RFID enhanced smart shopping and security system

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***Abstract* -- In our present world people's attachment to shopping plays a vital role in human life and it is a very needful process for many of those who are habitual to shopping. Customers go to supermarkets to get the items they need on a daily basis and pay for them. Therefore, it is necessary to determine how many things were sold and produce the customer's bill. When we visit a store to shop, we must exert effort to choose the appropriate item. Additionally, it is stressful to wait in line to bill for all the products after that. Therefore, we are suggesting to create a smartshopping cart system that uses RFID & GSM module to facilitate online invoicing transactions and monitor items purchased so that whatever people purchase will be in the notification message that is automatically sent to the customer with this, customers need not to waste their time by waiting in queues to get the items scanned and have a bill to pay the money. People can make their work so easy and save plenty of time by choosing this kind of method**

Key Terms – Smart shopping, RFID Tags, IOT, Arduino, Smart cart System, GSM module

Introduction

The Internet of Things (IoT) has made it possible for physical items to interact with one another. Now that everyday products are capable of being equipped with processing power and communication capabilities, anything can be connected to one another. This has resulted in a new revolution in the systems that govern industry, finance, and the environment, as well as significant difficulties in data management, wireless communication, and real-time decision-making. IoT research focuses on a variety of applications. The Smart Shopping system includes the smart, an embedded device with an RFID reader for reading product RFID tags, an LCD display for showing the bill, and SIM800L GPRS GSM module for wireless data transmission to our mobile. When the customers are shopping at a large shopping complex, people frequently go over their allotted spending limit. Additionally, customers experience lengthy lines at the checkout while they wait for the merchandise to be scanned and invoiced. The aforementioned issues are easily solved by the Smart Shopping Cart.

The RFID reader on the Smart Shopping Cart is used to scan products, and the Firebase Cloud is used to store the product

details. The customer then pays the bill using one of the available payment methods after an LCD shows the final bill total.
The system offers a feature that allows customers to delete any item from their cart in addition to seeing the entire cost of the goods they have in their cart. The tiresome process of scanning the items at the counter is also done by the consumer while they are shopping, therefore the Smart cart eliminates this step as well. The product has advantages for shopping centers as well because it aids them in maximizing their whole staff, which eventually leads to earnings.

Traditional shopping carts are simply carts with a steel frame that move on wheels and are used in markets. Electronics have not yet been incorporated in order to benefit customers and improve the shopping experience. Although there have been numerous attempts to update shopping carts, the goal of all of these initiatives is to use web servers and other tools to locate products in the market more quickly.
This system aims to accomplish the aforementioned tasks economically so that real-time implementation is doable. Numerous modifications have been made to the conventional shopping procedure.

With all that we mentioned in the above sentences, the real problem of people about the time taking shopping will get modified to easy way of doing shopping and remain end up saving so much time after adapting to this method. Not only customers who get benefited saving the time and descent the risk but also the employers working at the counter in the shop whose job is to scan the customer's item, make a bill and get the payment by scanning the items.

With the help of this article, the current shopping system will be improved, potentially leading to fresh developments in the world of shopping centers. Using RFID and RF transmission, the primary goal of this research is to offer a centralized and automated invoicing system. Budgeting, product recommendations based on discounts and special offers, along with product details and an anti-theft mechanism, are some of the special features included in addition to automatic billing.

I. Background

RFID:

RFID stands for "radio-frequency identification," a technology that uses radio waves to read digital data encoded in RFID tags or smart labels. In that information from a tag or label is recorded by a device and stored in a database, RFID is comparable to barcoding. Contrary to systems that use barcode asset tracking software, RFID has a number of advantages. The most apparent difference is that although barcodes require alignment with an optical scanner, RFID tag data can be read without being in line of sight.

