionality. To see the data that must be submitted, enter notification in the text box and press send. The data is forwarded to the NodeMCU. The Sender is in charge of transmitting critical data through the wireless network. The sender must first install the proper programmed before using the Smart Notice Board. To prevent unauthorized access to the application, we use security authentications such as login and password. This was the section for the sender. The receiver part includes a NodeMCU (ESP32), an LCD display, and a Wi-Fi connection.

3.4 System Flowchart

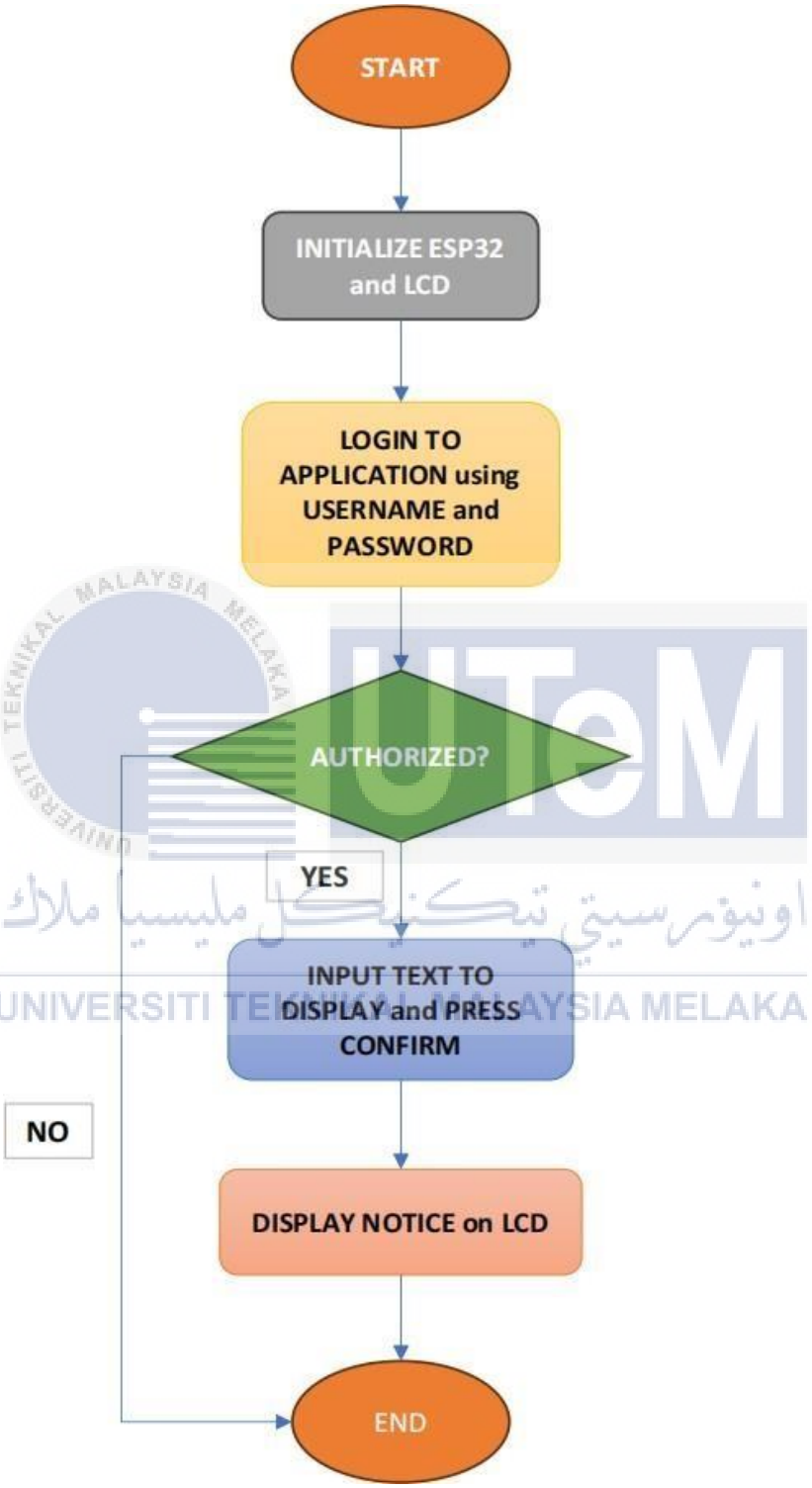


Figure 3.3 : System Flowchart

According to figure 3.3, when the system boots up, it initializes the NodeMCU, and the application. The sender must login to the application in order to pass information through the Smart Electronic Notice Board. The data can be sent using the NodeMCU's application. Only the authenticated sender has access and send the information. A sender who is not authorized will not be able to send information or notices. This project has progressed to the point where only authorized users can provide data. They gain access