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A STUDY ON IOT ENABLED SMART STORE

Ramesh S Nayak[1], Shreenivas Pai N[2], Akshay Nayak[3], Akhil Simha N[4*]

[1]*IS&E Dept, Canara engineering College, Benjanapadavu, Mangalore, INDIA*
[2]*ECE Dept, M. S. Ramaiah Institute of Technology, Bangalore, INDIA*
[3]*ISE Dept, M. S. Ramaiah Institute of Technology, Bangalore, INDIA*
[4]*EIE Dept, M. S. Ramaiah Institute of Technology, Bangalore, INDIA*

ABSTRACT

Most often, the store owners face the problems of refilling the stock in the store sporadically. In this paper, we present a feasibility study that leverages the Internet of Things (IoT) technology to make a store "smart". The ideology of the smart store is to notify the Store Owner about the stock and various other requirements through an application in their phone, which are explained in detail. This enables the Store owner to notify his supplier to refill the stock. From the supplier end, the supplier will get a message regarding the stock fulfillment. Customers can search their required products in the mobile application, select the product, quantity, delivery option, location etc. The app shows the user about the current status of the store (store is open or closed), the quantity available in the store and other details. Further development of this approach could lead to a complete change in our day-to-day shopping experience. The manuscript not only aims the idea of e-commerce but also includes the idea that can be implemented if the customer visits the store and the idea of smart trolley. The Smart Trolley includes indoor positioning system and other additional features.

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***Corresponding author: Email:** akhilsimha1059@gmail.com Tel: +91-9916913776

INTRODUCTION

An Recent advancement in the technology has led everything in this world to go and connect to the Internet. The internet of things (IoT) is the novel paradigm which has rapidly spread in the scenario of the emerging modern wireless communication [1]. Unquestionably, the main strength of the IoT idea is the high impact it will have on several aspects of everyday-life and behavior of potential users [2]. Supermarkets have been self-serving, where the shoppers select their required items and proceed towards the billing counters. In this Smart Store concept, we present how Internet can help the Store Owner and also to the customer to access various features of the store from just an application.

With little to none assistance, locating the shopping items in a big, sometimes mazelike, store can be very time-consuming, physically exhaustive and mentally frustrating [3]. The idea of supermarket combined with the internet facility is called as Smart Store. It uses the data that is being collected in cloud via Internet to perform the necessary analysis of the demand and need in the store. Refilling of the stock in the smart store is done with the help of Smart Shelf, which is concept of Smart Trolley. Other features may also be added.

Figure-1 shows the connection between the three main members who are associated with the store; the dealer or the factory representative, the store owner and the customer or shopper.

Fig: 1. Connections

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The paper presents the idea of Smart Store from three people's viewpoint and how Internet will help each one of them. This paper also includes the idea of implementing smart trolley in the stores.

STORE OWNER

The Store Owner will be provided with an app, where he will be notified about the location/place of the product in the store and its details such as quantity, cost, demand, expiry date, etc. A brief description has been provided in the following sections:

Stock Refilling Notification

In the current situation, the Store Owner has to manually check the stock and notify the dealer or the factory representative for the need of stock. But in a Smart Store, a Smart Weighing Scale is used to measure the weight of the products in a Smart Shelf. The complete weight of an individual shelf gives the total weight of the products, while dividing them with an individual product weight will give the total quantity available.
Total / Individual = Number
Total: Total weight of the shelf including the product
Individual: Weight of the individual product
Number: Number of Product left in the stock.

Every product has a certain weight, which can be measured. For certain products the weight may be low, so a precision Smart Scale has to be utilized. The Smart Scale is connected to the cloud service via Wi-Fi, enabling it to automatically update the quantity in the store as well as the app. If the quantity in the shelf reaches a minimum threshold the owner gets the notification about the stock requirement.

Smart Shelf consists of Smart Weighing Scale. It is connected to the Internet via Wi-Fi. The shelf generally consists of three rows. Third Row is for the stack (case) of products.

Fig: 2. Smart Shelf

RELATED WORK

As If the customer wants to buy a complete set of the individual product, then he can select the box from this shelf. Second Row is for the individual products, which may be picked by the customer. First Row is for the products, which are about to reach the expiry date. Owner of the store may put a discount on these items. The Smart Scale measures the weight of each shelf.

Analytics

As the quantity of the shelfis are available, the same date is updated in the cloud-based service via Internet. An algorithm is written to notify the owner about the most demanding product and non-demanding product. If a product is of more demand, then the shelf has to be always filled with product. In order to achieve this, lower threshold to notify about the requirement has to be raised up. If the stock is not in demand, the owner should be able to put a discount on the product to make sure that the product continues to be in the sale.

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Expiry Date Notification

When the dealer delivers the product to the store, the owner can scan the barcode present on it and enter the details regarding the product on the cloud. This will include the expiry date of the product also. If the product present in the shelf is about to reach the expiry date, the owner gets a notification regarding the date. Then the owner can shift the product to the First Row and apply some discount in order to attract the customer to buy the product.

