



Design and Implementation of a Smart Shopping Trolley Using RFID Technology

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This paper focuses on the design and implementation of a Smart Trolley Shopping in supermarkets to solve difficulties of customers whilst waiting in queues for billing. The trolley is designed to develop market services and make them modern, healthy and easy to use. The remote controls the movement of the trolley automatically and reduces the load on the client during pulling the trolley. In addition, it helps in saving money by not buying unwanted products, with the help of the Liquid Crystal Display in the trolley, which shows on the update of purchase limit. In this work the client writes the amount they have via the keypad, where the amount appears on the liquid crystal screen. The product used is then checked for price and RFID details. This information is sent to RFID in the product via radio to RFID reader which determines the radio waves. It has an antenna bar for receiving and transmitting data. It also contains a small memory for detailed information of up to 256 bytes. The total cost is summarized by the scanner for materials stored in memory, sent to Arduino. The cart moves according to the client's movements when shopping and then moves to the left, right, forward, backward, or even stops through the buttons. If the customer purchases the products more than the amount recorded on the keyboard, an alarm will serve as a reminder to the customer that he/she has exceeded the purchase limit. The smart trolley is characterized by the speed of accounting compared to conventional accounting and provides a quality service. It reduces congestion at the cashier counter and shortens the time and waste of effort during the accounting process.

Introduction

Technology has a great influence in human life. Over the last decade the development of e-commerce has changed our shopping styles and habits. The Internet has a direct connection with e-Commerce. With the use of the Internet, advertising, and marketing, online shopping has become possible. The online shopping has spread due to the existence of specialized sites such as Amazon, Julie Chic, Instagram and others. But the presence of e-commerce has not prevented the traditional markets from growing. The market is the real life place where the interaction between the seller and the customer takes place in terms of services and the sale of products. The emergence of commercial thought contributes to the increase of trade exchanges based on the sale and purchase. Different approaches have emerged to develop procurement, where there are a lot of trolleys that are used in different ways such as mobile food carts, baby strollers and shopping carts. The shopping cart is provided by the shops to the customers inside the shops to move the products inside the shop easily, until they reach the counter clerk (Hanwate & Thakare, 1AD).

This paper is focused on the implementation of a Smart Shopping trolley which is of great use in supermarkets to solve difficulties of customers such as waiting in queues for billing and controlling the purchases within a pre-set budget. This work also reduces the task of the cashier in calculating the total cost while billing.

The traditional trolley is different from a smart trolley. The traditional trolley is widely available in most supermarkets and is cheap. Comparatively, the smart trolley is sophisticated, expensive and very limited in number because of its manufacturing cost. The smart trolley is characterized by the



speed of accounting compared to conventional accounting. It also provides a high-quality service, by reducing the congestion at the cashier counter, and reduces the time effort during the accounting (Pandey, Gupta, Shaikh, Rawat, & Jangid, 2018). A shopping cart will help the user to transport larger quantities of supplies with less effort. It also helps people with disabilities as well as male and seniors who can walk but do not have the strength to pull carts. The cart is equipped with a wheel drive and a power source to ease the movement of the trolley and to operate the engines (Sivagurunathan, Seema, Shalini, Sindhu, & Engineering, 2018).

In this work, the customer can limit the purchase by setting the amount which appears in the Liquid Crystal Display (LCD). The items used are then checked for price and RFID details. The cost of each item decided to purchase is totalled up by the scanner and sent to Arduino. The trolley movement is controlled by the purchaser while shopping by means of an e-mote controller. If the customer selects items that exceed the purchase limit, the alarm sound will serve as a reminder to the customer.

The first section of this paper discusses various literatures related to this area. Section Two provides the proposed system. System Design and Implementation Results are presented in Sections 3 and 4, respectively. A discussion of the results is done in Section 5. Section 6 is reserved for the conclusion and recommendations.

1 Literature Review

This section includes some of the main articles referred to during the developing and implementing stage of the work.

