

# SMART BILLING SYSTEM FOR SHOPPING AUTOMATION USING IOT

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**Abstract-** The Internet of Things (IoT) is changing human lives by connecting everyday objects together. For example, in a grocery store all items can be connected with each other, forming a smart shopping system. In such an IoT system, an inexpensive RFID tag can be attached to each product which, when placed into a smart shopping cart, can be automatically read by a cart equipped with an RFID reader. As a result, billing can be conducted from the shopping cart itself, preventing customers from waiting in a long queue at checkout. Additionally, smart shelving can be added into this system, equipped with RFID readers, and can monitor stock, perhaps also updating a central server. Another benefit of this kind of system is that inventory management becomes much easier, as all items can be automatically read by an RFID reader instead of manually scanned by a laborer. To validate the feasibility of such a system, in this work we identify the design requirements of a smart shopping system, build a prototype system to test functionality, and design a secure communication protocol to make the system practical. To the best of our knowledge, this is the first time a smart shopping system is proposed with security under consideration.

## I. INTRODUCTION

The Internet of Things may be a hot topic in the industry but it's not a new concept. In the early 2000's, Kevin Ashton was laying the groundwork for what would become the Internet of Things (IOT) at MIT's Auto ID lab [1]. Ashton was one of the pioneers who conceived this nation as he searched for

ways that Proctor & Gamble could improve its business by linking RFID information to the Internet [2]. The concept was simple but powerful. If all objects in daily life were equipped with identifiers and wireless connectivity, these objects could be communicating with each other and be managed by computers. In a 1999 article for the RFID Journal Ashton wrote :

“If we had computers that knew everything there was to know about things using data they gathered without any help from us we would be able to track and count everything, and greatly reduce waste, loss and cost [3-7]. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory. RFID and sensor technology enable computers to observe identify and understand the world without the limitations of human entered data.”

At the time, this vision required major technology improvements. After all, how would we connect everything on the planet? What type of wireless communications could be built into devices? What changes would need to be made to the existing Internet infrastructure to support billions of new devices communicating? What would power these devices? What must be developed to make the solutions cost effective? There were more questions than answers to the IOT concepts in 1999. Today, many of these obstacles have been solved. The size and cost of wireless radios has dropped tremendously. IPv6 allows us to assign a communications

address to billions of devices [8-13]. Electronics companies are building Wi-Fi and cellular wireless connectivity into a wide range of devices. ABI Research estimates over five billion wireless chips will ship in 2013.2 Mobile data coverage has improved significantly with many networks offering broadband speeds. While not perfect, battery technology has improved and solar recharging has been built into numerous devices. There will be billions of objects connecting to the network with the next several years. For example, Cisco's Internet of Things Group (IOTG) predicts there will be over 50 billion connected devices by 2020.

Shopping mall, which is a retail business, assume an imperative part in India's financial improvement, there are still a few issues in its stock administration, grocery store stores, settlement and different angles, genuinely confining the intensity of ventures. Shopping mall is a place where people get their daily necessities ranging from food products, clothing, electrical appliances etc [14]. Sometimes customers have problems regarding the incomplete information about the product on sale and waste of unnecessary time at the billing counters. Continuous improvement is required in the traditional billing system to improve the quality of shopping experience to the customers. Now day's numbers of large as well as small shopping malls has increased throughout the global due to increasing public demand & spending. At the time of festivals, special discounts, holidays, etc. there is a huge rush in shopping malls. The use barcode reading technique in such situations always results in waste time since customer has to wait till whole items get scanned. These advantages can be avoided by using IOT based intelligent trolley proposed in this paper. This system uses RFID technique instead of barcode. Proposed system uses separate RFID reader for each trolley and RFID Tag for each product. When customer buys any product RFID reader reads the tag which is present on the product. The cost of product and the total bill of shopping items can be

displayed on LCD. IOT based intelligent trolley presented here is easy to use and does not requires the special training to customers. RFID technique has many advantages over barcode systems. RFID reader reads the tag from a distance of 300 feet whereas barcode can read the information at distance not greater than 15 feet. Also the barcode need one site of propagation. Reading frequency of barcode reads is only two tags whereas reading frequency of RFID is 40 tags. So the use of RFID is more useful than traditional barcode reading technique. Here use of RFID is helpful for customer. Using this system, customer will have the information about price of every item that are scanned in, total price of the item and also brief about the product. So use of this IOT based intelligent trolley for shopping malls is helpful for customer as well as owners.

## II. LITERATURE WORK

Udita Gangwal *et al.* (2017) described a prototype has been made based on the the idea of barcode scanner .The prototype uses a camera-based barcode scanner for implementation, which uses a small video camera to capture an image of the barcode and then use sophisticated Image Processing techniques to decode the barcode. We have used a webcam for this purpose, which is supposed to be fixed at the top, facing the slab attached to the cart. Limitation: they had used barcode scanners which have problem in scanning [15].

