

IoT Monitoring System for Vending Machine

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Abstract: This project is to develop an IoT Monitoring System for Vending Machine which could solve the problem of vending machine owners having to manually go to the vending machine and check the stocks. A prototype of wireless remote access for the vending machine was made by using a few components and the Blynk app on the phone to develop an IoT monitoring system for the status and availability of product which also provides an end user platform. The prototype consists of two parts, the dummy VMC and also a NodeMCU connected to the WiFi network. The prototype works when the dummy VMC displays the number of stocks on the display attached and the Blynk app displaying the same number on the dummy VMC. This project is to help vending machine owners in restocking by reducing the cost of transportation and manpower to restock the items. By developing this project and implementing IoT, the interest of the audience in the electronic industry in the vending machine area will be enhanced. This project report will fully provide the complete information and progress on how the IoT monitoring system for vending machine is made.

Keywords: Internet of Things (IoT), Blynk, Vending Machine, Vending Machine Controller (VMC)

1. Introduction

With the huge improvement in the means of internet and mobile phone communication, we may say that technology has made a major contribution to communication. Technology speeds up people's communication. Technology offers the ease of using more than one communication tool. For communication, individuals may now use email, social media, and emoticons. This could also be applied to the system of restocking vending machines.

These days, IoT or better known as The Internet of Things (IoT), also known as the Internet of Everything or the Industrial Internet, is a new paradigm of technology conceived as a global network of machines and devices capable of interacting with each other. IoT is recognized as one of the most important areas of future technology and is gaining wide attention from a wide range of industries. The

true value of IoT for businesses can be fully realized when connected devices are able to communicate with each other and integrate with vendor-controlled inventory systems, customer support systems, business intelligence applications and business analytic [1]. There are five types of IoT technologies that are generally used for the deployment of successful IoT-based products and services and for this project, IoT application software will be applied. The most important areas of application includes the smart industry, where the development of intelligent production systems and connected production sites is often discussed under the heading of Industry 4.0.

Latest vending machine have adapted to new technology band being fully automated. It can also accept a variety of payments [2]. Therefore, vending machines are known to be a great method to earn extra profits in Malaysia. In Malaysia, owners of vending machine are owners of second hand recondition vending machine. The issues are being unaware of the exact time and number of stock or inventory to refill the vending machines [3]. The current method of schedule stock refilling is considered ineffective due to loss of sales, time consuming and cumbersome.

In this project, an Internet of Things (IoT) monitoring system will be installed in the vending machine. The Internet of Things (IoT), a system of interrelated computer equipment, mechanical and digital machines, objects, animals or people with unique identifiers and the ability to transmit data over a network without the need for human or computer interaction with computers [4] will be used for this project. The fields of application for IoT technologies are as numerous as they are diverse, as IoT solutions are increasingly extended virtually to all areas of everyday life, it also has the power to change the world [5].

For this prototype the IoT system offers remote monitoring of products stock status in the vending machines so that the stock refilling is not a hassle and time consuming, and at the same time it could decrease the down-time of product availability. A few components such as the NodeMCU and Arduino are used in order to create the system and to connect the system with a user interface in a mobile phone.

1.1 Problem Statement

Vending machines available in Malaysia are not advanced in technology as most of it are reconditioned from other countries like Japan, in order to get low cost vending machines. The problem of these vending machines are that the stocks can only be known when when the machine is open manually in order to refill it. This problem also increases the down-time of product availability. If the owners could check through their phone on an app, they can estimate the amount of items needed to be restocked and also which vending machines need refilling. This makes the restocking process less hassle and not time consuming. Therefore, the vending itself needs to be modified with an IoT monitoring system in order to solve the problems.

2. Materials and Methods

It is important to know the extent of the electrical and programming areas in this project. This project is essential to the design of a prototype for the IoT monitoring system. Even if it is just a prototype, the machine must be able to run and function as required in the objective of this project.

2.1 Materials

For this project, a number of components is used as in figure 1. The prototype is divided into two parts, the Dummy VMC and the Wi-Fi Arduino connection for Blynk. A few software are also used in this project to program the Arduino and control the system.