In their paper, Shradha Dhavale et al discuss the implementation of a IoT based smart trolley (D, Dhokanetruputi, & S, 2016). In their paper the RFID tag placed in the trolley used to detect the price of the items decided to purchase and the cost is displayed on the LCD and the price sent billing counter using wireless modules FRAGMENT. This work includes the ARM processor, Buzzer, RFID tag and reader, LCD and an ESP module. Here there is no option to limit the purchase as per the amount available in the buyer. Here the whole information is passed to internet by an Ethernet module.

Today, the number of large and small shopping centers around the world is increasing due to increased demand and public spending. The shopping center has great momentum.

Second (!!), the use of barcode scanning technology in such cases always leads to waste of time, since the customer must wait until all items are checked. These benefits can be avoided by using a smart trolley based on IOT. In this article, the system uses RFID instead of barcode technology. In the proposed system, separate RFID readers are used for each trolley, and RFID tags are used for each product. When the customer purchases the product, the RFID reader recognizes the brand in the product. The cost of the product and the amount of the total purchase order bill can be displayed on the 16 * 2 LCD screen. The IOT-based smart trolley is easy to use and does not require any special training for customers. RFID technology has many advantages over bar code systems. The RFID reader reads the mark at 300 feet, but the bar code can read the information at a distance of 15 feet or less. The bar code also needs to publish a Web site. Radio frequency reading is 40. Therefore, RFID is more useful than conventional barcode scanning technology. If RFID is useful to customers. Using this system, the customer gets information about the price of each item being inspected, the price of the total item, and the product overview. Therefore, the use of this smart car based on IOT's business centers is beneficial to both customers and owners.

In order to reduce the man power in the hypermarket which will be already crowded by customers, smart trolley is a good option. According to B.N Arathi and M Shona, the difficulties and frustrations of customers on getting jammed in the cashier line could be avoided by the smart



trolley system(Arathi & Shona, 2017). Their system includes ARM Processor, Micro controller, Bar code reader, Android phone and ultrasonic sensors. The information of discounts, item prices and updated bill is provided by the GSM with WiFi connection. As per the work after finishing the shopping, the customer just pays the bill without waiting in a queue.

In the article, the author proved if there are many customers in the shopping center, performance will not deteriorate because of a stumbling block (Gangwal, Roy, & Bapat, 2013). Each shopping cart is equipped with a sensor, a load cell on the base of the cart, the camera is connected to the top (also works as a scanner), a local processing system and a display element. Each customer is identified by their Shopping Cart ID. The base station consists of a set of databases that store information about all products and a sensor channel to connect all the smart cars in the mall. When customers start shopping, they must check the barcode of the product by using the barcode scanner in the cart and place the product in the basket. The product barcode is sent wirelessly via braking to the base station using IEEE 802.15.4 (ZigBee protocol) over the ZigBee network. ZigBee is selected using an IEEE 802.15.4 compliant sensor. This is because it is available in large quantities. However, other wireless systems will work at close range. In response, the base station sends relevant information about the product used in the car's decision-making process. To handle all errors / inaccuracies, the design includes the use of image processing in the car. When a customer finishes shopping, he or she becomes a billing system and is only assisted by the provider if the system detects an inconsistency in the client's self-extracting process.

The advent of wireless technology for the first time, e-commerce has evolved to provide convenience and efficiency in everyday life. The main objective of this article is to provide a centralized automated billing system using RFID technology and ZigBee communications. This provide information about anti-theft products and information (Dheple, Kumari, Jadhav, Lihitkar, & Umakanttupe, 2018). Each product is provided in a supermarket equipped with an RFID card to determine its type. Each trolley includes a PID. Specifically, PID includes microcontroller, LCD screen, RFID reader, EEPROM module, and ZigBee module. Also there is a centralized database that allows customers to recommend products. The central database provides product recommendations and product information on the LCD screen of the shopping screen, which helps the customer buy the product. On the LCD screen, letters, numbers, and graphics are displayed. The invoice will be displayed on the LCD screen. The, RFID is attached to each product in the store and the mall. Each RFID reader will have a ZigBee and Trans Receiver. There is an online payment procedure for billing. If the product has been removed, it must be removed from the invoice. To prevent theft, (what?) requires output port RFID reader. Display / discount on screen according to customer ID. Product information, expiry date, and best options are displayed. So, using this, grocery shopping system becomes easier. Anti-theft systems are also offered to supermarkets. This will enable online transactions for billing and offer user suggestions such as purchase of items and bids. The RFID tag and ZigBee should work correctly (Sadia, Jee, Pal, Singh, & Marbaniang, 2019).

