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Iot Based Secure Smart Shopping System

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Abstract

In today's society, buying at supermarkets is on the rise. Trolleys are used to transport the object. After they've finished shopping, they head to the billing counter, where they wait in a long line due of the current barcode technology. A method based on RFID technology has been developed to cut down on this wait time. RFID tags are affixed to each item in the system, and an RFID reader reads the tag information when the trolley is inserted into the system. then the entire price paid for each item is sent to the main billing server, which then calculates the bill for display on a trolley-mounted LCD display. We're also developing an Android app for controlling the movement of the trolleys in conjunction with this system. Using the Trolley number and the total quantity of things purchased, the application is generated.

Keywords: Internet of Things (IoT), Radio Frequency Identification (RFID), Zigbee Technology, android.

1. Introduction

Physical items are connected to a network of embedded systems, sensors, networks, and software through the Internet of Things (IOT), which allows them to gather and exchange data for a common aim. Computing power and communication capabilities are increasingly built into everyday things, allowing them to connect with one other. New issues in data management, wireless communications, and real-time decision-making have arisen as a result of this new industrial, financial, and environmental revolution. Many security and privacy concerns have arisen, and lightweight cryptographic approaches are in great demand for IoT applications, as well. Various applications of IoT, such as smart homes, e-health systems, wearable gadgets, have been studied extensively. Radio Frequency Identification (RFID) technology is the topic of this work, which has not been extensively researched in the past. RFID tags are connected to every item for sale in such a system so that they may be monitored by any device equipped with an RFID reader in the store—for example, a smart shelf. The store's inventory management becomes a breeze because all goods may be scanned and documented at the press of a button. Smart retail systems might benefit from using ultra high frequency (UHF) RFID technology, which has a range of up to 12 metres.

1.1 Existing System

Customers must manually scan things with RFID scanners because of previous research on the design of smart retail systems, which mostly focused on low/high frequency RFID with inadequate ranges. To control product quality and quantity in a supermarket, humans are currently used. Manual errors may arise as a result. E-commerce, which has grown rapidly in recent years and now accounts for the vast majority of all financial transactions, is also studied in the literature to better understand current payment methods for online shopping carts. In the last two decades, the internet and mobile phone use has revolutionised both personal and corporate communication. As a result of this shift, the term E-commerce has been coined. In order for e-commerce to succeed, it must rely on the internet and the mobile phone revolution. Fig.1 depicts internet usage numbers from 1980 to 2030. As can be seen from the graph, the proportion of Indians who use the internet compared to the country's total population is rather high.