Product Location

As the smart scale used in the system is connected to the Internet, it can also be utilized to locate the product in the store. Inside the store, facility is also provided in the trolley to locate the product. The consumer can also locate the product in the nearby store by using the app in their smartphone.

Information Terminal can be placed at various places of the store to avail the location of a product if the customer/user is not having smartphone.

CONSUMER

The consumer will be provided with the app of all the smart stores registered. The consumer can open the app and search for his required product. If the customer specifies the name of the brand, other details then the product will be displayed directly on the smart phone screen. If a general name is mentioned, then all the relevant products will be displayed. User then needs to enter the quantity required which will then filter all the stores nearby with the quantity available. The app will also be able to display whether the store is open or closed depending on the response sent by Smart Door of the shop connected to the cloud via Wi-Fi network. If there are many stores available with the requirement, the consumer will be asked to select the store or the product depending on their convenience.

After this the consumer can continue shopping or go for the payment screen, depending on the needs. Finally, the user need to opt for delivery options such as home delivery or pickup from the store.

In an outdoor environment, the Global Positioning System (GPS) works efficiently in positioning and targeting different types of entities [4]. The app and sore is GPS enabled, which will automatically help both the customer and the store to locate each other.

DEALERS

Dealer will receive request orders from the associated stores. If there is any change in cost of any of the commodity, a cross check message is sent to the store owner. After confirmation of the order and payment, the app shows the nearest route to deliver the goods to the stores office using the GPS technology. A confirmation message will be sent to both dealer and Store Owner after the delivery is successful.

SMART TROLLEY

Almost every customer uses a trolley. In order to reduce the time, the customer just has to scan the product in the trolley using the barcode scanner provided. It also consists of a small display screen where various details regarding the store or the product will be displayed.

In-Store mapping system can be utilized using the Display screen present in the trolley. The Indoor Positioning system automatically locate the store items and send the location information to the display screen of the trolley via cloud networking.

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Fig: 3. Smart Trolley

The working of the smart trolley has been explained in detail below:

- The customers take a trolley and enter the shopping area. The trolley gets registered at the owner's desk.
- When the customer selects a product, they need to scan the barcode using the barcode scanner present in the trolley, which is connected, to the cloud.
- As soon as the product gets added, the trolley compares the weight of the goods present in trolley with the database present in the cloud.
- The display screen enables the customer to see all the products that are added in the trolley.
- After the completion of shopping, the customer can then push the trolley to the exit zone of the store and can swipe their bankcard using the Swiping machine, which can also be added next to the display screen in the trolley.

If any customer enters the billing zone of the store and the weight of the trolley doesn't match with the products list in the screen, a notification to the security will be sent, where the security can take the necessary action.

IMPLEMENTATION

The web technologies have since enabled the fusion of digital and real worlds by providing a simple yet intuitive platform to interact with cloud services and virtual reality platforms [5]. The basic architecture of the system is presented in the **Figure–4**.

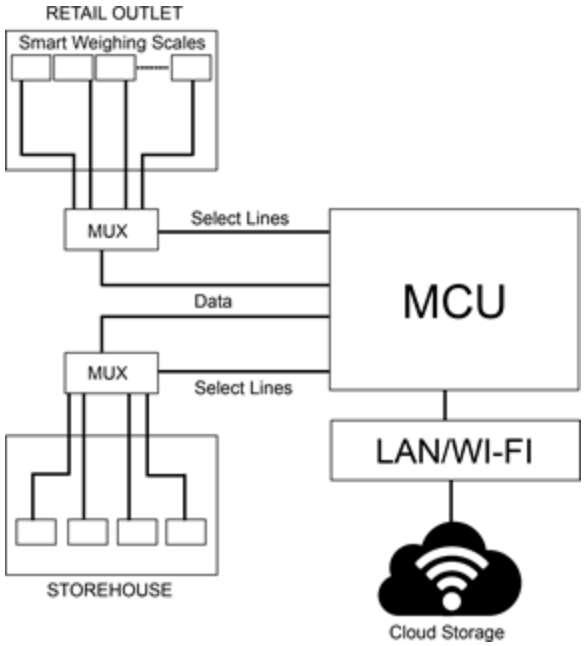

Fig: 4. Architecture

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Fig: 5. Basic template of an application.

The idea involves the usage of a simple microcontroller (such as TI SimpleLink Wi-Fi CC3200 LaunchPad) which requires less power and is easily available [6]. A rectenna for the harvesting of electromagnetic energy associated to the European RFID band has been utilized [7]. The MCU should be able to access the Internet at every point of the time. Data acquisition is to collect data by sensors or other measurement equipment [8]. The microcontroller should be capable of updating the data in the Cloud storage via a LAN or Wi-Fi network. Smart Weighing scale is connected in the similar manner to the internet.

Application differs accordingly with the kinds of user interfaces. It consists of three modules, one for the customer, one for the Store Owner and other for dealer. The app is equipped with GPS in order to trace the location of the customer. A separate login id will be provided to various users, like owner, dealer and the customer.