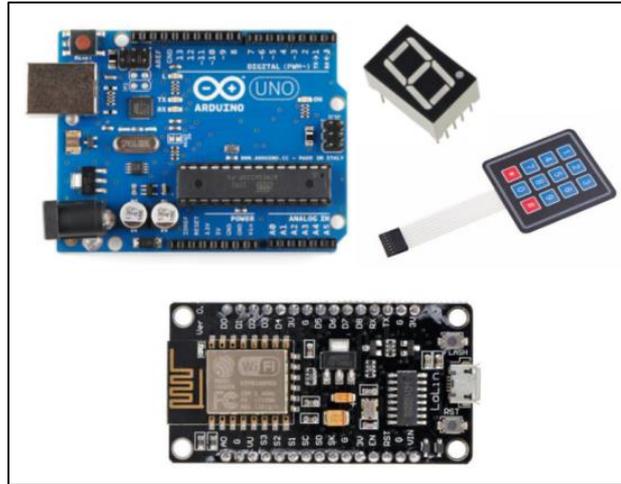


Figure 1: Components for prototype

Components for Dummy VMC:

- Arduino Uno
- Keypad
- 220 k resistor
- 1 digit 7 segment display

Components for Wi-Fi connection for Blynk:

- NodeMCU

Software:

- Arduino IDE
- Blynk

2.2 Methods

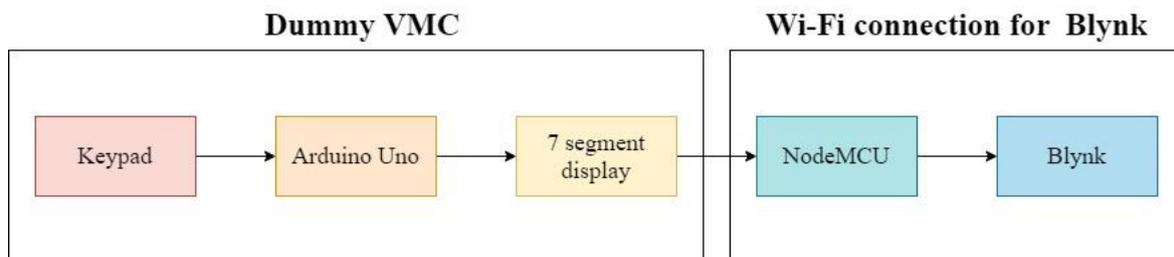


Figure 2: Block Diagram of electrical hardware design

In Figure 2 shows the block diagram of the electrical hardware design which shows the input and output of the components in the system. The first part of this system is the dummy VMC which is made to replicate the real vending machine controller function. The keypad button is to act as the buttons in front of the vending machine where you can choose the items you want, then the 1 digit 7-segment display is to show the number of the button pressed from the keypad like how the real vending machine process works, where the display in the VMC will show the items that the customer had picked, and also the stocks that are left in the vending machine. So, for this dummy VMC, When the keypad is pressed, the 7-segment led will light up the segments in forms part of a numerical digit that had been pressed from the keypad.