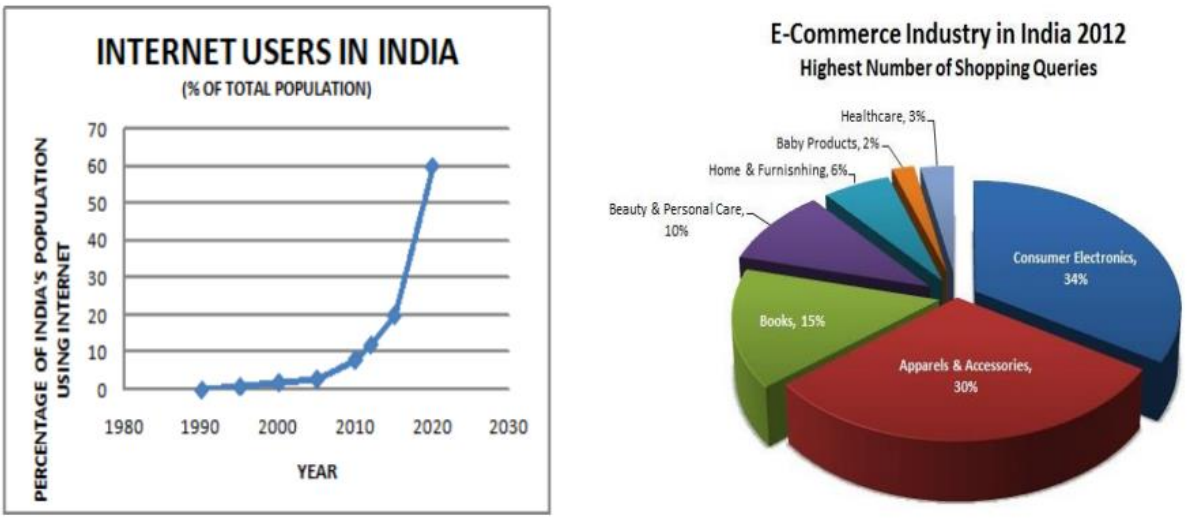

Fig.1. Internet users in India

E-commerce is a form of online shopping. For the most part, the internet serves as a virtual marketplace where buyers and sellers may connect and transact for the acquisition of products and services. According to fig.2, "E-commerce" evolved as a result of the globalisation of trade by making boundaryless trade-offs between sellers and buyers. A virtual shopping cart is created for the customer once an order is placed in the system. All relevant taxes and shipping and handling costs are included in once an item has been selected [4]. To sum it up, we've just introduced the world to the concept of the "smart shopping cart." An effort has been made to improve the application for all end users via this engagement and innovation. Hardware employed in the contemporary smart electronic cart has been surveyed in the literature. The majority of shopping cart teams have incorporated online payment methods such as credit/debit card, internet banking, wallet payment, and point-of-sale (POS) (Point of sale machine). Cash-on-delivery was advocated by a few of them. As a part of this project, I contributed to the development of a novel Cash on Delivery (COD) technique. As a reference, here's a breakdown of the cash-on-delivery method:

Cash on Delivery (COD) is the most popular mode of payment among customers in today's online buying sector (COD). Merchants offer customers the option of having their purchases delivered directly to their doorstep when they place an order. Only when the goods is delivered to the consumer must they pay for it. Cash on delivery's key selling point is that customers don't have to be concerned about whether or not their purchased item will arrive on time, and they also don't have to keep track of where it is going since they won't lose any money if it does not. It is a simple approach to use after the goods is at the customer's doorstep; all they have to do is hand over the money and get their hands on what they want. COD is still the most popular mode of payment for online shopping applications throughout the world because of its many advantages. A great deal of attention and study has been devoted to how online shoppers might pay for delivery services. Cash on Delivery (COD) or a Point of Sale terminal are the most popular options for clients nowadays (POS).

As a result, the following are the main downsides of COD: Due to the risk of theft, misuse, fabrication, or destruction of financial documents, the fundamental disadvantage is that no

initial records can be produced when dealing with cash. Customers may think this payment option is straightforward and easy to use, but it comes with a high level of danger when dealing with cash. There is a substantial chance of acquiring counterfeit notes, which are not easily seen by sales representatives at the point of sale. At the moment of delivery, the client and the sales representative both confront a tough task: providing the correct amount by tendering the precise change. This might result in losses for both parties. When you have cash on you, you run the danger of becoming a victim of fraud or having it stolen, lost, or otherwise mishandled.

Fig.2. Evolution of Commerce

At the time of delivery, a point of sale (POS) machine and terminal were installed to address these issues. Customers' shopping carts have changed dramatically after the installation of a POS machine that accepts cash at the moment of delivery. The adoption of a point-of-sale (POS) system eliminates the danger of carrying cash, challenges with correct change, and the return of items owing to a lack of cash. There were several concerns that were dealt with by the POS system, which made it easier for the end user to be comfortable and generally accepted. It's a PC platform that's integrated with specialised hardware for retail service environments, such the POS terminal [5]. PC is a standard computer system, however a POS terminal is a cost-effective bespoke design that removes unnecessary functionality from the PC. The POS machine has a few limitations, which are outlined below. From the standpoint of the end user, a POS machine is beneficial. However, this approach has a plethora of flaws. Here is a list of the POS machine's problems.

