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Inventory Management for Retail Applications Using Iot Systems

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Abstract*: The retail sector has grown tremendously over the past century. Retail shopping has now become a part of our everyday life. There are two main players here: the retailers and the customers. The retailer's main objectives are to obtain maximum sales with minimum operating costs. Customers will want to check for the availability of the product, and get to know its details beforehand. In this paper, we use Internet of Things (IoT) technology to integrate networked information systems with real world entities. It connects objects such as smartphones, sensors, etc with the cloud where the data is stored. When a product is selected for purchase, its details are displayed upon scanning its RFID tag and the product quantity is updated in the cloud once the purchase has been made. With this data, the retailers can keep track of the stock of each item, and restock items that are less in quantity. Customers can check for the availability of a particular product on the mobile application. This will save time for the customer in case a product is not available at a particular store. For the retailer, it will ensure that they never run out of stock of a particular product. This setup can be implemented in retail stores of varying sizes.

***Index Terms*: cloud, customers, IoT, retail, shopping**

I. INTRODUCTION

Internet Of Things (IOT) has gained widespread acceptance in various walks of life. In an Internet of Things (IoT) network, a number of objects are interconnected and are able to communicate with other objects in the network. It is a system of interconnected computing devices, digital machines, objects which are provided with unique id and which are capable of sending and receiving data over the IoT network without requiring any sort of interaction in either human or machine form. One of the main factors in loT devices to function properly in both physical world or in cyber world is trust. Under IoT, a number of applications are under development. Some of them include e-health, smart city, air pollution check in the city and so on. With the rapid urbanization in society over the past century, supermarkets have become part of our everyday life. Due to the wide range of products in the market, we can buy anything we want. A lot of time is wasted by customers in locating a product. The program is intended to allow customers to take advantage of the latest technology in easing the shopping process, while keeping the essential steps of shopping intact. In the smart supermarket, we can eliminate complaints of long queues for shopping and checkout by the customers.

The primary aim of this paper is to use IoT technology to tackle the everyday problems that are faced by retailer and customer, with the help of the mobile app. In this proposed system, retailers are initially aware of the quantity of products remaining in their store .If the quantity of a product goes low, a warning message is sent to retailers desk for refilling the products or order new ones from the vendor. On the customer's side there will be an app which will inform them about the availability of a product and if available then it shows the date of expiry, its cost, nutrient value, etc. of that product which saves the time of customer. In the proposed system if the products are less in quantity then the system gives warning message to the admin, who receives the alert and takes appropriate action. If the product is less then administrator will restock it or else they will place an order for new products. It also displays a map of the store, enabling the customer to search for a particular product and purchase it. It also provides details like list, discount, which will help the customer in making a list of products that they require

II. RELATED WORK

An Arduino UNO can be used to develop an effective IoT system which is used to keep a check on the inventory of the store and an alert is issued in advance when the quantity of a product goes low. [1] RFID automatically identifies the tags which are attached with the objects. The importance of RFID tags are implemented in many manufacturing industries. The production of RFID tags had a greater impact on retailers to tag each and every product with RFID tag which reads the linked information of the product and makes it easy for the customers to have a better shopping experience.[2] Once customers step into a retail store they save their time by getting suggestions on the app about certain products of concern and where the product is located. [3] The ultimate aim is to provide a stress free and easily accessible system of shopping for the customers. [4] RFID technology can be used for locating, reading, computing and updating the position of each product in a store.

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This is done by attaching RFID tags to each item or their price tags. It can also be used to monitor the quantity of each product in a shop. Here, an RFID reader is placed on the shopping cart which helps in real-time updation of the stock of each product. [5][6] Image processing is a technique that can be used to process various images and to compare the present stock of products on a shelf to the ideal (full) scenario. It notes down parameters like the occupation rate of each shelf, the rate of sale, etc. [7] Wireless sensor network working on IoT technology can be used to track the grocery stock at homes and retail stores. This is chiefly done to watch the food consumption patterns and its levels. [8]
Localization is the place or identification where the exact location of products plays an important role. There are four different section of components which are located in a particular order. Initially it is the Location of Everything component location, secondary is the data filtering component and the data collection component finally the data mining component. Locating orbital component is initiated, so that the location can be known specifically. [9] Shopping for visually impaired people without guidance is very difficult. This proposed system provides guidance to identify the products in various retailing stores. The products in the supermarket is read or identified by RFID tag. [10] One of the smarter ways of shopping grocery items is by automated systems for smart homes. Optimal/ minimal parameters are obtained by certain mathematical and logarithmic methods to have a smarter system of shopping.[11] RFID ensures the datasets for smart manufacturing shop floors which are used in generating of various sites in such a manner for shop floors in supermarkets. Big data analytics play a major role in processing and analysing data in manufacturing management. [12] The introduction of Electronic Smart Card System reduces the number of people standing in line for billing, this is done with the help of RFID cloud smart card system. This type of smart system provides an effective way for customers for doing their billing process in an easier way. [13] Smart Market is a digital change that helps the customers and retailers in form of digital shopping rather than searching and buying products in supermarket. RFID technology for offline markets helps the offline markets to cope up with the sale trend as the shopping now is dominated by online shopping. This helps the dealers to predict the sale trend so that they can save the cost for entity business. [14]