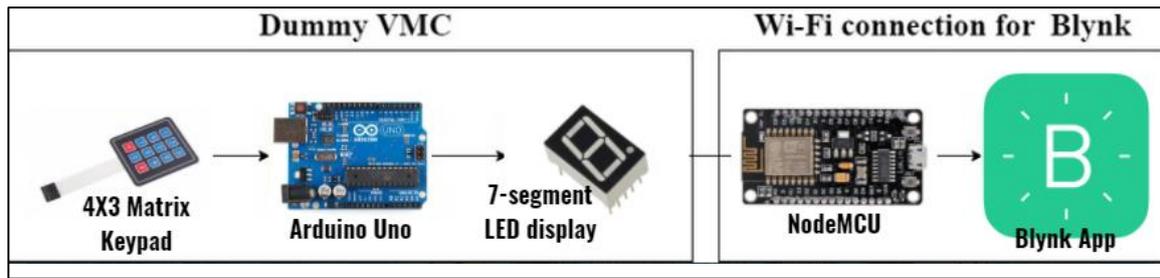


Figure 3: Block Diagram of process flow

For the second part, is the Wi-Fi connection for Blynk. The process starts with the Blynk App receiving input. Next, after the first part of the process where a number is pressed on the keypad and displayed on the 1 digit 7-segment display, from there the output of the 7-segment display acts as an input for the NodeMCU connected to the dummy VMC. The NodeMCU will also provide WiFi connection to the system so that it could communicate with the user interface which is the Blynk App in the mobile phone. From there, the Blynk App would be able to monitor the display of the 7-segment display with Blynk App on the mobile phone. This is the same process that will be applied to the vending machine with a real VMC in order for the owner of the vending machine to check the stocks from their phone. The Blynk app acts as an interface between smartphone and the NodeMCU. Therefore, the Blynk App could display data at the owner’s device. In Figure 4, a schematic diagram for the prototype hardware shows the connection between the components in order to function.

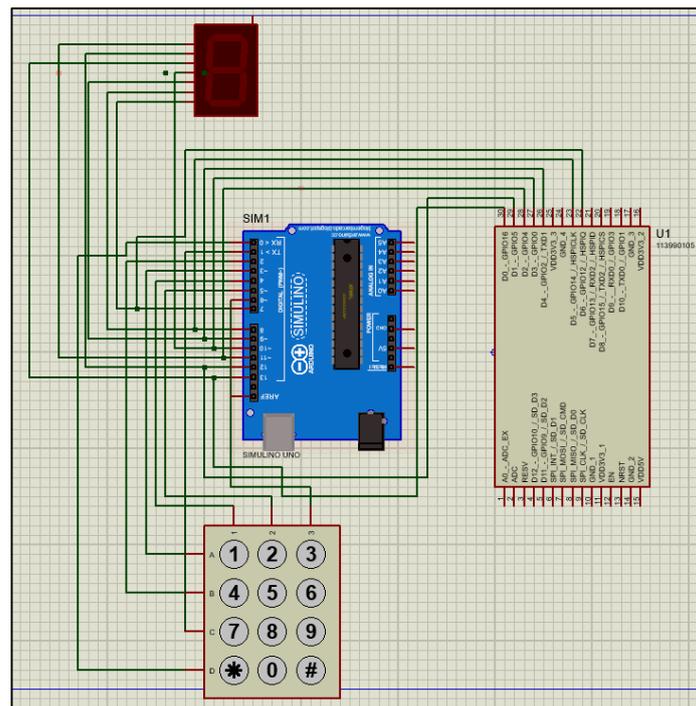


Figure 4: Schematic diagram for prototype hardware connection

3. Results and Discussion

Once the components and parts of the system is successfully built and developed, an analysis was carried out to determine whether all the components of the system work correctly and does not face any problems. The analysis involves the electrical components and the related problems and issues that have been face during the development process.