How much does this thing cost? Bank provides the POS machine, and the retailer is responsible for paying all service fees and taxes associated with the unit. It's the merchant's responsibility to pay all service fees and taxes, as they are mandated by the relevant authorities. This fee is on the upper end of the scale, making it difficult for all shopping cart merchants to implement. As well as an agreement that must be signed by both the merchant and the bank in order for the latter to be held responsible for any fraudulent transactions.

Regardless of how often the POS equipment is used, the merchant must pay the bank an annual maintenance charge (AMC) every year.

It's a bit of a hassle for the delivery guy to carry around this equipment, and the cost and danger of each unit is also rather significant.

You must enable GPRS on the point of sale device in order to make internet-based payments and keep track of them with the bank's servers and card switches. GPRS machines are more expensive than non-GPRS machines. The delivery guy also has to contend with network issues. As soon as the transaction is completed, the delivery guy can go out and deliver the products based on the transaction's progress.

In light of the aforementioned drawbacks of traditional point-of-sale systems, the suggested system aims to provide an improved shopping experience for customers while still ensuring a safe and secure transaction. Since QR codes may be used to prevent fraudulent transactions and to provide a secure environment for end users, they are the ideal technology. As a trademark term, the two-dimensional barcode technology is referred to as QR codes. Denso Wave, a Toyota company, created it in 1994 to follow automobiles in the production line and rapidly scan the components. There is a patent on QR Code technology held by Denso Wave, which has granted a free licence so that anybody can use it. In comparison to 1D bar codes, QR codes are digitally scanned and can carry 100 times as much data. The image is scanned using the camera on the smartphone. In order for the system CPU to comprehend the data, the image sensor on the smartphone scans the block of tiny black-and-white squares. A new programme, known as the Mobile Bill Presentment System (MBPS), has been developed to eliminate all of these problems and save money for each transaction by replacing the POS machine at the moment of cash on delivery with a QR (Quick Response) code-based payment system, which is known as MBPS. Programming in Microsoft ASP.Net with a SQL server database may be used to create the application.

1.2 Proposed System

If we take into account security, cash handling (in COD), additional hardware requirements (in POS system), processing fee burden on merchants (in POS system), and machine transportation and maintenance (in POS system), we may eliminate many current bill payment system problems. All of these problems have prompted the development of a bill payment system that is secure and does not necessitate the use of additional technology. An RFID reader with a Zigbee adaptor and a weight sensor are all included in each smart cart in our system design. The RFID reader on the smart cart allows it to automatically read the contents of a cart. For data processing, the cart is fitted with a micro microprocessor and an LCD touch screen. We have chosen Zigbee technology (data exchange purpose) for the smart cart since it is low-power and affordable.

We have a weight scanner put on the smart cart so that we can measure the weight of our goods. We also placed an RFID reader in front of the exit door to ensure that all of the things in the cart have been purchased and paid for. Security and privacy concerns for smart commerce systems have never been studied before. This method ensures consumer pleasure by automatically checking product quality and quantity.

2. Architectural Design

2.1 System Architecture

An identifier for each product on the cart is connected (PID). An automated central billing system uses ZigBee connectivity to determine the net price of all acquired items. Customers can acquire their billing information at the billing or packaging department by providing their trolley identification number.... If a consumer pays their net bill using a debit or credit card, a cash collector is unnecessary. A ZigBee transceiver and a server/system connected to a product database make up the automated central billing system.