Working:
RFID means Automatic Identification and Data Capture technology family (AIDC). AIDC techniques require minimal to no human involvement as they automatically recognize things, gather data about them, and input that data into computer systems. Radio waves are used by RFID techniques to do this. An RFID tag or smart label, an RFID reader, and an antenna make up an RFID system at its most basic level. RFID tags comprise an integrated circuit and an antenna, which are used to transmit data to the RFID reader (also called an interrogator) (also called an interrogator). After that, the reader transforms the radio waves into a more useful type of data. Afterward, a communications interface transfers the data gathered from the tags to a host computer system, where the data can be stored in data base

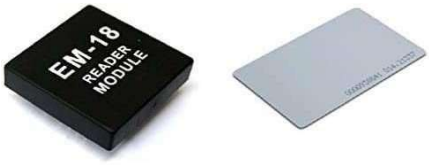

Fig. 1. RFID EM-18 Reader Module & RFID Tag

ARDUINO UNO:

A microcontroller board called Arduino UNO is based on the ATmega328P. It contains 6 analogue inputs, a 16 MHz ceramic resonator, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; to get started, just plug in a USB cable, an AC-to-DC adapter, or a battery.

How it works:
The Arduino development environment is connected to the Arduino board through USB when it is attached to a computer (IDE). The user creates the Arduino code in the IDE, uploads it to the microcontroller, and the code is then executed by the microcontroller while interacting with inputs and outputs like sensors, motors, and lights.

Fig. 2. Arduino UNO

GSM MODULE:

GSM module is a device which is used to send the data wirelessly to a particular network which uses GSM mobile technology.

Mobile phones and other devices that communicate with mobile telephone networks uses GSM modules to identify their device to the network, they need SIMs. A GSM module is just like a mobile phone which sends the data to the respective network that the user wants to send through the SMS or MMS. A GSM modem can be an independent device having a serial, USB, or Bluetooth connection, or it can be an accessory for a mobile phone.

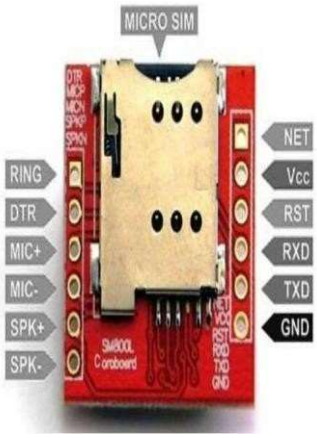

Fig. 3. SIM 800L GSM Module

II. Literature Review

Customers' shopping experiences are made easier by the incorporation of smart shopping carts with specific functionality [1]. First, a barcode scanner is used to avoid separate billing counters so that customers can scan their purchases as soon as they are made. Next, a camera is mounted on the cart to watch customers for any suspicious behavior. Finally, a weight sensor calculates the total weight of all purchases so that it can be compared to the ideal weight of all those purchases. Finally, a small computer is used for computing. The customer's smartphones, which are connected to the cart, are used to display all the item details in order to save money. Wi-Fi is often utilized to link various carts so that customers can shop simultaneously and split the cost, which can help save time. Customers are asked to log in to a special app created for this purpose so that each item suggestion is personalized for each user based on their purchasing history. Since only the payment is made there, which is comparatively more efficient than traditional methods of shopping, this might quickly alleviate the congestion at the billing counters.

Numerous publications already written on the subjectdemonstrate that researchers are quite interested in the concept ofsmart cart billing. For example, the article in the reference [3] explains a project of Smart Cart that is comparable and seeks to accomplish the same goal of decreasing market line up times. Each item in the smart cart is scanned using RFID technology inthat article. The scanned data is transmitted through wireless channels to the main server database. However, the hardware implementation and a few processes of the embedded system in that paper is done by using raspberry pi with Arduino whereas in the current project there is no raspberry pi used in the hardware system and it saved the cost of the components used for the project and it also makes the circuit looks simple with the very limited connections involved in it. So, there are no complex connections to be applied to get the output and it also saves the time in setting the circuit connections. The same with the article [5], there was no raspberry pi used in the project of smart cart billing system.

