Borneo Engineering & Advanced Multidisciplinary International Journal (BEAM)
Volume 2, Issue 1, May 2023, Pages 33-36

Design and Development of IoT Based Inventory Management System for Small Business

Shariman Johari[1]*, Wan Abdul Aziz[1]

[1]Department of Mechanical Engineering, Politeknik Sultan Abdul Halim Mu'adzam Shah, Bandar Darulaman, 06000 Jitra, Kedah, Malaysia

*Corresponding author: shariman@polimas.edu.my
Please provide an **official organisation email** of the corresponding author

Full Paper

Article history
Received
11 October 2022
Received in revised form
8 March 2023
Accepted
23 March 2023
Published online
1 May 2023

Abstract

Nowadays, everything is made simpler with information and communication technological advancements. The Internet has been part of human lives with the rapid increase on the usage of internet over the past decade. With these technological advancements, almost everything around us is now automated. Humans tend to carry out their daily activities via portable smart devices or simply said a smart phone. It is preferable to track and monitor using these devices rather than perform it manually. This resulted in the rapid growth of Internet of Things (IoT) technology and relevant markets. Low cost IoT products have made access to IoT much easier and desirable. These low cost IoT devices and related technologies are widely used in areas such as educational, transportation, tracking, inventory management and many more. IoT has been a game changer in the inventory management system. However, some IoT developed inventory management systems have its own advantages and disadvantages. The use of Arduino and RFID in the inventory management system lacks in some areas including hardware limitations. In conjunction to the limitation of using Arduino and RFID technology, this project aims to develop an IoT based inventory management system that incorporates the uses of a NodeMCU and a Load Cell. In comparison of the NodeMCU to an Arduino, the NodeMCU stands out with the built in Wi-Fi module with much higher processor and additional properties of it being much smaller. While the use of a Load Cell is much more convenient as to suit all kinds of inventory management needs compared to the use of RFID that suits better to larger scale businesses with larger inventory and massive stocks. Towards the end, this project is expected to ease inventory management by the implementation of IoT. This project should generate stock count automatically and is accessible online. Data history and status should also be generated with notifications on stocks running low. There are several things that can be upgraded for future recommendation for design. The project has only one compartment to store the stock so in the future recommendation, more space/drawer that can be used to store product. Also, for the weight maximum in one drawer that is 1 kg only. It is unusable because 1kg can only put light objects, some small business owners store their stocks with a larger weight, hence the future recommendation is that the maximum value of the drawer will be upgraded to 5 kg or 10 kg.

Keywords: - Internet of Things, emergency switch, remote access

1. Introduction

Nowadays, during this pandemic attack of COVID-19, lots of people out there has lost their jobs because of unstable economic conditions. So, some of them started to find their own incomes by starting a small business. They probably store their own goods in their house and probably in a confined space. Some small businesses have started to grow their business with a lot of stocks, stored in their home but do not know how to have proper storage management (Lee et al., 2018; Dennert, Friedrich & Kumar, 2021 and Doss, Trujillo-Rasua & Piramuthu, 2020). Therefore, when it comes to counting their stocks, they have to count their stocks one by one manually and it will lead to man- made error. Not to mention, they cannot keep in touch with their stock when they are away from

home. Also, the situation becomes quite complex when they only notice the number of their stock is getting lower after they have checked their storage.

1.1 Design and Development of IoT Based Inventory Mangement

The system for small business is built to ease the small business owner to keep their stocks quantity and keep track of their stocks that will lead to proper pre-planning decision making. This design is the key to effective storage and can help lots of small businesses out there. The selection of this project aims to reduce costs and time by creating a more efficient system that can be used to all owner stores.

1.2 Project Background

Most small business owner store their goods at home or in a confined space. Some of them don't even learn how to have a proper storage keeping because they just have started to do some small business to earn some income. The storage place was small but sometimes small business owners tend to forget how much stock they have left. In Fig. 1 is the example of how small business owners store their goods in a narrow place or at home.

Fig. 1. Example of storage room

The project build is specially for the small business owner to store their goods/products easily. Some of the small business owners are new to business and never learn about a proper storage management. The problems came when they wanted to know the current quantity of their stocks. The owners must count one by one manually of their stocks. This process not only takes time but also introduces to man-made errors. In the case of small business that unable to hire any workers, this situation becomes very complicated. Not to mention when the stock of their goods reaches a low-level quantity, they will only notify it when they have checked the stocks manually and it will lead to less customer buying products at their store because it is always out of stock.