2 Proposed System

The smart trolley shopping design is based on Arduino design to adjust the trolley movement and use RFID to put the product on it. The system uses the Arduino system to control all processes. The system consists of inputs and outputs that determine the operation of the system. The block diagram of the proposed system is shown in Figure 1.

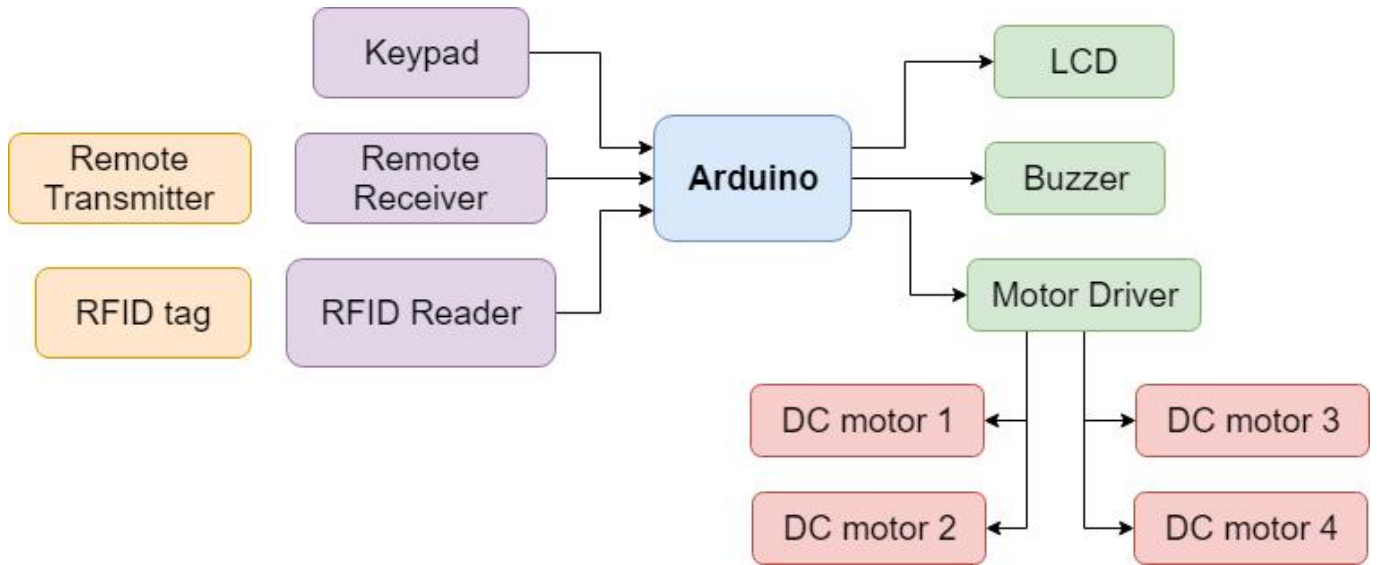


Figure 1. System Block Diagram

Figure 2 is a step to interpret the system flow and the options presented in this plan in the project flow for each stage of the project. It shows all system steps.