III. SYSTEM DESCRIPTION

Fig.1 shows the block diagram of a proposed system for implementing this work. To measure the weight of the products, we use a load cell and a HX711 weight sensor module together. For reading and identification of products, we use an RFID reader and an RFID tag. This data is communicated to the Arduino Uno. The Wi-Fi module is used to provide network connectivity. Cloud storage is used to store information about products, their status and availability, etc. We can access this data through mobile applications that we can install on our smartphones.

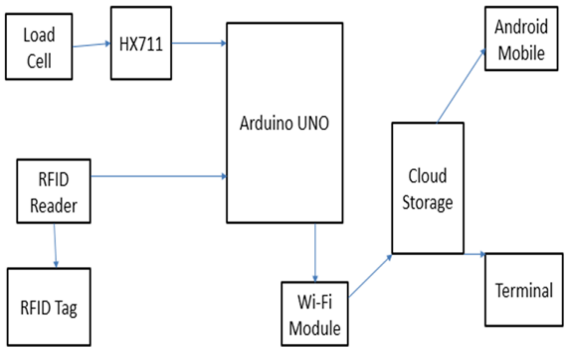

Fig 1. Block diagram of a proposed system

IV. COMPONENT DESCRIPTION

A. *LOAD CELL*

Fig 2. Load Cell

Fig.2 shows the Load cell. It is a weight measurement device which converts applied force into electrical signals. It usually consists of a spring element. On this spring, strain gauges are placed. Usually steel or aluminium is used in the manufacture of spring element. As the name "spring element" suggests, when a load is placed on it, the steel is slightly deformed, but then returns to its initial position, thus giving an elastic response to every load. Strain gauges can thus be used to measure extremely small changes. By determining the strain of the strain gauge, we can measure the weight of the object.

B. *HX711 WEIGHT SENSOR*

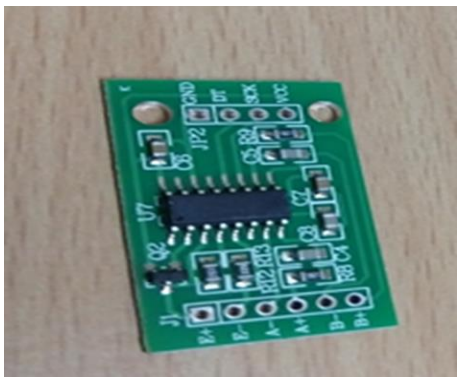

Fig 3. HX711 weight sensor

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Fig 3 shows the HX711 weight sensor. It is a 24-bit analog-to-digital convertor primarily used in determining weight of an object. It is made to interface directly with a bridge sensor. The load cell's deformations and subsequent electrical signals generated need to be amplified to enable these signals to be read by an Arduino. The weight sensor used here is a HX711 model.

C. *ARDUINO UNO*

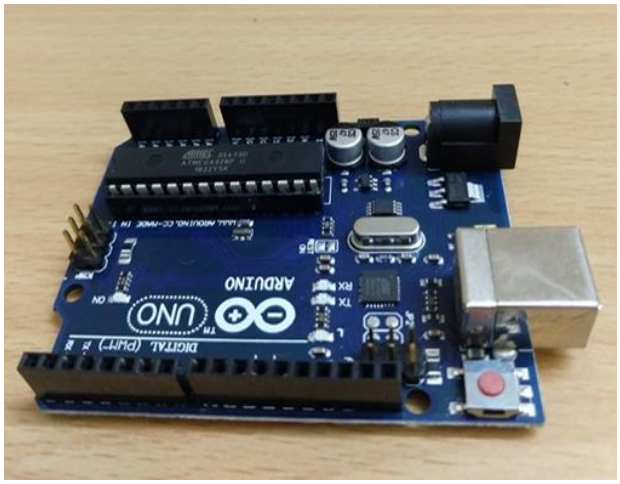

Fig 4. ARDUINO UNO

It is capable of building digital devices that can sense and control objects. It is a microcontroller board based on the ATmega328P (datasheet). It consists of 14 digital I/O pins, 6 inputs in analog form, a quartz crystal of 16 MHz capacity, a USB connection, a power jack, an ICSP header and a reset button. It consists of all the necessary parts that are required to support the microcontroller. It is shown in Fig.4.