The entitled of this project is 'Design and Development of IoT Based Inventory Management System for Small Business' can be applicable to all small business owner, mini stores and housewife that wanted a proper organized storage. This project system can ease the small business owner and make their business management easier. This system will replace the old traditional ways of counting stocks. The project will use the Load Cell and Node MCU ESP32 microcontroller that will automatically detect the number of stocks left/present on the shelves. This way will make less of stock counting error. Furthermore, this design won't let you worry about your stocks going low anymore. This design will notify/alarm you via email if your stocks reach a certain amount of low quantity level using the IFTTT. All the information about the stocks will be updated through our smartphones only (Patnaik, Yang & Sethi, 2021).

Back when the Industrial Revolution had not started, people had already started to buy and sell their things such as vegetables, clothing, and other raw materials. Hence, in logically thinking the seller back then had their own way on managing their business-like writing there in and out stock on their notebook or an anything else. Or perhaps they might have another way. This tells that the inventory management system has already exist when the high technology is still undeveloped (Shakhovska, 2017 and Shabandeh, 2021).

Inventory Management system is a process that you can track your stock till the end of the sales. After some years have passed when the technology has developed there's a lot of inventions have been made. The best invention was made are design by a team from Harvard back in 1930 that used a punch card that was inserted to a computer that would read and the information will be sent to the store. This system was very expensive, but it can manage the inventory system very well (Buntak, Kovačić & Mutavdžija, 2019; Panigrahi, Jena & Jena, 2020 and van Geest, Tekinerdogan & Catal, 2021)

Nowadays, the bar-coding and RFID system has been invented. Some of the business owner also use the micro-chips that transmit everything about the products information that are relevant to the business owner. The inventory management system was mandatory for all business owner who holds a lot of stocks such as Shein, Amazon, J&T Express and lots of other big company.

2. Methodology

This chapter consists of a way or method used to achieve the objectives and the purpose of this project. Methodology makes the conducted project more systematic, and the project journey becomes easier on achieving the objective. The researcher has planned the ways and the methodology used to find the information and the data through some sort of method. Also, will discuss in detail a few important things in the methodology and strategies used in completing the project in this chapter.

Design and Development of IoT Based Inventory Management System for Small business are used by small business owner to keep in track of their stock wherever they are away from the storage place/home. Also, the owner does not have to manually count their stocks anymore. This project functions by the load cell detecting

the weight measurement of the stock. The differences between this project with other inventory management systems is that this project used the IoT technology to send the information of the stock. Also, the design of this project is also suitable and that will help all the small business out there.

2.1 Project Design

The type of project that will be making is the real type project that is producing a prototype machine in inventory management system for small business owner. This project aims to ease the management of stock for small business owners. In completing this project, the researcher has constructed a flowchart for the project to show the process and the step.

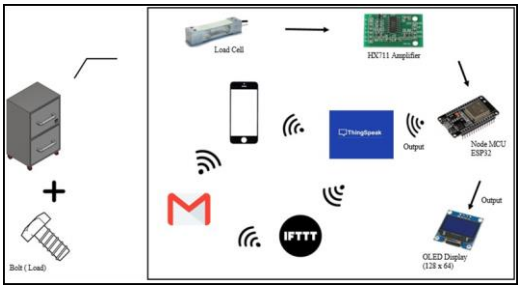

Fig. 2. Block diagram

3. Result and Discussion

Proceeding, Chapter 3 of the project progress report contains the results obtained from the project and discussions that can be made based on the achieved results. This chapter will cover the design concept of the IoT based inventory management system using load cell and Node MCU. A few discussions will also be included.

3.1 Study Findings

In this project the researcher has created a drawer that can automatically detect the number of stock left. Testing this project requires some samples to set as an example for the stock. An example of some objects that has been made to use as a sample is a nut and bolt (17pcs). This testing will prove which object is the most suitable to become an example for this project. The measurement used in this testing in grams (g) and there are some formulae that are used that is:

a. Nut Calculations

d = *biggest value – lowest value* (1)

= 23.1 – 20.6

= 2.5 g

t = *Plus Total Everything* (2)

= 20.6 + 21.1 + 21.1 + 21.3 + 21.3 + 21.1 + 21.1 + 21.7 + 21.6 + 21.8 + 21.5 + 21.3 +22.5 + 22.4 + 23.1 + 22.1 + 22.5

= 368.1 g

a = *Total weight* (g) / *Number of quantity* (*17pcs*) (3)

= 368.1 / 17 = 21.6 g

b. Bolt Calculation

d = *biggest value – lowest value*

= 44.1 – 43.7

= 0.4 g

t = *Plus total everything*

= 43.9 + 44.0 + 43.9 + 43.8 + 43.8 + 43.8 + 43.7 + 43.9 + 44.1 + 43.7 + 43.8 + 43.9 + 44.0 + 43.9 + 43.7 + 44.0 + 43.9