3.1 Results

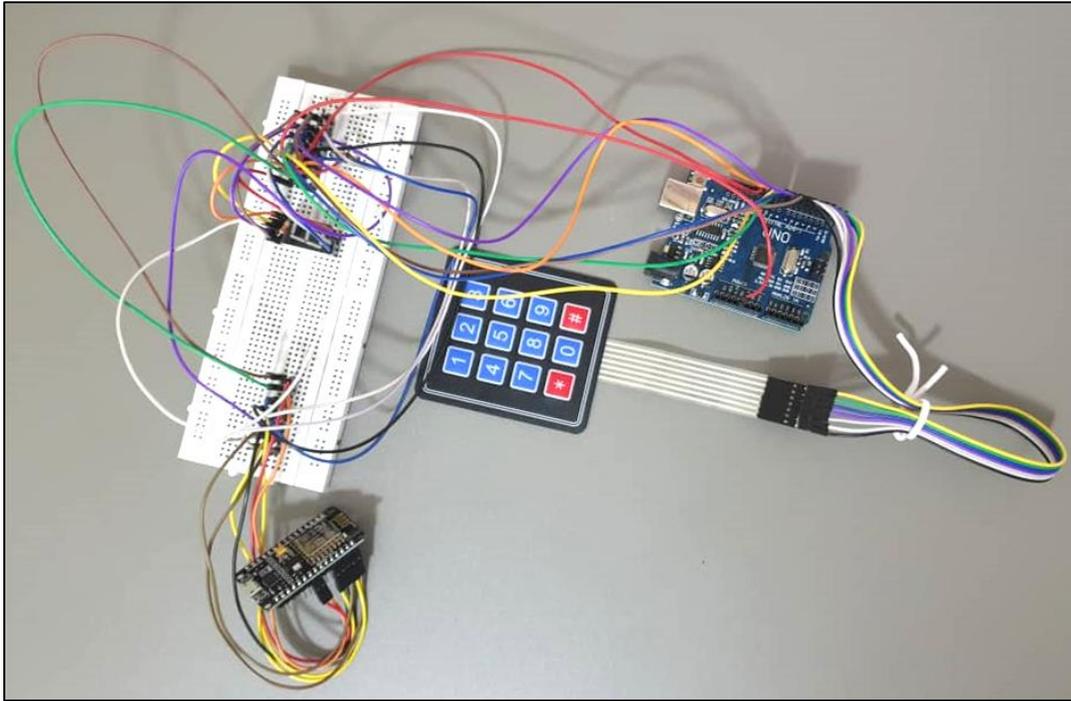


Figure 5: Actual hardware for prototype

The programme has been successful and thoroughly operational in the execution of its duties. The full picture of the actual hardware prototype connection is shown in figure 5. This evaluation decides the performance of the machine that works inside the original project idea. On the basis of the project, the process was accomplished as follows:

- i. Task 1: To display the number of keypad pressed on the 7-segment display. When the keypad is pressed, the 7-segment led will light up the segments in forms part of a numerical digit that had been pressed from the keypad as shown in figure 6. Each segment of the LED is shown in figure 7.

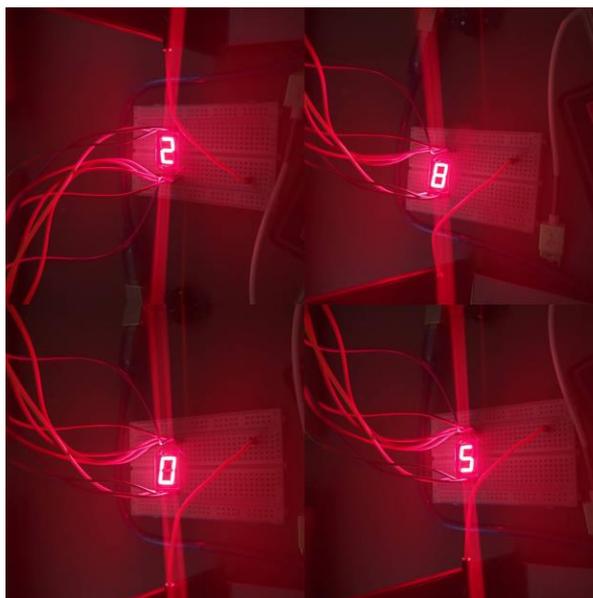


Figure 6: 7-segment display lighting up after pressing keypad

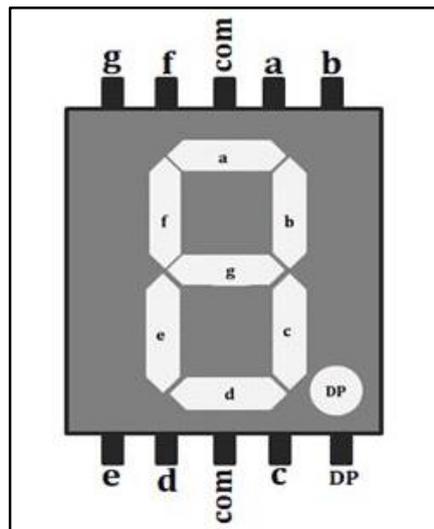


Figure 7: 1 digit 7-segment display pins

Table 1: Number display on a seven - segment display for common anode configuration

Number	g f e d c b a	Hex code
0	1000000	C0
1	1111001	F9
2	0100100	A4
3	0110000	B0
4	0011001	99
5	0010010	92
6	0000010	82
7	1111000	F8
8	0000000	80
9	0010000	90

- ii. Task 2: The NodeMCU can be easily attach on the breadboard with jumpers. The NodeMCU is connected to the power source with a micro USB cable to give power in order to access the Wi-Fi network. The input port from the dummy VMC is connected to the output port of the Arduino Uno by using a jumper, with this the NodeMCU could get the output, which is the number on the 7-segment display after the keypad is pressed, so that the Blynk App can show the number displayed on the 7-segment as in figure 8 where it shows that the number 6 and 3 on the keypad had been pressed. With the WiFi connection, the NodeMCU can communicate with the Blynk app on the phone so it will be able to display the numbers on the 7-segment LED on the terminal widget in the Blynk app.