D. *RFID READER AND TAG*

Fig 5. RFID Reader and Tag

It is a device used to capture and record radio waves. It also stores data in the required database. RFID is the abbreviation of "Radio Frequency Identification". RFID tags are tiny chips (usually comes in a smart card or visiting card shape) that are used in our day to day life for unlocking hotel rooms, entering into cars etc. These tiny chips along with an RFID reader, which reads the information on the RFID tag, forms the RFID system.

E. *ESP 8266-01 WI-FI MODULE*

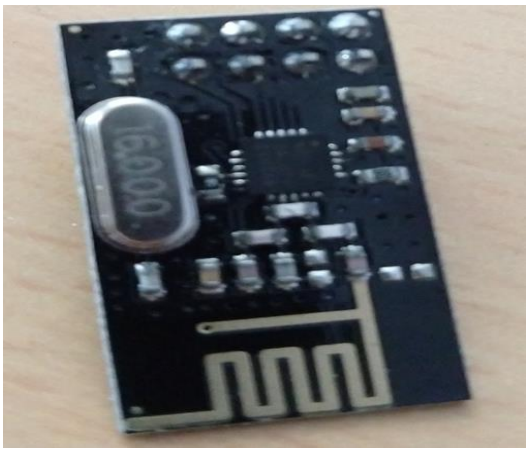

Fig 6. ESP 8266-01 Wi-Fi module

The ESP8266 Wi-Fi Module is shown in fig.6. It is a self-contained SOC with integrated TCP/IP protocol stack that provides any microcontroller with Wi-Fi access. It is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. The ESP8266 module is an efficient board with an ever-growing popularity.

F. *ARDUINO IDE*

The Arduino Software (IDE) is an open-source software which helps us to write code with ease and upload it to the board. It is capable of running on Windows, Mac OS X, and Linux platforms. Java is used as the primary language in the coding environment, which is based on processing and another open-source software. This software is compatible with any Arduino board. The programming languages C and C++ are also supported by the Arduino IDE.

V. FLOWCHART

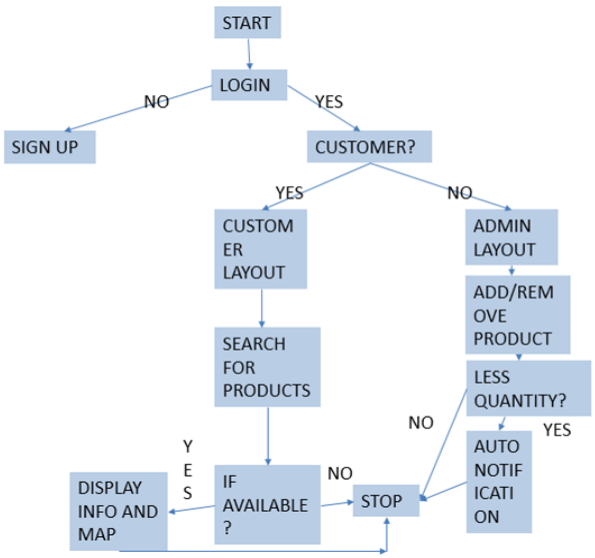

Fig 7. Flow chart of the proposed work

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Figure 7 shows that flow chart of the proposed work. At the beginning, it asks whether you have a login ID, and if you don't have, it prompts you to sign up. Once you have registered, it asks whether you are a customer or a retailer. If you are a customer, it leads you to the customer layout where you can search for the product and its details will be mentioned. If you are a retailer, then it leads you to the admin layout where you can add and remove the products. If the product quantity is less than the sufficient quantity, it gives an automatic warning to restore the product.

VI. RESULTS

The hardware components are as follows; Load cell, HX711 weight sensor, Arduino Uno, RFID reader and tag, ESP 8266-01 Wi-fi module, and a display component. The weight of the products is measured by load cell which converts force into electrical signals and also by determining the strain we can calculate the weight. These electrical signals are further amplified using weight sensor. These signals are carried towards Arduino by connecting wires and fed into it and the Wi-Fi module maintains the network access in carrying the amplified signals. RFID 'Radio frequency identification' reads and records the incoming radio waves. RFID reader reads the products information on the tag and makes the RFID system.