= 745.8 g

a = *Total weight* (g) / *Number of quantity* (*17pcs*)

= 745.8 / 17 = 43.8 g

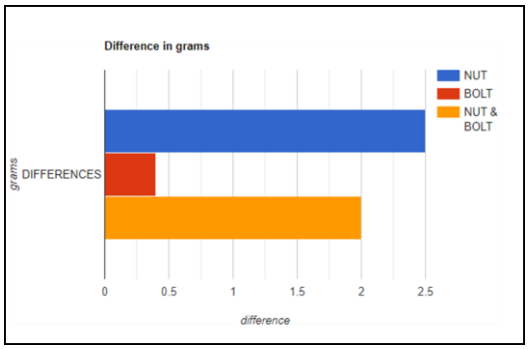

Fig. 3. Nut data

Fig. 3 shows the difference in grams for nuts. In this project weight similarities between each stock are very important because the sensors that are used that is Load cell have a fewer sensitive senses. Hence it is not suitable to use project example with a big difference in weight with each other. The number of pieces left will give a different value that are wrong.

Refer to the graph, the bolt has the very lease different in weight with each other that is only 0.4 g. Next the nut shown on the graph, has a very big difference with each other that is 2.5 g. Lastly for the nut, the difference is not

that small, because the difference is 2.0 g. From the bar graph above we can clearly see the perfect object that can be used as an example for this project. This project will be using the bolt as an example for the project because the slight difference in weight can avoid any miscalculation when the sensor is reading the weight.

4. Conclusion

The summary that can be made based on the development of the project report is that the design of the IoT based inventory management system using load cell and NodeMCU was constructed successfully. The project aims to design an IoT based inventory management system that tackles the problem involving small items inventory. The implementation of this project will be useful for small stocking inventory as such a hardware department in a factory or a hardware store. The progress for is that the project's design was successfully constructed by using the Fritzing software. A circuitry connection on a breadboard and donut board and the schematic view of the connections was constructed and obtained. The programs for the microcontroller were also written. The code writing process was done using the Arduino IDE software successfully.

There are several things that can be upgraded for future recommendation that is from the design of the project have only one compartment to store the stock so in the future recommendation, more space/drawer that can be used to store product. Also, for the weight maximum in one drawer that is 1 kilogram only. It is unusable because 1kg can only put light objects, some of small business owner store their stocks with a larger weight, hence the future recommendation is that the maximum value of the drawer will be upgraded to 5 kg or 10 kg. To summarize all that has been indicated above, objective one of the IoT based inventory management system using load cell and NodeMCU which is to build the IoT based inventory management system using load cell and NodeMCU have been successfully achieved.

Acknowledgement

This research is fully supported Politeknik Sultan Abdul Halim Muadzam Shah for the approved fund which makes this important research viable and effective.

References

Buntak, K., Kovačić, M., & Mutavdžija, M. (2019). Internet of things and smart warehouses as the future of logistics. *Tehnički glasnik*, *13*(3), 248-253.

Dennert, K., Friedrich, L., & Kumar, R. (2021). Creating an Affordable, User-Friendly Electronic Inventory System for Lab Samples. *SLAS TECHNOLOGY: Translating Life Sciences Innovation*, *26*(3), 300-310.

Doss, R., Trujillo-Rasua, R., & Piramuthu, S. (2020). Secure attribute-based search in RFID-based inventory control systems. *Decision Support Systems*, *132*, 113270.

Lee, C. K., Lv, Y., Ng, K. K. H., Ho, W., & Choy, K. L. (2018). Design and application of Internet of things-based warehouse management system for smart logistics. *International Journal of Production Research*, *56*(8), 2753-2768.

Panigrahi, R. R., Jena, D., & Jena, A. (2020). Deployment of RFID technology in steel manufacturing industry—An inventory management prospective. In *Advances in Machine Learning and Computational Intelligence: Proceedings of ICMLCI 2019* (pp. 705-719). Singapore: Springer Singapore.

Patnaik, S., Yang, X. S., & Sethi, I. K. (2021). Advances in machine learning and computational intelligence. https://doi. org/10.1007/978-981-15-5243-4.

Shabandeh, M. (2021). Apparel Market Worldwide. Retrieved February 12, 2022 from https://www.statista. com/topics/5091/apparel-marketworldwide.

Shakhovska, N. (2017). *Advances in intelligent systems and computing*. Springer International Pu.

van Geest, M., Tekinerdogan, B., & Catal, C. (2021). Design of a reference architecture for developing smart warehouses in industry 4.0. *Computers in industry*, *124*, 103343.