Evolution in Electrical and Electronic Engineering Vol. 3 No. 2 (2022) 1014-1021

EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

Smart Retail in Market Place Using IoT Technology

Abdul Rahman Mohd Sokri[1], Aizan Ubin[1]*

[1]Department of Electronic Engineering, Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/eeee.2022.03.02.119
Received 28 June 2022; Accepted 11 October 2022; Available online 30 October 2022

Abstract: Nowadays, smart retail systems using IoT technology are mostly applied in the sales industry worldwide. The smart retail system can increase product sales and usage, which will surely help more in data collection or sales reports because the output obtained from this system is more accurate and systematic. This case study is for developing smart retail in the marketplace using IoT technology. In retail, some of the mistakes made by sellers are that they are not alert to the quantity or stock left on their sales shelf, or maybe products are missing from the shelf. This project aims to develop a smart retail system to monitor and collect data on the number of products and customer presence. Therefore, a new concept was developed with a smart shelf system. Hibiscus Sense ESP32 is used as a microcontroller that controls all system processes. Ultrasonic sensors and IR sensors are used to detect the quantity of stock on the shelf, while an LCD is used to display the price. The output displays in the data stream are "Has/No Presence" for the IR Sensor and "Quantity" for the ultrasonic sensor through the Favoriot platform. When the system determines that the quantity of stock at the sales shelf is less than three, an alert notification from Favoriot is sent through email. Based on this smart retail using IoT technology, the smart shelf can be used as an alternative to a small marketplace.

Keywords: Smart Retail System, Iot Technology, Smart Shelf, Favoriot Platform.

1. Introduction

The Internet of Things (IoT) represents the next step towards the digitization of our society and economy, where objects are interconnected through communication networks and exchange information about their status and the surrounding environment. Smart retail includes a lot of characteristics, such as a combination of technology, technology modernization, integration of supply, integration services, full service and network, and architecture of a retailing system [1].

IoT is a new technology that may be used by both consumers and marketers to increase product sales and usage. Such as smartphones that support mobile applications and sensors that are connected to a network and can be uniquely identified and generate as well as gather data are examples of IoT devices [2].

Corresponding author: aizan@uthm.edu.my

Marketers can use the obtained data to create effective marketing campaigns by analyzing the information. The information gathered is extremely valuable to marketers in terms of identifying potential buyers and developing effective marketing strategies. It is decided to create a situation where the seller can monitor the stock and gain data inventory based on a monitoring system [3].

The main objectives of this project are to develop a smart retail system that can detect the number of products and customer presence at the shelf for notification of seller, to monitor the number of products and customer presence at the shelf via the Favoriot platform, and lastly is to generate the data analysis based on IoT system via Favoriot platform.

2. Methodology

This process starts by studying the marketplace flow to understand on how it works. From the information and research that was carried out, the decision had been made and from that come out with solutions to make smart retail in the marketplace which is focused on sales shelf. By determining the objective and problem statement, this project succeeded. Next is by studying the IoT technology on how it works for smart retail in the marketplace and the programming that is needed. The software or platform for IoT that using in this project is Favoriot. Arduino IDE was also used in this project for the programming or coding that was already created and Hibiscus sense ESP32 as the microcontroller. The sensor that had been used to make this project work is the Ultrasonic sensor and IR sensor. When the supply is turned on, both sensors will starts working and send the output result to the Favoriot platform which is can be monitored. There will be an LCD for the price display on the shelf. Lastly, generate the data analysis based on the IoT system via the Favoriot platform [4].

2.1 Flow chart

Figure 1 shows the flowchart of the project. The development process should start with the Ultrasonic sensor will be developed at the sales shelf, which is the project will run after the item or stock has already been added to the shelf. Next, set up the measuring of the Ultrasonic and IR sensors parameters at the shelf. Then the ultrasonic sensor will detect the quantity of stock or product on the sales shelf. If the reading for the stock at the sales shelf is an error or the parameter is an error, the process will go back to the parameter and need to be set again or adjust the parameter for the ultrasonic to detect the product. Furthermore, if the sensor detects the quantity of stock or product at the sales shelf, the data for current stock or product and the sales report can be monitored via the Favoriot platform. If the data for the product was detected as less than three, there will be an alert email from Favoriot. After that, the IR sensor will detect the presence of the customer on the shelf and the data for the IR sensor can be monitored at Favoriot either no customer or otherwise.