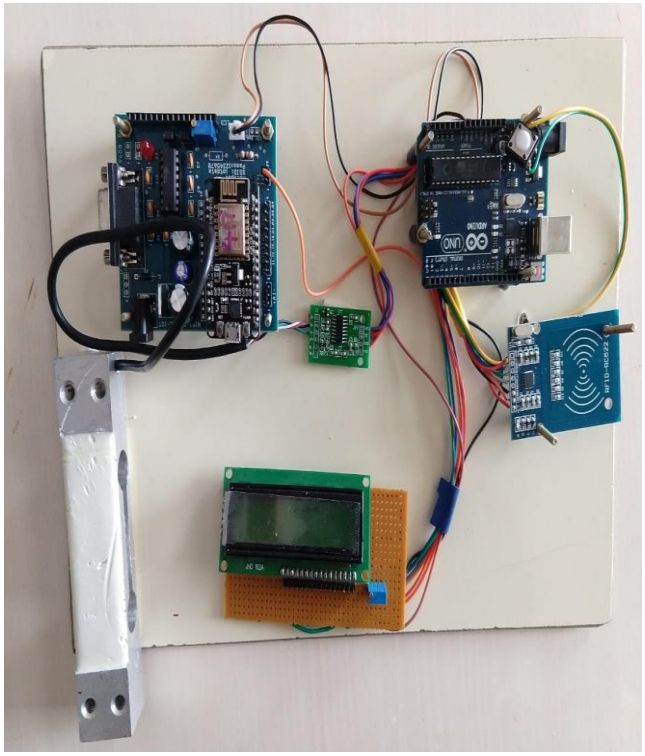

Fig 8. Experimental Setup

When a product is placed on the load cell, the weight of the product is measured and displayed. On scanning its corresponding RFID tag on the RFID reader, the product is identified. Once this is done, the data is passed on to the cloud through the network provided by the Wi-Fi module. The data on the cloud is correspondingly reflected on the mobile applications.

Here, for example, a purchase of 10 soaps is made. Figure 9 and 10 shows the "before" and "after" product count on the mobile application.