to send information after successfully logging in. After finishing their information, the sender can send it to the notice board by clicking the send button. The Smart Electronic Notice Board would display the information they want to broadcast. Meanwhile, the information sent would remain unchanged until the new information was sent. Finally, this system will be powered by a DC connection attached to the solar panel, and when night falls or there is no sunlight, the battery will take over to power the equipment.

3.5 Circuit Diagram

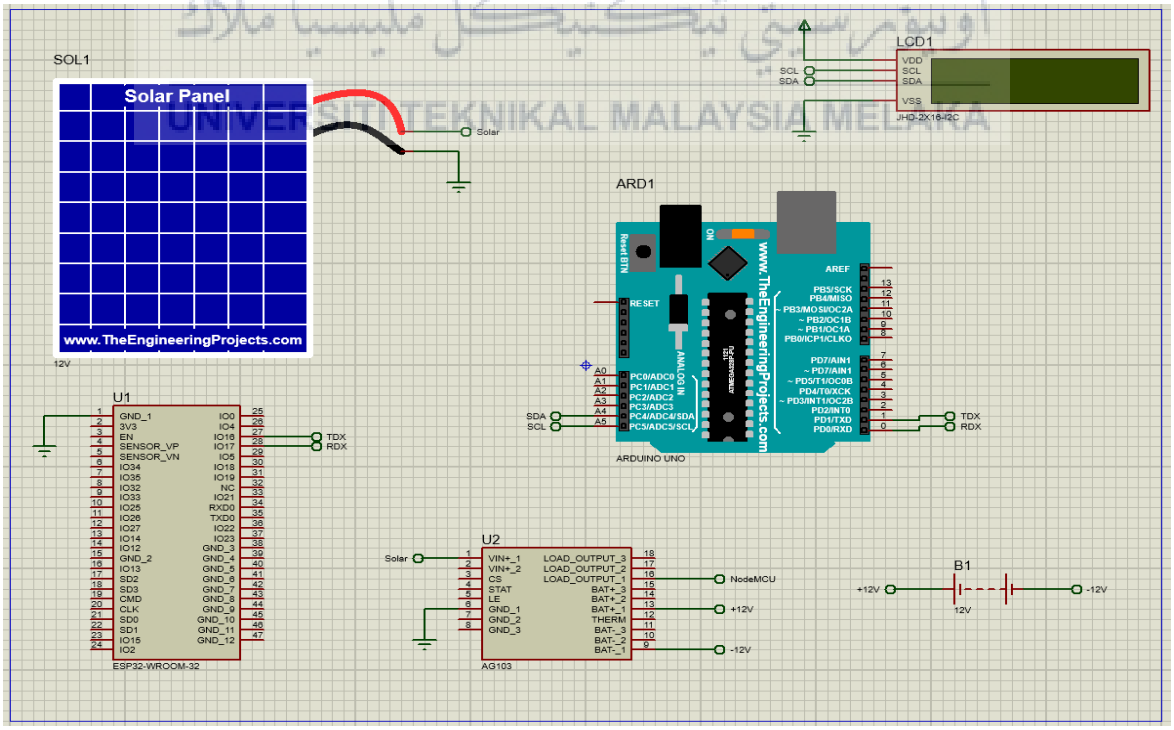


Figure 3.4 : Project circuit diagram

The LCD display and ESP32 are the primary components used. When the NodeMCU (ESP32) is linked to Wi-Fi and the user sends a message, the NodeMCU (ESP32) will receive the data and send it to the LCD display. On the other hand, the solar charge controller will operate as a bridge between the solar panel and the battery to preventing overcharging while also applying the battery as a power source for the NodeMCU (ESP32). The power source is a 12V valve-regulated lead-acid battery and the backup source is a solar panel with a 12V output.