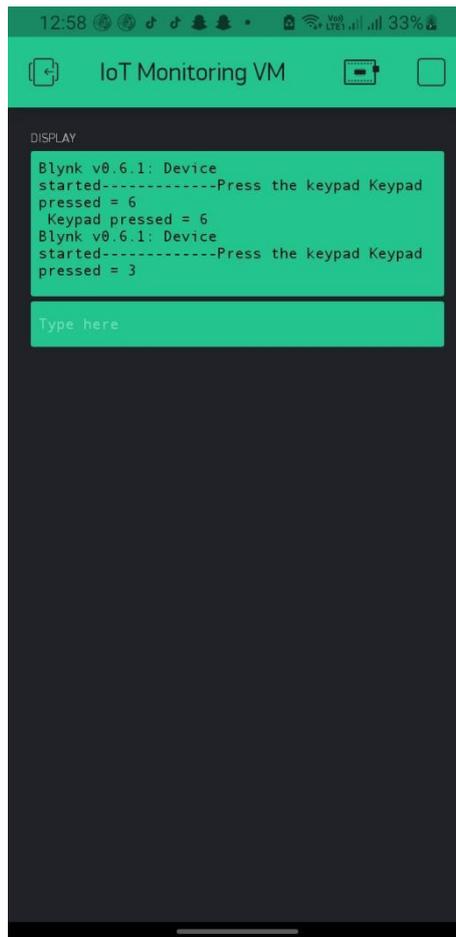


Figure 8: User interface display in Blynk app when numbers in keypad is pressed

3.2 Discussions

This prototype is an idea on how the monitoring system would be when attached to the real vending machine. The dummy VMC is to replicate on how the real vending machine works when the customer picks a product to buy and the choices will be displayed on the 7-segment display attached to it. The NodeMCU, will give the vending machine a Wi-Fi connection, so that it could give the current stock information to the Blynk app on the owner's phone, without having to go to the vending machine and check the stocks manually.

From testing the prototype a few issues had arisen such as the error in the display of Blynk app and the dummy VMC not being able to give a lot of data as only a number is able to display at a time. Due to that, a few recommendations are available for the hardware and software. For the hardware, the prototype can be improved by using a real VMC. By making a prototype with a real component of the VMC, this could help with increasing the efficiency of the result of the process as the real VMC have more data to be sent to the Blynk app compared to the dummy VMC which only have one output at a time. Besides, the real VMC has a larger display that could be filled with more numbers and also letters where the 1 digit 7-segment display could not. With this, a better result could be achieved and work better at real time.

For the user interface, the current prototype uses Blynk app which is a user friendly application to use with IoT applications. The problem with Blynk is that with the real vending machine, more selections and opinion are needed. Therefore, to improve the user interface, an app that allows users to aggregate, visualize and analyze live data streams in the cloud such as ThingSpeak could be used instead.

4. Conclusion

The development of the IoT monitoring system for vending machine using the Blynk app is one of the best developments for vending machine that uses mobile phone to check the inventory stocks of the vending machine. With this application introduced, inventory tracking is far easier to configure and manage compared to the manual system of opening the vending machine and counts its stock by hand. Blynk apps are the latest innovation in this age that can make a difference to human life. It will make it easier for people to monitor the machine or the entire process by using just a cell phone.

For this project, the Blynk app is used to monitor the stocks of the vending machine as it will display the number of the 7-segment displayed on the dummy VMC. Moreover, the prototype created with the dummy VMC has the same mechanism if it is using a real vending machine controller too as the Blynk app is used as a user interface and the whole projects acts as an end user platform for monitoring system.

Acknowledgement

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