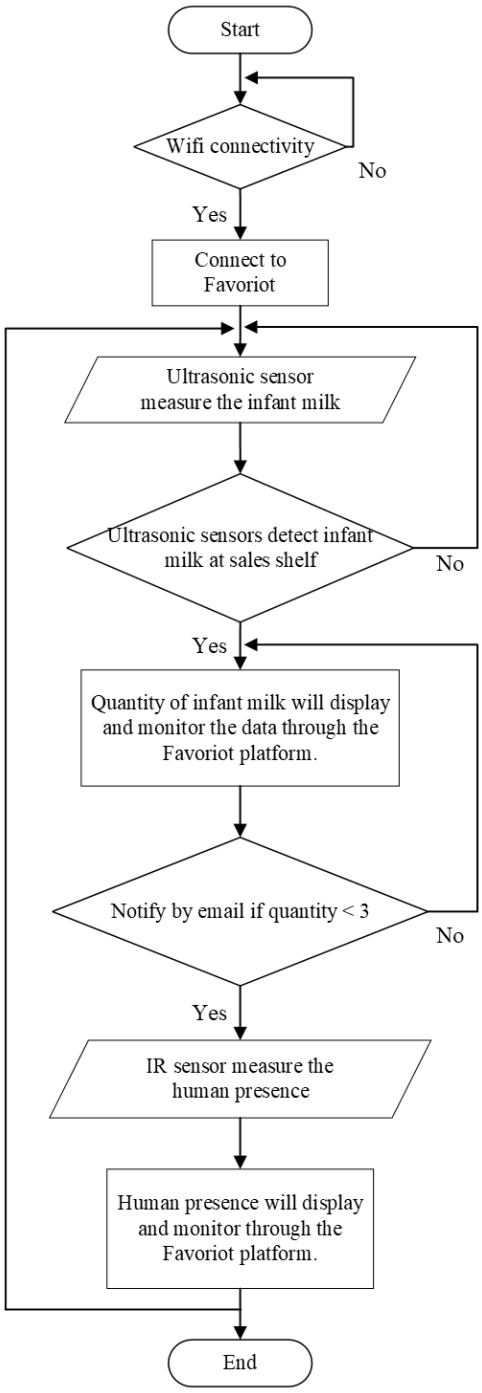

Figure 1: Flowchart of smart retail

2.2 Block diagram

Figure 2 shows the block diagram for smart retail. Based on the research that will be done, the predicted outcome of this project is smart retail using IoT technology. The expected performance specification at the end of the project is the marketplace that will monitor based on the number of products from ultrasonic sensor data, and the presence of customers from IR sensor data analysis by using Favoriot software. The ultrasonic and IR sensor will start measuring and data will display every three seconds and monitored through the Favoriot Platform. By understanding this project, the IoT in the marketplace will be easily monitored and gives alert or notifications if there occur a reduction in the quantity of stock below three.

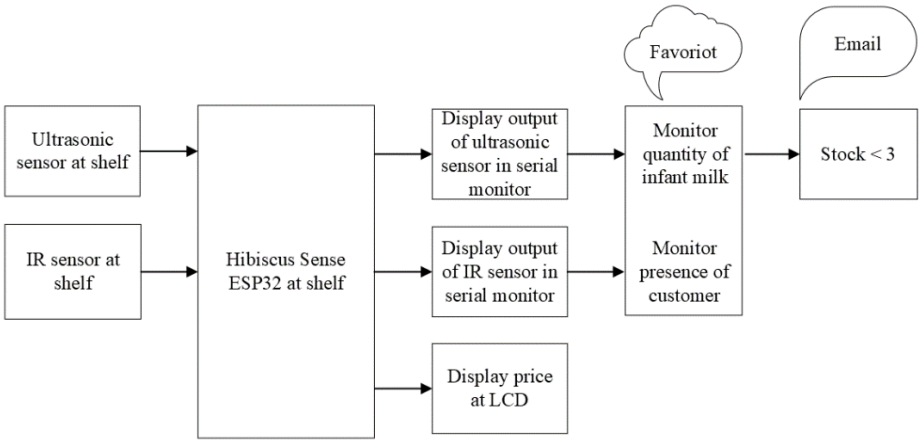

Figure 2: Block diagram for smart retail

2.3 Circuit diagram

A complete circuit connection is the main to make this project function well. Figure 3 shows the complete circuit diagram and its connection to this project.