3.6 List of equipment

3.6.1 Hardware

Table 3.1 : Hardware equipment

Hardware	Picture	Quantity	Price	Description
NodeMCU (ESP32)		1	RM29.00	The NodeMCU (ESP32) is a development board with Wi-Fi and Bluetooth built in. It enables you to connect to the internet and communication with other devices with ease.
I2C LCD Display		1	RM15.90	LCD module that uses to interface with microcontroller or another device. It can display characters, symbol and graphics.
Solar Panel		1	RM55.30	A solar panel known as photovoltaic (PV) panel, is a device that converts sunlight into electrical energy using photovoltaic effect.

Table 3.1 : (Continue)

Solar Charge Controller		1	RM29.90	A solar charge controller, known as a solar regulator, used in solar power in power systems to regulate and control the charging of batteries from solar panel.
Li-Ion Rechargeable Battery 12V 2300mAh		1	RM66.90	Provides high energy density while its rechargeable nature allows for multiple cycles of charging and discharging. Safety features are protected against overcharging and short circuits.

3.6.2 Software

Table 3.2 : Software Applications

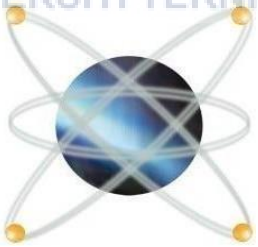
Software	Picture	Description
Proteus 8 Professional		Proteus is a popular sofrware tool used for designing and simulating electronic circuits. Proteus provides a comprehensive set of tools and features that allow users to create circuit diagram, design printed circuit boards (PCB) and simulate. The software user friendly interface and a vast library of electronic components, enabling users to easily build and test complex circuits.
Arduino IDE		Arduino IDE is a software designed for programming and developing projects with Arduino microcontrollers. The IDE supports the Arduino programming language, which is simplified version of C/C++. The software offers a range of built in libraries and functions, making it easier to interface with various sensors, actuators and other electronic components.

Table 3.2 : (Continue)

MIT App Inventor		MIT App Inventor is a visual development platform that allows people to create mobile application for Android devices. It provide a simple and intuitive interface where users can drag and drop components, such as buttons, text boxes, and sensors.

3.7 Summary of Methodology

Before beginning the hardware design process, it essential to plan the project flow, develop the circuit diagram, create the flow of block diagram consisting of input, microcontroller and output. Construct a flowchart to show how the system works, and determine the hardware and software that will be used. To ensure the projects success, it is necessary to have an excellent knowledge of it.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter focuses on the project's result and discussion. The result is presented by using software and hardware. The software is examined for its ability to perform according to theory. The hardware is studied for the functionality of interfaces between the NodeMCU ESP32 and the solar panel.

4.1.1 Description of Project

The solar charge controller regulates the power supplies in two ways. Initially, the systemis connected to the solar panel, which powers the device and charges the battery. When there is a nightfall, they will be replaced with a 12V lead-acid battery to power the system. ESP32 is the system's interface. The I2C LCD display and ESP32 will initialize when the system turns on. Auto-connection to the assigned WI-FI will occur for the ESP32. The userhave to login to the Notice Board App which is created using the MIT app inventor after initialization. The user is unable to log in to the notice board app if they are not authorized. After that the authorized user logged in, they can type and click send in notice board app tosend any kind of message to display in notice board. Thingspeak will receive the information, transmit it to the ESP32 and display it on the LCD display. The system perpetually loops the previous information until the authorized user send new information.

4.2 Full Prototype

Figure 4.1: Prototype of hardware connection

Figure 4.2: Overview of prototype

4.3 Result and Analysis

4.3.1 Case 1: When Open Notice Board App

Figure 4.3: Login interface of Notice Board app

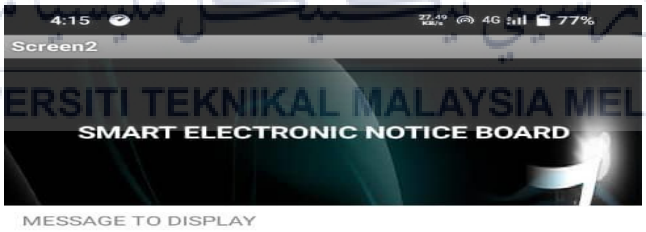


Figure 4.4: Text interface of Notice Board app after logged in

Figure 4.5: Unsuccessful login

In case 1, the user authorized themselves by logging into the notice board app with the correct username and password. The next interface shows up so the user may type text on the textbox which information need to display. The interface will stay the same and notice stating “incorrect password” will appear if the user is not authorized.