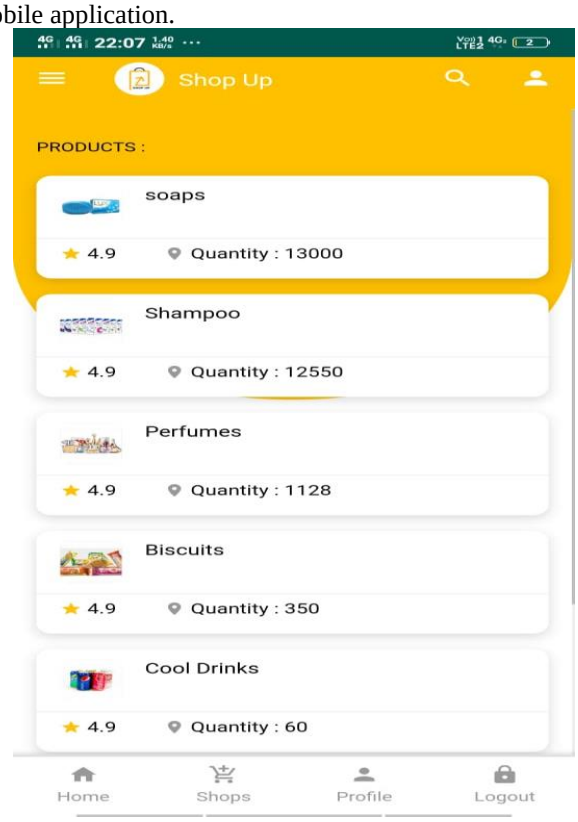

Fig. 9. Before Purchase

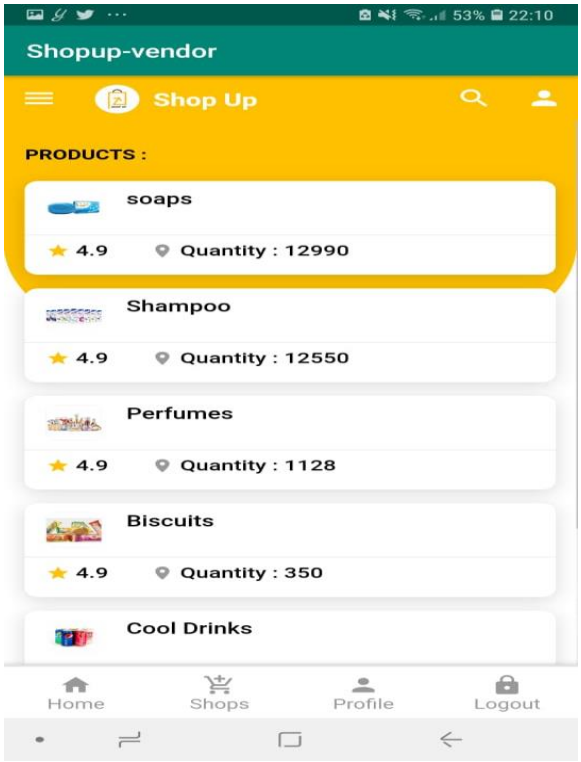

Fig. 10. After Purchase

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It is observed that the quantity of soap goes down from 13000 to 12990 after the purchase of 10 soaps.

VII. CONCLUSION

To conclude, this paper proposes a system designed to improve the retail experience of customers and retailers alike. By designing a system that helps both customers and retailers know the quantity of each product in a store, a lot of time and effort can be saved for them. Using this information, customers can search for the availability and details of a product online, through the mobile app. The retailers can monitor the sales of each product and restock if necessary, avoiding the situation where the store runs out of a particular product. By implementing this system in stores, the stores can improve their sales and profits. So it turns out to be a win-win situation for both customer and retailer.

REFERENCES

1. Santosh H. Kalange, Dipti A. Kadam, Asmita B. Mokal ,Avinash A. Patil- "Smart Retailing using IoT", International Research Journal of Engineering and Technology (IRJET) Volume 4, Issue 11, Pages 263-268, Nov 2017.
2. Kai Ding, Pingyu Jiang- "RFID-based production Data Analysis in an IoT-enabled Smart Job-shop.", IEEE/CAA Journal of Automatica Sinica Volume 5 Issue 1 Pages 128-138, January 2017.
3. W. U. L. J. R. Perera, M. S. Karunarathne - "Enhancing and speeding-up real-time-shopping using an indoor map, intelligent suggestions and calculations, built upon a smart phone application" 2013 IEEE 8th International Conference on Industrial and Information Systems, Dec 2013
4. Zeeshan Ali, Reena Sonkusare- "RFID based smart shopping", 2014 International Conference on Advances in Communication and Computing Technologies, Aug 2014.
5. Dylan Hicks, Kevin Mannix, Hannah M. Bowles, Byron J. Gao
6. "SmartMart: IoT-based In-store mapping for mobile devices" 9th IEEE International Conference on Collaborative Computing: Networking, Applications and Worksharing, Oct 2013.
7. Ruinian Li, Tianyi Song, Nicholas Capurso , Jiguo Yu , Jason Couture , Xiuzhen Cheng -"IoT Applications on Secure Smart Shopping System", IEEE Internet of Things Journal, Volume 4, Issue 6, Pages 1945-1954, Dec 2017.
8. Rakesh Satapathy, Srikanth Prahlad, Vijay Kaulgud- "Smart Shelfie -- Internet of Shelves: For Higher On-Shelf Availability" 2015 IEEE Region 10 Symposium, May 2015.
9. Hardi Desai, Divya Guruvayurappan, Mustafa Merchant, Smeet Somaiya, Hetal Mundra- "IoT Based Grocery Monitoring System" 2017 Fourteenth International Conference on Wireless and Optical Communications Networks (WOCN), Feb 2017.
10. N.Madhan Kumar, N.Sugandhi, " A Low Cost Smart Shopping Facilitator for Visually Impaired" 2013 International Conference on Advances in Computing, Communications and Informatics, Aug 2013.
11. Ki-Sung Hong, Hyoung Joong Kim, Chulung Lee, "Automated Grocery Ordering System for Smart Home" Future Generation Communication and Networking (FGCN 2007), Dec 2007.
12. Ray Y Zhong, "Analysis of RFID Data Sets for Smart Manufacturing Shop Floors" 2018 IEEE 15th International Conference on Networking, Sensing and Control (ICNSC), March 2018.
13. Yerlan Berdaliyev, Alex Pappachen James , , "RFID Cloud Cart System" 2016 International Conference on Advances in Computing, Jaipur, India, Sept 2016.
14. Ramneek Kalra, Kamal Kumar, Shivani Batra, Namrata, Hmr institute of technology, "Smart Market: A Step Towards Digital India" 2017 International Conference on Computing and Communication Technologies for Smart Nation, Oct 2017.
15. Xin Su, Rongzhi Gu, Can Qi, Xuewu Zhang, Dong Min Choi, "Interest Degree of Product Analysis by RFID Technology for Offline Shops Marketing Optimization" 2016 IEEE Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC), Oct 2016.

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