Sagar Sojitra *et al.* (2016) proposed the idea to decoding the QR codes, thereby launching a URL in the web browser. This is because in today's retail environment, products come with label tags for unique identification and theft protection. Novelty underlies in the idea of linking retail item identifiers to network application. This also helps in exposing the customers to rather detailed information regarding the product to be purchased. This in turn gives rise to in-store marketing and access to information. The impact of IOT comes in the case of mobile payment where by enabling NFC, one may get access to

systems and virtual wallets. From a retailer's point of view this increases the convenience and simplicity these kinds of transactions are beneficial in providing opportunities for personal interaction with the customers. Limitation: They used QR scanners which have problems in scanning. The plug-in uses sensing and inbuilt wifi capabilities of the Edison board to connect to cloud this is cloud enabled solution which helps in remote monitoring system. Limitations: having some problem if the cloud server is low

Sharaddha in her paper stated that Each trolley is attached with product identification device through zigbee communication pid device sends its information to automated central billing system where net price is calculated but the data is stored in the cloud Komal ambekar in her paper stated that Each trolley is attached with product identification device through zigbee communication pid device sends its information to automated central billing system where net price is calculated the main drawback of this process is it needs an android device.

Mr. P. Chandrasekar Ms. T. Sangeetha main aim of the authors in this paper was to devise a system with automatic billing. This avoids the long queues in supermarkets and shopping malls. The use of Radio has been proposed in this work. This paper proposes a centralized, feasible and automated system for billing using RFID and ZigBee communication. This requires assigning an RFID tag to each and every product of super markets. This will enable its unique identification. Each shopping cart containing components like microcontroller, an RFID reader, EEPROM, LCD and ZigBee module, is designed with a Product Identification Device (PID). RFID reader enables reading product information associated with the product being purchased. Meanwhile, EEPROM stores the product information attached to it and the data is sent to Central System for billing via ZigBee module. Central system gets access to information like the cart and EEPROM data, thereby allowing easy calculation of payment amount.

The following points were noted in this research paper:

- Limitation 1: In this paper I found out that microcontroller they are using does not support I2c protocol
- Limitation 2: Authors didn't specify that how they will access their database to read and write data.

Apart from this, the system can be modified as per requirement to develop a complete working prototype.

Dylan Hicks et Al had presented a feasibility study for incorporating smartness, in products or items found in retail stores. Internet of Things (IOT) technology will prove helpful for this by enabling these items to automatically register and update their location information in a retrieval system. This will allow the customers to search, map and locate the products on the store floor using their mobile phones. A freely accessible Android based mobile app named 'SmartArt' has been developed to demonstrate the promise of this preliminary work.

- Limitation 1: This paper provides brief view on how we can create map dictionary of product placed in the store. But does not provide any access to object or billing.
- Limitation 2: There is no any solution provided on how to read product localization using RFID.

The research carried out in this paper will be helpful in developing a better application by adding personalized searching options feature to the proposed design.

Pascal Urien Selwyn Piramuthu has considered the identification and communication technologies as well as their advances. RFID (Radio Frequency Identification), smart phones, real-time response, and automated checkout systems have been considered in devising an NFC equipped smart phone. LLCPS protocol has been used as an envelope in order to establish communication between the Smartphone and the NFC reader, A suite of authentication protocols i.e. SISO has been developed for secure processing of payment in a retail store.

- This paper provide better light on secure transaction between two devices, which uses NFC for secure transaction.

- LLCPS provide better security to authenticate transaction between to device which uses P2P protocol for communication. Rong Chen, Li Peng, Yi Qin in their research paper, the authors have undertaken the issue of product identification in shopping malls and supermarket. It has been accomplished by using electronic tags along with wire-less communication and Internet of Things. The proposed system has been designed keeping the consumer's convenience in mind. A combination of RFID and ZigBee technology has been presented successfully. The system is targeted at reducing the queuing up and wastage of time in supermarkets as a result of product searching and bill payment. Thus using the above-mentioned technologies, an automated list will be generated as per the shopping requirements of the consumer by automatically updating the true product information. Thus, the design of Internet of things Supermarket Shopping guide system has been proposed. The benefits like facilitating people's shopping experience, time management, greater efficiency will be derived on completion and evaluation of this research paper. Also, this design will make the supermarket 'smarter' thereby promoting business sales.

- Limitation: Expense for electronic tags, formulation of regulations for IOT applications, security constraints.