4.3.2 Case 2: When the prototype display information

Figure 4.6: No display information when prototype ON

Figure 4.7: Text information sent from Notice Board app

In case 2, the system enables the prototype to link with the notice board App and displays the information that user has sent through the smartphone when the ESP32 is connected to the allocated Wi-Fi. As a result, it will display anything information that sent by user through notice board app. Even if the user tries to send information via the app, the LCD display will remain blank if the ESP32 is not connected to Wi-Fi and until a new information sent, the system will keep display the prior information.

4.4 Data Analysis

4.4.1 Data analysis of Notice Board

Table 4.1: Condition of Notice Board

Bil	Condition 1	Condition 2	Result
1	Login Successful	Wi-Fi connected	• Notice board will display information. • Authorized user can send new information.
2	Login Successful	Wi-Fi disconnected	• Notice board does not display information. • User can send new information but not will display in notice board.
3	Login Unsuccessful	Wi-Fi connected	• Notice board will display information. • User cannot send new information.
4	Login Unsuccessful	Wi-Fi disconnected	• Notice board does not display information. • User cannot send new information.

4.4.2 Data Analysis of Solar Energy

4.4.2.1 Design of the Solar Power

NodeMCU ESP32

Voltage = $3.3V$

Current = $500mA$

Power = Current x Voltage

$= 500mA\ x\ 3.3 = 1.65\ W$

I2C LCD Display

Volatge = $5V$

Current = 30mA

Power = Current x Voltage

$= 30mA\ x\ 5 = 0.15\ W$

$$\text{Total Power} = 1.65 + 0.15 = 1.8\ Watt$$

1.8W power assume as 2W

The 2W electronic notice board is scheduled to be operational for whole day. As a result, daily energy consumption is calculated.

Daily energy consumption = power x time

$$2W\ x\ 24hrs = 48Wh$$

Pv Module Sizing :

$$\text{Pv Module} = \frac{Total\ Daily\ consumption}{Peak\ run\ hours\ x\ (1 - Percentage\ loss)}$$

$$= \frac{48W}{4\ x\ (1-0.30)}$$

Total watt of Pv module = 17.14W

Hence 20W Pv module used to power the electronic notice board.

Number of Pv module = $\frac{17.14}{20} = 0.85 \approx 1$ Pv module

Notice board = 2W

Pv module Watt = 20W

Number of Pv module = 1 Pv module

4.4.2 Battery Sizing

Daily energy consumption = Power x Duration

$$= 2W\ x\ 9h = 18Wh$$

Actual battery capacity $= \frac{Energy\ consumption}{(1-loss\ percentage)}$

$$= \frac{18}{(1-0.15)}$$

$$= 21.18\text{Watt-hours}$$

Battery capacity (Ah) $= \frac{Actual\ battery\ capacity}{System\ voltage}$

$$= \frac{21.18}{12}$$

$$= 1.76\ \text{Ah} \approx 2.3\ \text{Ah}$$

Battery Capacity: 12 V 2.3 Ah

4.5 Conclusion for result and analysis

This chapter concludes with a demonstration of the prototype's results, complete hardware connection, LCD display and data analysis to compile the entire result. As a result, the desired outcome of displaying information sent through a smartphone achieved. Furthermore, the prototype functions and operates well.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This project, title “IoT Based Solar Powered Electronic Notice Board”, is appropriate to be designed because it can have a significant impact on traditional notice board and make a significant contribution to university authorities, particularly employees and students. The application in the smart phone is one of the important advances that have come with our current period as we transformation into the IoT world. The creative concept behind developing this project is a progression from past project in which merging a solar power system with the project makes it possible even in the absence of electricity. The electronic notice board continues to function in the same manner as previous electronic notice board, but it has undergone a transformation in the way it activated. As a future recommendation, this project can become a more advanced project by adding picture based and text-based information instead of just text-based information.