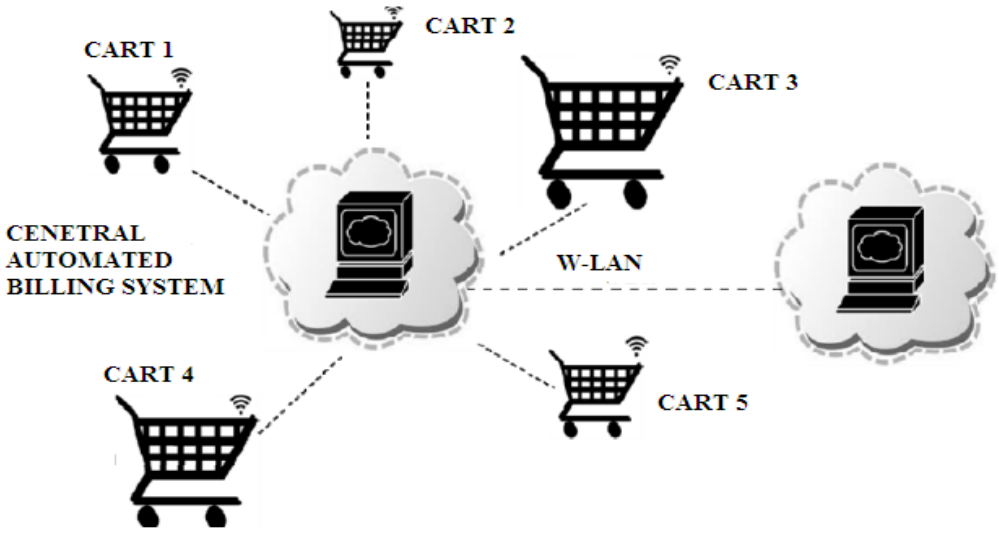

Fig.3. Central Automated Billing System product database

2.2 Hardware Architecture

Hardware components such as RFID reader, microcontroller, EEPROM memory, and Liquid crystal display are mounted to each trolley at supermarkets and malls (LCD).