Irene Cappiello Stefano Puglia Andrea Vitaletti authors have presented a ubiquitous touch based remote grocery shopping process. This fits well with the advantages and characteristics of RFID as well as NFC. Design and implementation of prototype system software is proposed to test the process of customer's touch based approach. Evaluation of the process has been carried out in an initial study on a group of 5 customers, comprising of trained as well as non-trained computer users. The shopping was carried out with an NFC equipped mobile phone for various RFID tagged items. Average completion of time was estimated to

be 40 seconds while the error rate was calculated to be quite low. Qualitative study disclosed that the percentage of users that considered the web-based approach to be more convenient was much higher than the other ones.

The approach undertaken by the author was quite successful but following limitations has to be considered:

- Limitation 1: This research paper is mainly focused on comparison between web based shop-ping experience and in-house shopping experience

- Limitation 2: There is no any hardware model proposed in this paper, which can be in application.

Based on the study in this paper, a working prototype needs to be designed. The benefits and percent-age acceptance rates of the technology have already been estimated to be far beyond the acceptance level. Hence, the next step will be practical implantation of the concept in working reality.

### III. PROBLEM STATEMENT

At the time of festival or special offers there is a huge rush in mall customers waste a lot of time at the billing counter to overcome this disadvantage different techniques are developed among some of them I had found some problems which are stated below:

- Some of them used barcode scanners which have problems in scanning these wont scan even if we had a small scratch on the bar code

- Some of them used QR scanners which have problems in scanning

- Some of them used cloud data to store the information they faced a problem when the cloud server is slow

- Most of them didn't include the stock management system

- Some doesn't provide access to billing.

#### IV. OBJECTIVES

The proposed system objectives are

- To make smart INDIA by avoiding long queues in shopping malls and to consume time.
- To use less power technologies and less expensive devices and fast communication wifi modules.
- And the customers also should understand the process easily to do shopping in a easyway.

#### V. PROPOSED SYSTEM

In this paper, we focus on a smart shopping system based on Radio Frequency Identification (RFID) technology, which has not been well-studied in the past. In such a system, all items for sale are attached with an RFID tag, so that they can be tracked by any device equipped with an RFID reader in the store - for example, a smart shelf. Intuitively this brings the following benefits:

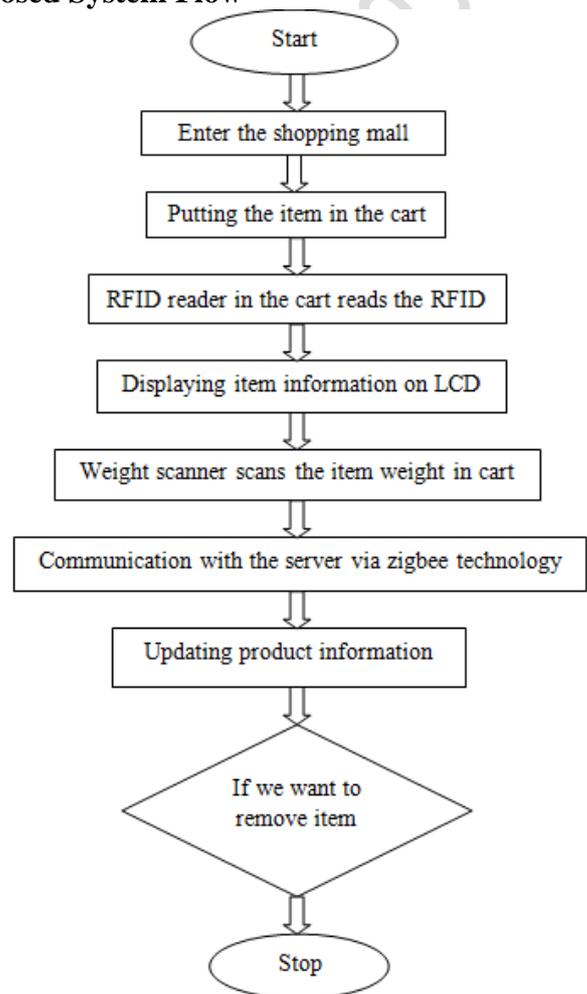
- Items put into a smart shopping cart (with RFID reading capability) can be automatically read and the billing information can also be generated on the smart cart. As a result, customers do not need to wait in long queues at checkout.
- Smart shelves that are also equipped with RFID readers are able to monitor all stocked items and send item status updates to the server. When items become sold out, the server can notify employees to restock.
- It becomes easy for the store to do inventory management as all items can be automatically read and easily logged.