If we see the article in the reference [7] everything is same to the current one but a slight change that, can we observe between the two projects is an algorithm called RUN CPR was used, and accordingly lot of changes were made in a easy way possible to make it successful. By using algorithm and make set up accordingly is not easy one to create a smart cart billing system, process of getting an output may be took a less amount of time but the connections involved in that process is a time taking and difficult as well. Both the [3] and [5] articles mentioned above are far better in many ways than article [7] as it involves an algorithm in the process both the time to put and cost to be paid for the components used in reference article [3] and [5] are placed in top priority.

Likewise many projects on smart cart billing system are almost related to each other if we look carefully into all of those that we have taken as a reference but only the components and the way of process involved in that are looking different.

III. Proposed Methodology

Generally, Super market will have may smart carts which can be used by the costumers. All these carts are connected to the server of the super market where the database of each and every product is stored which can be accessed by the costumer. First the costumer needs to register and create an account in the Website of that super market. This gives him the login credentials for logging into customer’s account which will store the data of the customer.

When the customer goes for shopping, he needs to select the smart cart and need to login with his credentials. This will create a separate private space for the customer for saving his information. In Super market, for identification of each product we insert an RFID tag in each of them which are scanned under the RFID scanner. Each RFID tag has unique Tag number which has the product details in the market database. When the customer adds his desired products into his cart, the RFID scanner which is present in the opening of the cart reads the tag which is present on the product. When the tag is read by the reader, the details of the product is requested from the cloud database and viewed on the display screen. Along with we attach a LED & a Speaker which upon glow and make a sound respectively when scan the tag under RFID reader.

We have different scenario with respect to customer in the usages of Smart cart system. In basic scenario customer can add different

products with multiple numbers to his cart. Each product will be assigned to particular number which is the cost of the product. We have initialized a variable SUM as zero and we will increment the SUM by the cost of the product. When customer wants to remove the product from his cart, he needs to press the delete button manually and scan that product under the RFID scanner. Even the cost of the product is subtracted from the sum variable and is displayed on the screen. By this feature the customer can add and delete his desired products from the cart.

So, there is some problem here. Let us suppose the cart is empty which makes the variable sum as zero. In the worst case if the customer pressed the delete button and scans the product the sum will go to negative value. For solving this problem, we can create an array which can store the unique tag number which the RFID tag possessed. When we scan product, the unique code is stored into the array that we initialized previously. When customer scans the product with the delete button pressed, our processor will check if the unique code is already present in the array and if the unique code is not present in array, it will do nothing because the product isn't scanned previously & the product is not present inside the cart.

There is another scenario in which the user tries to remove the items which is not previously scanned and not present in the cart then the item will not be deleted. In the algorithm we created an array which stores the data or names in it when the remove button is pressed, the algorithm checks the item is present in the array or not. When the reset button is pressed, data present in the array is sent to the mobile through SMS and later the message is transmitted the system is reset that clears the data present inside the array and makes the variable sum to zero. Below figure represents the simple circuit diagram of our Smart cart system which mainly consists of Arduino UNO, RFID Scanner, LED's, LCD display.

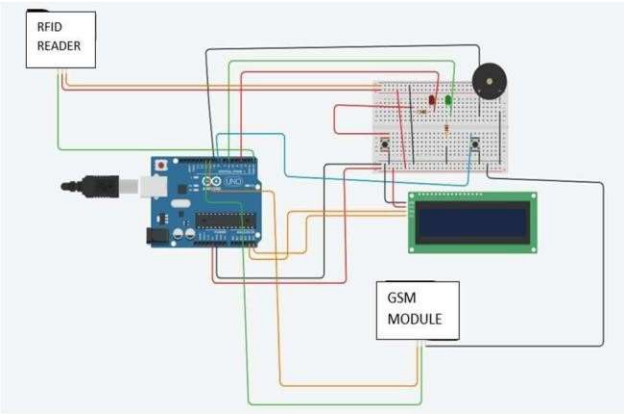

Fig. 4: Circuit diagram

The block diagram in figure 6 clearly demonstrates the integration and intercommunication of three systems. The arrows in this diagram have two heads. Demonstrate that communication occurs in both directions and that a single-headed arrow only points in one direction. For instance, while Smart Cart hardware accesses and updates data in the database, anti-theft gates only obtain information about the RFID tags that have been detected from the Cloudant database.