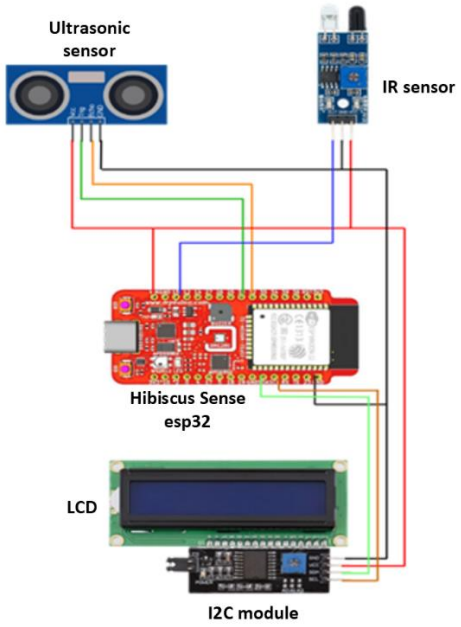

Figure 3: Circuit Diagram of the project.

The ultrasonic sensor is used in this project to detect the number of products on the sales shelf. This sensor has four pins which are Vcc, Trig, Echo, and Gnd. The Vcc pin is connected to the 5V pin on the Hibiscus Sense ESP32 and the Gnd pin to the Gnd of the Hibiscus Sense ESP32. Meanwhile, Trig and Echo pins connect to pins 33 and 32 on Hibiscus Sense ESP32 which is Analog to Digital Converter (ADC). While IR sensor is used in this project to detect customer presence at the sales shelf. This sensor has three pins which are Vcc, Out, and Gnd. The Vcc pin is connected to the 5V pin on the Hibiscus Sense ESP32 and the Gnd pin to the Gnd of the Hibiscus Sense ESP32. Meanwhile, the Out pin connects to pin 15 on Hibiscus Sense ESP32 which is Analog to Digital Converter (ADC) [5]. LCD is used in this project to display the type and price of the product. I2C has four pins which are Gnd, Vcc, SDA, and SCL. The Vcc pin was connected to the 5V pin at the Hibiscus Sense ESP32. While Gnd is connected to Gnd, SDA to SDA, and SCL to SCL on Hibiscus Sense ESP32.

3. Results and Discussion

This chapter analyzes the experimental results and progress of the project development for Smart Retail in Market Place using IoT Technology. attained from each phase of the methodology implemented. Figure 4 shows the complete circuit connection that had been developed. The source of data is generated using an Ultrasonic sensor and IR sensor. Generally, Ultrasonic and IR sensor operating modes are when the Hibiscus Sense ESP32 transmits a start signal and waits to finish the start signal. Ultrasonic and IR sensor response signal to ESP32 when it's done, which includes the quantity of stock and customer presence. The LCD, on the other hand, is the part of the device that displays the price for the stock on the sales shelf.

The most important part of this project is the Hibiscus Sense ESP32. This board is used and has 4 MB of SPI Flash memory and runs at 240MHz. It works with Wi-Fi, Bluetooth Low Energy (BLE), and the Espressif ESP-NOW protocols for low-power 2.4GHz wireless networking. With the different ways to connect, Hibiscus Sense can be used to set up a wireless sensor platform that can be linked to other wireless connections. Also, the Hibiscus Sense ESP32 can't be used or managed without an emulator. In this case, the Arduino IDE is used to set variables and make lines of commands that carry out instructions. For the script to be loaded through the emulator, the ESP32 device must be connected to a laptop. Lastly, once the data extraction process is done successfully, all of the extracted data will be gathered at the intermediate computing devices. This will make it possible to upload the data to Favoriot, the cloud server platform used. When the data that was collected is successfully sent to the Favoriot platform, it is shown in the data streams.

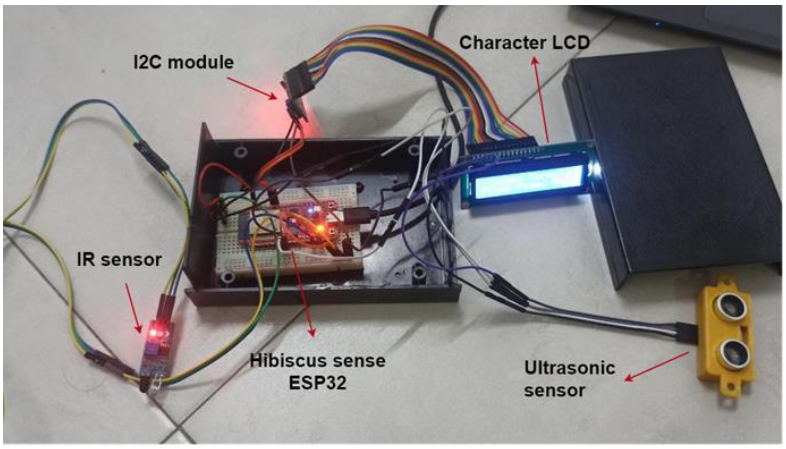

Figure 4: All parts circuits connection

3.1 Smart shelf simulation

Figure 5 shows the complete prototype and circuit connection for smart shelves in a smart retail system. For this system, an IR sensor, Ultrasonic sensor, LCD, Circuit box, and power supply from the laptop had been installed to complete the simulation for a smart retail system using IoT technology.