We propose the use of ultra high frequency (UHF) RFID technology in the smart shopping system, as UHF passive tags have a longer range, from 1 to 12 meters. Previous research on the design of smart shopping systems mainly focused on using low/high frequency RFID, which have inadequate ranges, and leave customers to manually scan items with a RFID scanner .In our proposed system, each smart cart is equipped with a UHF RFID reader, a micro controller, an LCD touch screen, a Zig-Bee adapter, The

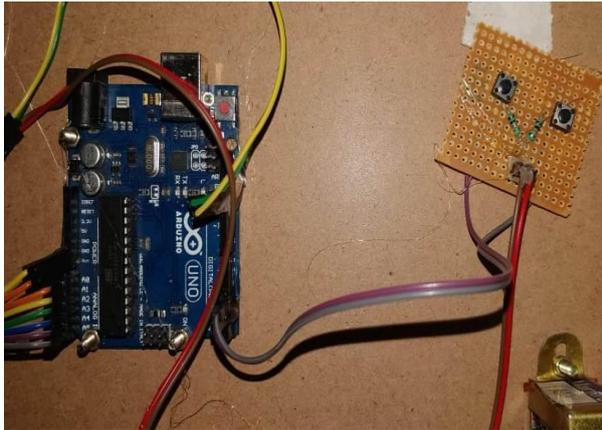
smart cart is able to automatically read the items put into a cart via the RFID reader. A micro controller is installed on the cart for data processing and a LCD touch screen is equipped as the user interface. In order for the smart cart to communicate with the server, we have chosen Zig-Bee technology as it is low-power and inexpensive

#### VI. SYSTEM DESIGN

##### Proposed System Flow

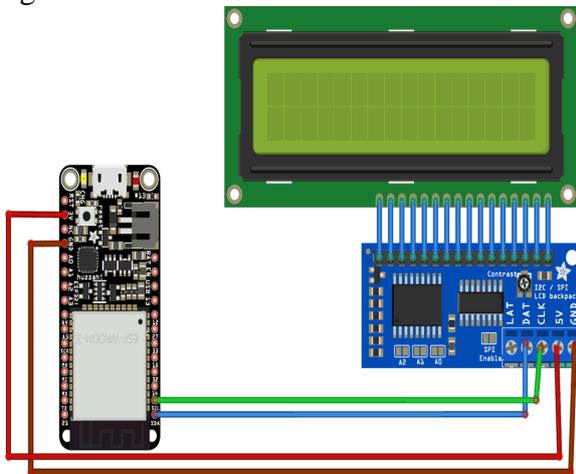


**Fig.1: Flow Chart**

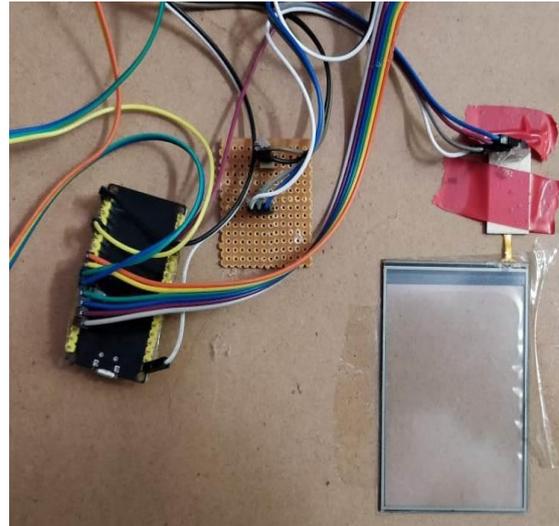


**Fig.2: Interfacing Arduino UNO with the Selection Buttons**

I2C protocol is used for interfacing ESP32 Microcontroller with the LCD display Unit. It is the ‘two-wire interface’ used for connecting the devices which are slow in speed such as EEPROMs, Analog to Digital Converters and vice versa. ESP32 microcontroller can be connected to the LCD Display Unit using this protocol as shown in figure.

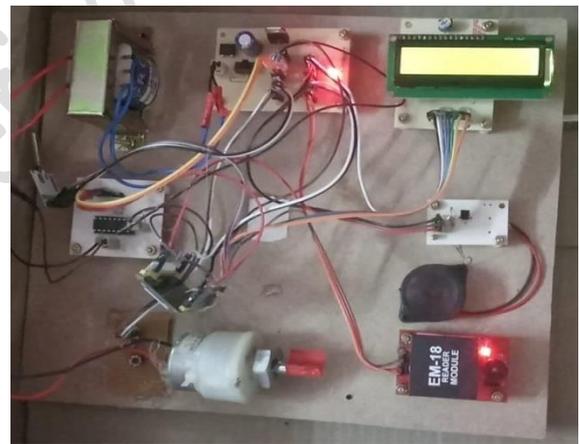


**Fig.3: Interfacing ESP32 with LCD Display Unit Using I2C**



**Fig.4: ESP32 interfaced with the touch screen display**

## VII. RESULTS



**Fig.5: Hardware setup**



**Fig.6: Billing on LCD**

## VIII. CONCLUSION

In this paper, we propose a secure smart shopping system utilizing RFID technology. This is the first time that UHF RFID is employed in enhancing shopping experiences and security issues are discussed in the context of a smart shopping system. We detail the design of a complete system and build a prototype to test its functions. We also design a secure communication protocol and present security analysis and performance evaluations.

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