Since the IBM-developed Cloudant database is already on the market, it is not considered to be a component of the Smart Cart system despite being heavily used.

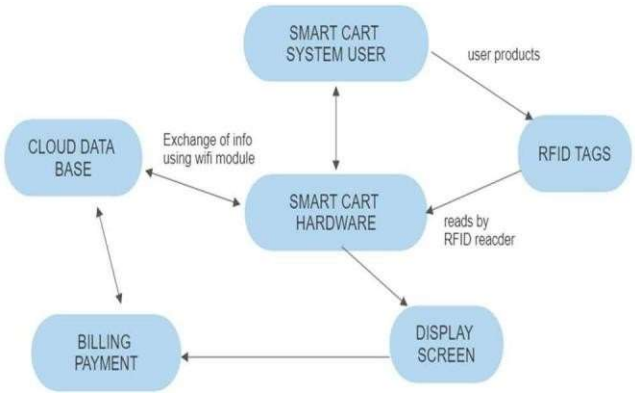

Fig. 5: Block diagram

IV. Experimental Results

Initially, the display screen shows some default test which is in the Fig 9. When the RFID tag is scanned under the RFID scanner the details of the items will be displayed on the screen. For example, we scanned a tag under the scanner in whcih the data stored is of Diary milk. So the details of the Diary milk such as Name and the cost is displayed on the display screen as shown in the Fig 9.

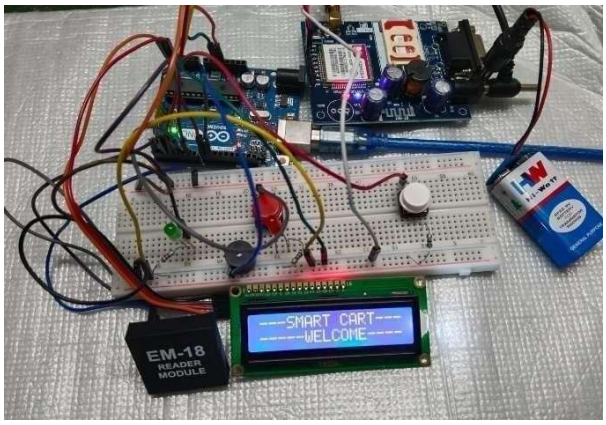

Fig. 6. Hardware setup

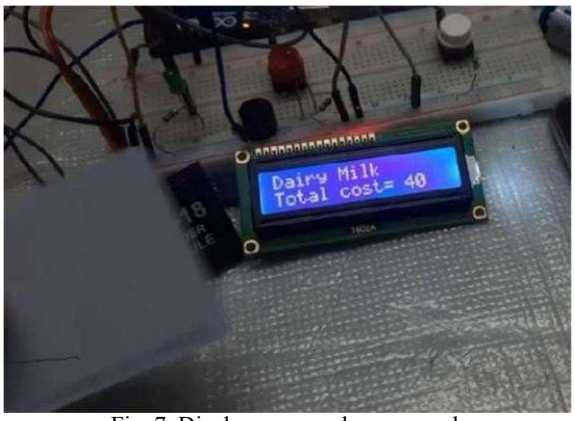

Fig. 7. Display screen when scanned

After the shopping completes the user needs to press the reset button so that he receives the message the at contains the data that he added into his cart which is shown in the Fig. 10. And Fig. 11. Later the customer goes for the payment which completeshis shopping. Also, there will an Anti-theft gate which is implemented using RFID in the Exit gate. When a person exits the mall with an unscanned product that means he is trying to rob, the Alarm will ring & this will alert the staff about robbery.