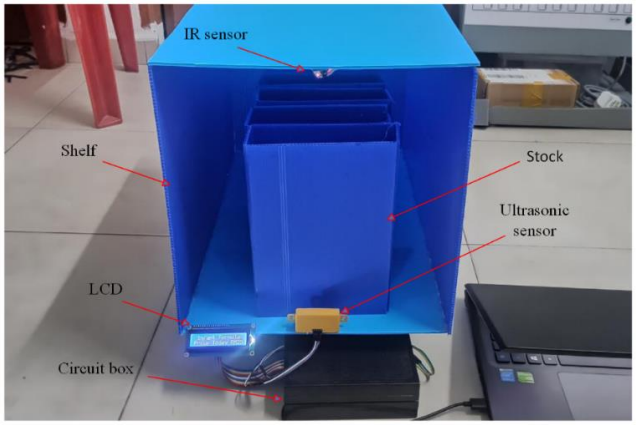

Figure 5: Smart shelf complete simulation

Figure 6 shows the data gained from the IoT platform which is the quantity of stock on the shelf and also the customer presence through the IoT platform which is Favoriot. The time delay was set to three seconds for every data to upload in data streams. The device developer ID and the time for data uploaded are also shown in the result.

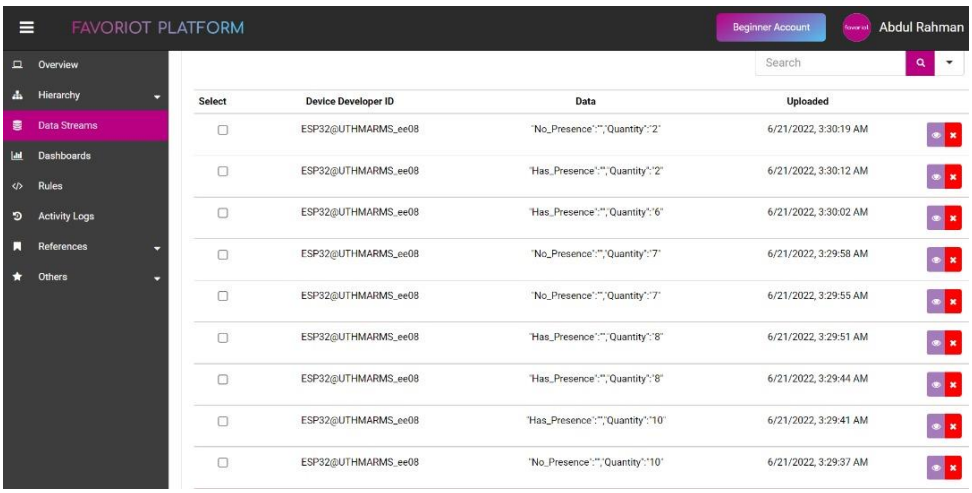

Figure 6: Output data via the Favoriot platform

As shown in Table 1, data analysis from the result generated the output for the project through the Favoriot platform. Data analysis for stock at the shelf was generated by taking time/date data and the product was taken by the customer and uploaded to the Favoriot platform.

Table 1: Data analysis from the Favoriot platform.

Device Developer ID	Quantity	Presence	Time/Date
ESP32@UTHMARMS_ee08	2	No_Presence	6/21/2022, 3:30:19 AM
ESP32@UTHMARMS_ee08	2	Has_Presence	6/21/2022, 3:30:12 AM
ESP32@UTHMARMS_ee08	6	Has_Presence	6/21/2022, 3:30:02 AM
ESP32@UTHMARMS_ee08	7	No_Presence	6/21/2022, 3:29:58 AM
ESP32@UTHMARMS_ee08	7	No_Presence	6/21/2022, 3:29:55 AM
ESP32@UTHMARMS_ee08	8	Has_Presence	6/21/2022, 3:29:51 AM
ESP32@UTHMARMS_ee08	8	Has_Presence	6/21/2022, 3:29:44 AM
ESP32@UTHMARMS_ee08	10	Has_Presence	6/21/2022, 3:29:41 AM
ESP32@UTHMARMS_ee08	10	No_Presence	6/21/2022, 3:29:37 AM

Figure 7 shows the setup of the edit rule information platform to edit any rules and notify if the rule is triggered notification alert through email.