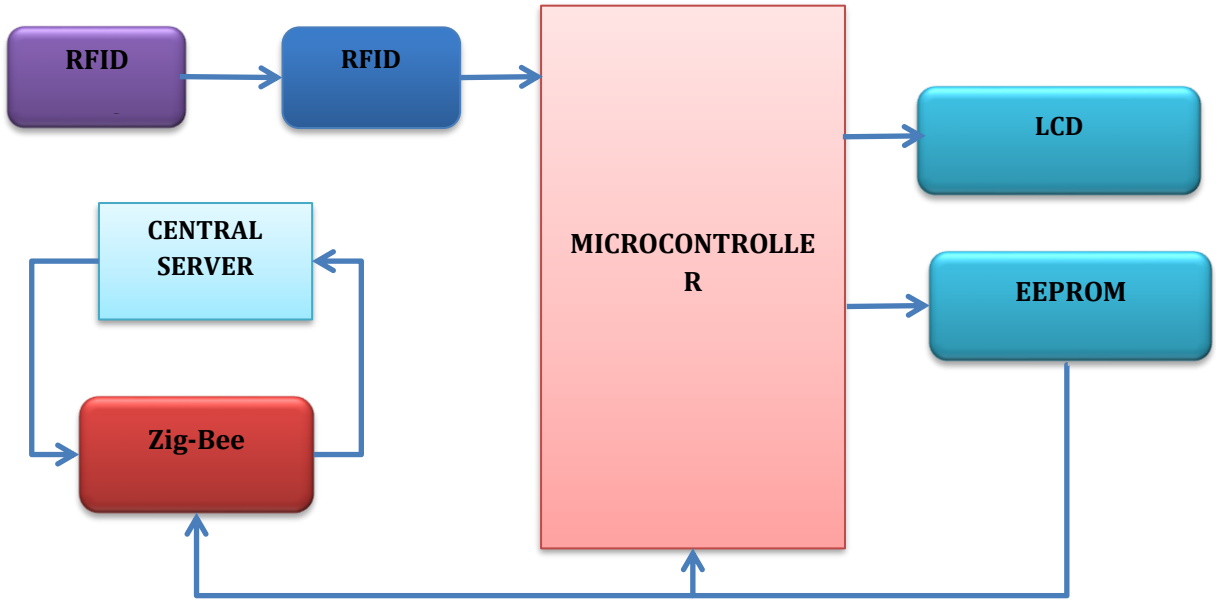

Fig. 4. Hardware architecture of system

3. System Working

All supermarket trolleys are connected to the RFID reader, microcontroller, and Zigbee device. In order for the final bill to be calculated, each trolley will communicate information about the products it contains to the billing server. We're utilising Zigbee instead of Bluetooth or Wi-Fi to relay data about each trolley. When a consumer enters the store and grabs a shopping cart, the work begins. Using an Android app, the trolley's RFID reader generates the bill. The data is read by the RFID reader and sent to the EPROM through the microcontroller when the consumer places the products in the reader. This data is relayed to the main server through Zigbee, where it is used to get the item's cost and display it on the LCD attached to the cart. During the checkout process, if the consumer wants to remove an item from the trolley, the cost of that item is deducted from the final bill. Finally, the bill is computed on the main server.

Trolley movement controller and outline map display make up the first half of the Android app. Trolley movement is controlled by an android app that is initially connected to the trolley. Customers may see on the map the general layout of the store and the locations of specific goods. As a result, the purchase is made with ease. Inventory management is simplified for the store because all things can be instantly read and readily logged on.

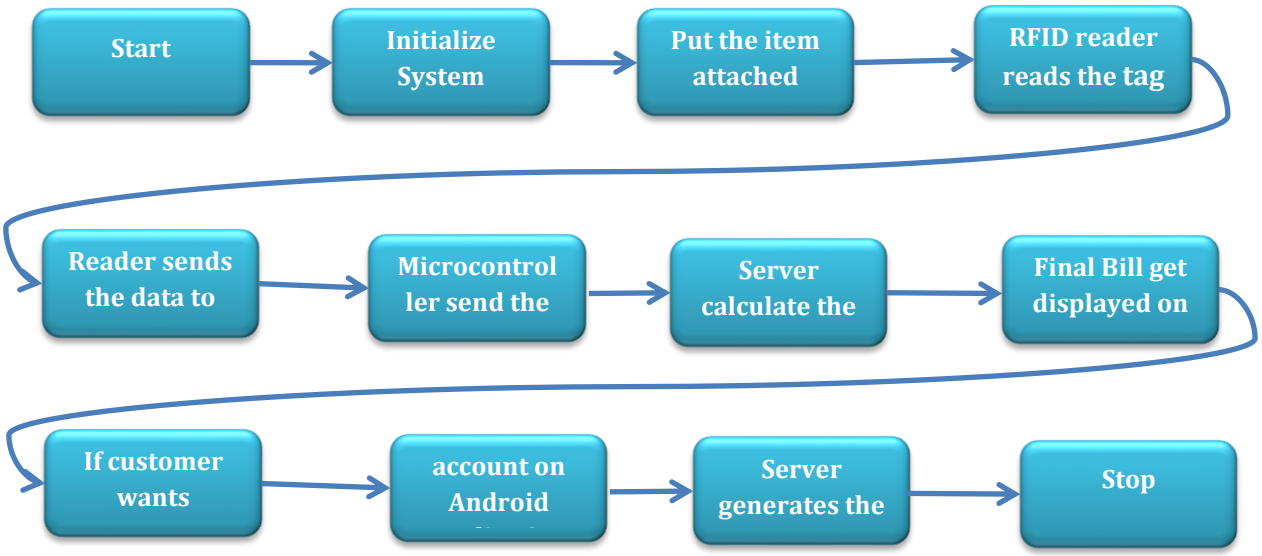

Fig. 5. Algorithm

4. Case Study

A smart job shop prototype is developed in this part, and a demonstrative case study is used to test the feasibility and efficiency of the data processing approach presented. In our Lab, we've installed an IoT-enabled smart work shop and smart warehouse. Workstations include the EMCO Mill 55 and MANIX 360 in the job shop, as well as the C56A from Xian Dao in the machine shop. IoT features are installed on each workstation according to the suggested setup strategy. Using Java/- JavaScript, MySQL, and Jquery, a web-based system is created. In addition, the job-shop is where the network and database are set up and configured. Parts that need to be manufactured are outsourced A-type shafts, which have an active RFID tag attached since they must be monitored independently during the manufacturing process. There are

around 30 different categories of data on heterogeneous manufacturing that have been gathered. We use the offered methodologies to evaluate the obtained data in order to better understand the production state of this smart job-shop.