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APPENDIX A

Gantt Chart PSM I

UNIVERISITI TEKNIKAL MALAYSIA MELAKA		DOC	PREPARED BY							CHECK BY						
DEVELOPMENT OF AN IOT BASED SOLAR-POWERED ELECTRONIC NOTICE BOARD BY USING ESP-32 MICROCONTROLLER		PSM I	DENASVARAN KANASAN							ENCIK TS.TG MOHD FAISAL BIN TENGKU WOOK						
			B082010192							DATE				JUN, 2023		
			WEEK													
NO	**DESCRIPTION OF TASK**		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Briefing about PSM 1 and title selection	PLAN														
		ACTUAL														
2	Deciding title, objective, and scope	PLAN														
		ACTUAL														
3	Introduction (Chapter 1)	PLAN														
		ACTUAL														
4	Literature review (Chapter 2) and supervisor meeting	PLAN														
		ACTUAL														
5	Methodology (Chapter 3) and Chapter 4	PLAN														
		ACTUAL														
6	Chapter 5 (Conclusion)	PLAN														
		ACTUAL														
7	Supervisor review the Research Report and do correction	PLAN														
		ACTUAL														
8	Prepare slide for presentation	PLAN														
		ACTUAL														
9	Presentation PSM 1 complete with Q&A	PLAN														
		ACTUAL														

APPENDIX B

Gantt Chart PSM 2

UNIVERISITI TEKNIKAL MALAYSIA MELAKA		DOC	PREPARED BY							CHECK BY						
DEVELOPMENT OF AN IOT BASED SOLAR-POWERED ELECTRONIC NOTICE BOARD BY USING ESP-32 MICROCONTROLLER		PSM 2	DENASVARAN KANASAN							ENCIK TS.TG MOHD FAISAL BIN TENGKU WOOK						
			B082010192							DATE				JAN, 2024		
			WEEK													
NO	DESCRIPTION OF TASK		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Briefing about PSM 2	PLAN														
		ACTUAL														
2	Supervisor meeting for corrections and comments on PSM 1	PLAN														
		ACTUAL														
3	Decide and buy hardware & component	PLAN														
		ACTUAL														
4	Component testing, create programming code and create app	PLAN														
		ACTUAL														
5	Troubleshoot the prototype and app	PLAN														
		ACTUAL														
6	Full thesis and technical report writing	PLAN														
		ACTUAL														
7	Submit full report to supervisor	PLAN														
		ACTUAL														
8	Final correction and submission to panel	PLAN														
		ACTUAL														
9	Presentation PSM 2 complete with Q&A	PLAN														
		ACTUAL														

APPENDIX C

Coding

```
#include <ThingSpeak.h>
#include <WiFi.h>
#include <LiquidCrystal_I2C.h>
const int notify = 13;
int totalColumns = 16;
int totalRows = 2;
LiquidCrystal_I2C lcd(0x27, totalColumns, totalRows);
void scrollMessage(int row, String message, int delayTime, int totalColumns) {
 for (int i=0; i < totalColumns; i++) {
 message = " " + message;
 }
 message = message + " ";
 for (int position = 0; position < message.length(); position++) {
 lcd.setCursor(0, row);
 lcd.print(message.substring(position, position + totalColumns));
 delay(delayTime);
 }
}
WiFiClient client;
unsigned long counterChannelNumber = 2267675; // Channel ID
const char * myCounterReadAPIKey = "9AHGPFYDBO02RLGE"; // Read API Key
const int FieldNumber1 = 1; // The field you wish to read
String presentStr,previousStr = " ";
void setup()
{
 pinMode(notify,OUTPUT);

 lcd.begin();
 lcd.backlight();
 lcd.clear();
 Serial.begin(115200);
 Serial.println();
 WiFi.begin("MY DATA", "denas0721"); // write wifi name & password
 Serial.print("Connecting");
 while (WiFi.status() != WL_CONNECTED)
 {
 delay(500);
 Serial.print(".");
 }
 Serial.println();
 Serial.print("Connected, IP address: ");
 Serial.println(WiFi.localIP());
 ThingSpeak.begin(client);
}
```

```
void loop()
{
presentStr = ThingSpeak.readStringField(counterChannelNumber, FieldNumber1,
myCounterReadAPIKey);
if(presentStr != previousStr)
{
 lcd.clear();
 Serial.println(presentStr);
 lcd.setCursor(0, 0);
 tone(notify,1000);
 delay(100);
 noTone(notify);
 scrollMessage(1, presentStr, 500, totalColumns);
 previousStr = presentStr;
}
else
{
scrollMessage(1, presentStr, 500, totalColumns);
noTone(notify);
}
}
```

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Final PSM2 Report

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