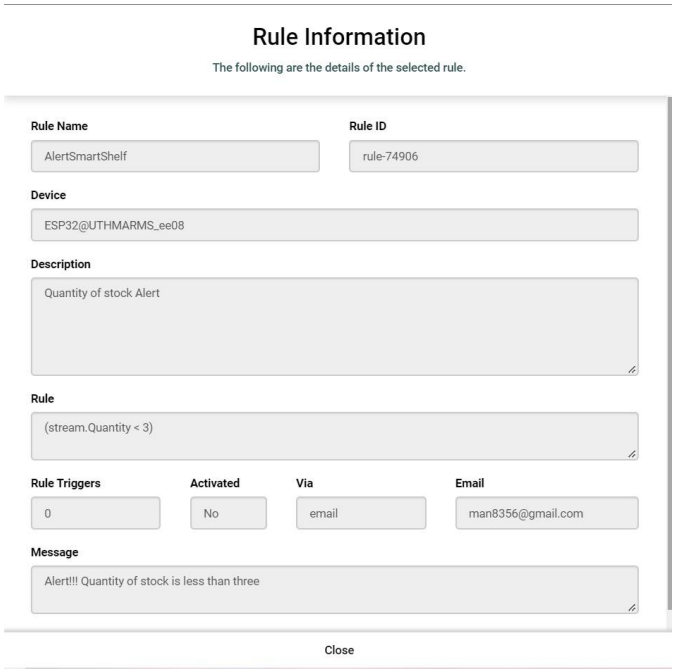

Figure 7: Edit Rule requirement in Favoriot Platform

Figure 8 shows notify alert through email when the quantity of stock is less than three which is Rule Information was triggered.

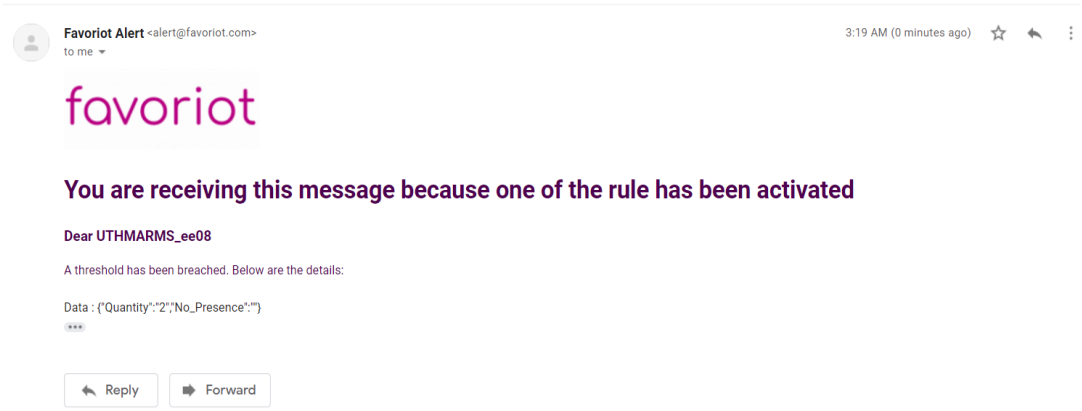

Figure 8: Notify through email if Rule Information was triggered

This is the results and overall analysis of the smart retail system. The prototype for a smart retail system which is a smart shelf has finally been developed. This system works when the Ultrasonic sensor detects the quantity of stock at the shelf, the IR sensor detects the customer's presence at the shelf, and LCD the price at the shelf. Output data for both sensors will send to the Favoriot platform. The quantity of stock and customer presence can be directly monitored through a data stream on the Favoriot platform. Analysis of the results based on objectives which the system can be monitoring directly and an alert notification will send if the quantity is less than three. All those components have been analyzed throughout the development and troubleshooting process.

4. Conclusion

In conclusion, smart retail in the marketplace using IoT technology by using Ultrasonic sensors and IR sensors to create smart shelves can be used as an alternative to the small marketplace. By developing a smart retail system that detects the number of products and customer presence, the seller becomes

more alert about the quantity of stock left on their sales shelf. In retail also always occur product missing. Applying the system that detects the quantity of stock at the sales shelf and detects the customer present at the sales shelf was make the seller easy to monitor the data through the Favoriot platform. This system generates the data analysis based on the IoT system via the Favoriot platform. The missing data problem had been solved with the installation of this system. An alert notification will be sent to the seller via email once the system read the quantity of stock is less than three. Hibiscus Sense ESP32 act as a microcontroller to control the flow of this project system. Through the results of this project, the objective is accomplished and the problem statement had been solved.

Acknowledgement

The author would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

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