RESULTS

The 89V51 microcontroller is used in the system. The trolley contains a barcode scanner for billing purpose. The microcontroller is connected to the barcode scanner using MAX232IC. An on-board ultra-low-power MCU manages the sensor data sampling and the wireless communication by means of a new generation UHF I2C-RFID chip whose EPC code is dynamically updated with actual sensor measurements [9]. There is a quantity mismatch detector which is 38 KHz IR trans-receiver. The cost of the product and quantity is displayed using LCD display. Any product chosen by the customer need to be scanned by the bar coder in the trolley. After scanning the barcode, customer do have the option to delete the item/product from the list. A quantity mismatch will occur if the product purchased is directly kept in the trolley rather than scanning the barcode.

The system is tested in the super bazar store and experiments are conducted for number of items/products. The system found to be functioning satisfactorily.

ADVANTAGES OF THE PROPOSED SYSTEM

- The implementation of this idea will reduce a lot of human efforts and human intervention as well.
- In the proposed system shop owner need not be concerned about the demand and supply balance of the store as the data regarding the product gets updated in the cloud.
- Shop owner need not be concerned about the stock coming and going out as all the updated details are available in the cloud at any moment.
- Customers can access the real time information of the store and the products available in it.

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- With help of this app, the dealer or the factory representative gets an efficient way of collecting different data of the product from the registered stores and supply the goods when needed or on demand.
- The customer need not wait in the queue for billing. The bill is automatically generated as the Smart Trolley is enabled with a barcode reader.

CONCLUSION

Many applications are proposed having online facility with various stores and other details, but none of them provides the facility to search the product in the current and nearby stores. This paper presents a novel approach for smart shopping along with Smart Scale which incorporates the idea of Smart Trolley. The app is very helpful in saving precious time. The idea has the feasibility and advancement that can be done in a normal store to enhance it to a Smart Store.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

FINANCIAL DISCLOSURE

No financial support received to carry out this research.

REFERENCES

[1] Asghar MH, Mohammadzadeh N, Negi A. [2015] Principle application and vision in Internet of Things (IoT), in Computing, Communication & Automation (ICCCA), 2015 International Conference on, vol., no., pp.427–431, 15–16 May.

[2] Luigi Atzori, Antonio Iera, Giacomo Morabito [2010] The Internet of Things: A survey, Computer Networks, Volume 54, Issue 15, 28 October 2010, Pages 2787–2805, ISSN 1389-1286.

[3] Hicks D, Mannix K, Bowles HM, Gao B J. [2015] SmartMart: IoT-based In-store mapping for mobile devices, in Collaborative Computing: Networking, Applications and Worksharing (Collaboratecom), 2013 9th International Conference on , vol., no., pp.616-621, 20-23 Oct.

[4] Al Nuaimi, K Kamel, H. [2011] "A survey of indoor positioning systems and algorithms," in Innovations in Information Technology (IIT), 2011 International Conference on, vol., no., pp.185–190, 25–27 April

[5] Pereira PP, Jens E, Rumen K, Jerker D, Asma R, Mia J. [2013] Enabling cloud connectivity for mobile internet of things applications. In: Proceeding of the IEEE 7th international symposium on service oriented system engineering (SOSE), pp 518–526.

[6] Asghar MH, Mohammad zadeh N, Negi A. [2015] Principle application and vision in Internet of Things (IoT), in Computing, Communication & Automation (ICCCA), 2015 International Conference on, vol., no., pp.427–431, 15–16 May.

[7] Hicks D, Mannix K, Bowles H M, Gao B J. [2015] SmartMart: IoT-based In-store mapping for mobile devices, in 9th International Conference on Collaborative Computing: Networking, Applications and Worksharing (Collaboratecom), vol., no., pp.616-621, 20-23 Oct. 2013.

[8] Al Nuaimi, K Kamel, H. [2011] "A survey of indoor positioning systems and algorithms," in Innovations in Information Technology (IIT), 2011 International Conference on, vol., no., pp.185–190, 25–27 April

[9] Luigi Atzori, Antonio Iera, Giacomo Morabito.[2010] The Internet of Things: A survey, Computer Networks, Volume 54, Issue 15, 28 October 2010, Pages 2787–2805, ISSN 1389-1286.

ABOUT AUTHORS

Prof. Ramesh Nayak *is currently working as associate professor in Canara Engineering College, Benjanapadavu, Mangaluru, Karnataka, India. He is currently faculty in the department of Information Science and Engineering. He received his M.Tech degree from University of Mysore, Mysore, India. He is pursuing PhD in image processing. His research interest includes Image processing, Data Mining, Computer Networks. He has teaching experience of 14 years and research experience of 3 years. He has published research papers in national, International conferences and Journals.*

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Shreenivas Pai *is currently an engineering student of Electronics and Communication at M.S.Ramaiah Institute of Technology, Bangalore. Karnataka, INDIA.*

Akshay Nayak *is currently an engineering student of Information Science and Engineering at M.S.Ramaiah Institute of Technology, Bangalore, Karnataka, INDIA.*

Akhil Simha *N is currently an engineering student of Electronics and Instrumentation at M.S.Ramaiah Institute of Technology, Bangalore, Karnataka, INDIA.*