Fig. 8. Display screen when reset pin pressed

V. Conclusion

The developed proto type model can successfully implement the proposed RFID technology. It may not be difficult to use the created result, and no preparation is necessary. It requires the effective application of Wi-Fi technology and a shrewd trolley that can reduce the lines in the shopping mall. Customers who are physically examined will require more discounts. The entire emulating transform will be used to produce a friendly process. This approach will result in a larger reduction in robberies.

VI. References

[1] Y. Berdaliyev and A. P. James, "RFID-Cloud smart cart system," 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI), 2016, pp. 2346-2352, doi: 10.1109/ICACCI.2016.7732405.

[2] C. Paul, S. Sabu, R. Angelin and A. Pardeshi, "Smart Shopping Application using IoT and Recommendation System : An effective mobile assisted software application for grocery shopping," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 2021, pp. 522-526, doi: 10.1109/ICACCS51430.2021.9441762.

[3] R. R. Vallabhuni, S. Lakshmanachari, G. Avanthi and V. Vijay, "Smart Cart Shopping System with an RFID Interface for Human Assistance," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), 2020, pp. 165-169, doi: 10.1109/ICISS49785.2020.9316102

[4] R. Gupte, S. Rege, S. Hawa, Y. S. Rao and R. Sawant, "Automated Shopping Cart Using RFID with a Collaborative Clustering Driven Recommendation System," 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA), 2020, pp. 400-404, doi: 10.1109/ICIRCA48905.2020.9183100.

[5] S. Mekruksavanich, "Supermarket Shopping System using RFID as the IoT Application," 2020 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering (ECTI DAMT & NCON), 2020, pp. 83-86, doi: 10.1109/ECTIDAMTNCON48261.2020.9090714.

[6] S. Kowshika, S. S. Madhu mitha, G. Madhu Varshini, V. Megha and K. Lakshmi, "IoT based Smart Shopping Trolley with Mobile Cart Application," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 2021, pp. 1186-1189, doi: 10.1109/ICACCS51430.2021.9441866.

[7] R. Badi and B. Momin, "SCAR: Smart Cart based on ARM algorithm and RFID technology," 2018 3rd

IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2018, pp. 2387-2392, doi: 10.1109/RTEICT42901.2018.9012562.

[8] M. Shahroz, M. F. Mushtaq, M. Ahmad, S. Ullah, A. Mehmood and G. S. Choi, "IoT-Based Smart Shopping Cart Using Radio Frequency Identification," in IEEE Access, vol. 8, pp. 68426-68438, 2020, doi: 10.1109/ACCESS.2020.2986681.

[9] T. Mohammed Ashique, V. Mohammed Rishin, V. K. Muhammed Junaid, K. Vyshnave, T. Sneha and Subrahmanian, "Quick Cart: A Smart Cart System," 2018 International Conference on Emerging Trends and Innovations In Engineering And Technological Research (ICETIETR), 2018, pp. 1-4, doi: 10.1109/ICETIETR.2018.8529071.

[10] T. K. Das, A. K. Tripathy and K. Srinivasan, "A Smart Trolley for Smart Shopping," 2020 International Conference on System, Computation, Automation and Networking (ICSCAN), 2020, pp. 1-5, doi: 10.1109/ICSCAN49426.2020.9262350.

[11] S. S, A. R. R. K, S. Sai B, V. K. K. M and G. Kumar C, "AIoT-based Smart Cart System," 2022 International Conference on Smart Technologies and Systems for Next Generation Computing (ICSTSN), 2022, pp. 1-6, doi: 10.1109/ICSTSN53084.2022.9761346.

[12] P. K. Khairnar and D. H. Gawali, "Innovative shopping cart for smart cities," 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2017, pp. 1067-1071, doi: 10.1109/RTEICT.2017.8256762.