It is important to note that when smart WIPs enter the smart jobshop, the active RFID tags in them communicate and interact with machine tools and other physical assets. A procedure may only begin if all necessary physical assets are in place and ready to go. RFID readers and antennas also capture real-time data on the movement of moving physical assets such as smart WIPs and trucks, operators, cutting-tools, and more. There are several other IoT capabilities that monitor the environment and machine condition for real-time data collection. According to the suggested production data model, these real-time production data are kept in the manufacturing database. In the third step, the real-time production data are integrated into the real-time production statuses, such as the present process and the workload of machine tools and operators, as well as the material flow. In addition, past RFID-based production data is dug to provide production-related information, knowledge, and rules that may be used for production control and decision making. The prototype system for the demonstration example is shown in four different views in Fig. 6. There are a total of six processes for shaft #A1 based on this example. The fourth procedure of #A1's manufacture is complete, and it represents 40% of the total (achieved by comparing the finished process time and the undone process time). As a result, the overall manufacturing progress for #A1 has reached 63%. Other A-type shafts' manufacturing data is also accessible. This day's workload for operator #R021 is 8 hours, 12 minutes, and 7 seconds, as determined by tracking the length of time he spends on various tasks (these data are derived from the RFID production data). He's now working on the Btype shaft's No. 3 procedure (key seat milling). The machine tool's workload is another type of workload. EMCO Mill 55 had a workload of 10 hours, 35 minutes, and 21 seconds specified on that particular day. The B-type shaft's No. 16 process (end milling) is the group's most recent assignment right now. This may also be used to monitor processes. In addition to the foregoing management implications, real-time production control is possible. Because of this, the machine tool at this workstation is unable to proceed with the next step in its process because of a data record in the database. Unexpected incidents are brought to the attention of management via a pop-up notice and full log. To locate a suitable one in accordance with the pre-set regulations and the incidence connection matrix, the smart WIP then communicates with other machine tools in the smart job shop. A new process command is then loaded into the active RFID tag on the smart WIPs package. There are a number of advantages to this kind of production control. Finally, with the use of big data analysis, certain previously unknown laws and information have been discovered. It is possible to take advantage of the distribution of various industrial processes. Xian Dao C56A, for example, performs all No. 1 procedures (end face rough turning) on A-type shafts. These two procedures (excircle rough-turning and excircle semi-finishing-turning) are carried out by Xian DaoC56A and MANIX 360 respectively. It is evident from the scheduling of these activities that these two machines have quite different capabilities. In order to achieve a harmonic production orchestration, the mined data may be used for dynamic production planning and scheduling. It is possible to extract information about transportation processes, such as vehicle loads and trajectories from the data, by looking from the transportation perspective. Vehicle #1 transports goods between the

warehouse and the smart job-shop, while vehicles #2 and #3 transfer goods among the machine tools within the factory. Vehicle #2 has a greater burden than vehicle #3, resulting in an imbalance. Consequently, it is necessary to optimise the procedures for assigning labour to reduce transportation delays. Other than that, historical data may be mined for knowledge and rules that can be used to production control. It is possible, for example, to determine where production bottlenecks are occurring at various workstations by analysing the residence time of smart WIPs in the in- and out-buffers. It is possible to forecast the standard machining time for distinct features with varied machining settings on different machine tools by using a deep neural network (DNN)-based processing time assessment model. A cutting tool lifespan prediction model may be created by considering the workload of different cutting tools.

5. Conclusion

RFID-based production data analysis for IoT-enabled smart job-shop production control is the focus of this study. Using the trolley number, the system generates a bill for the things purchased from the trolley. These malls save time and money by implementing this method. As a result, it ends up being the most convenient method of purchasing. The Android application is also used to implement the reward point system using this approach. The app's goal is to take the place of the current card-based system with an Android one. As a result, the desired outcomes were attained within the framework provided.

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