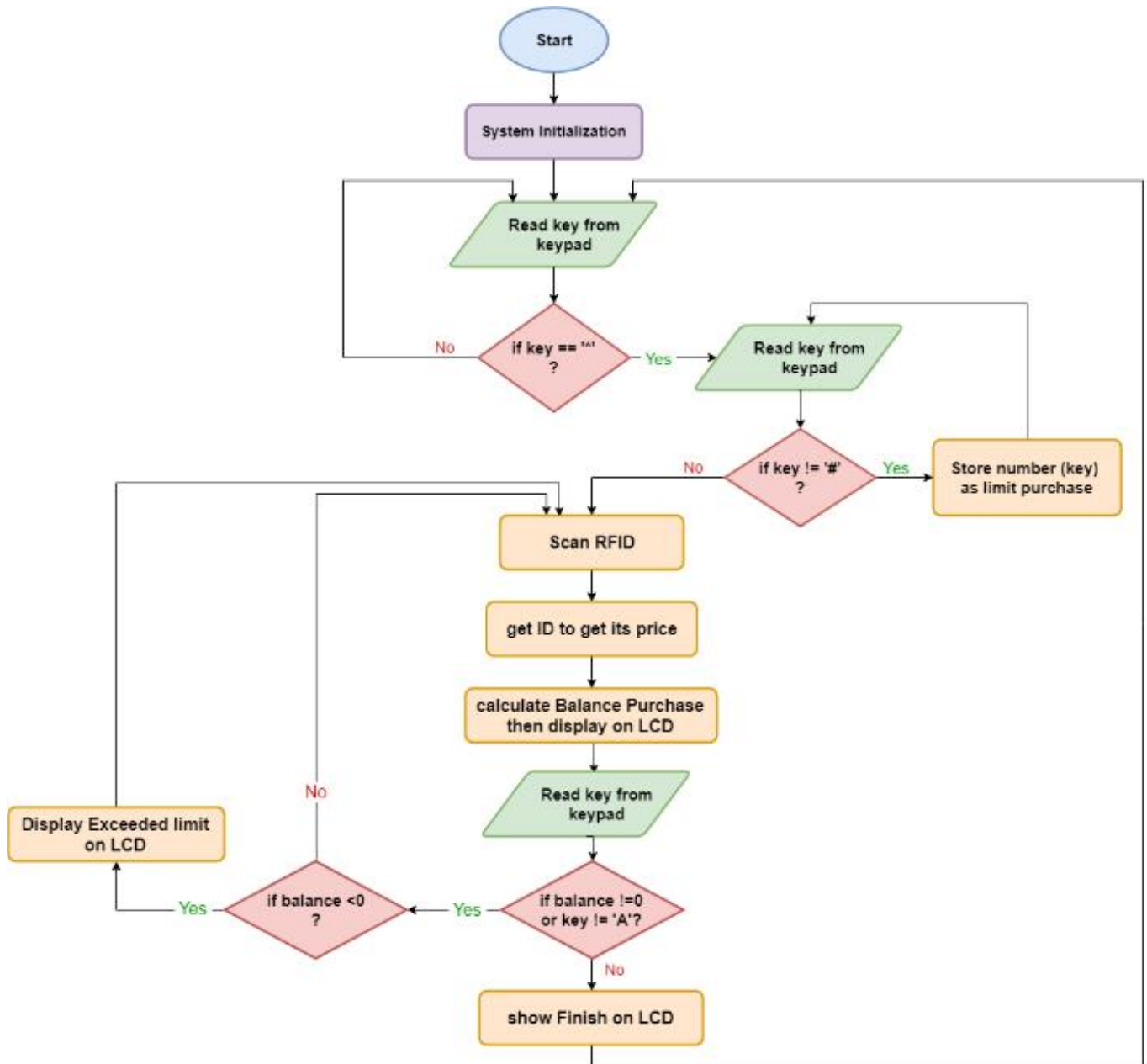


Figure 2. System Flow chart

3 System Design

The design of the smart shopping trolley system includes hardware and software parts. The hardware part includes the main components as Arduino Mega 2560, Arduino UNO,RFID tag, RFID reader, LCD screen, buzzer, keypad, DC motor, L298N Motor Driver, and RF Receiver and Transmitter module.

The software part includes Proteus for performing the schematic simulation and Arduino IDE used to capture and load a computer code into a microcontroller and the native motherboard or IDE partition that runs on the computer.

4 Implementation Results



The main component of this work is the Arduino, which will use all the function and the code will be on it. The keypad is connected via 8 digital pins in Arduino and it is also an input, it will be used it to enter the wanted limited amount (Sentence construction; unclear). Buzzer is output and connected at pin A0. RFID reader is connected at SPI pins and it is used to read the product price. LCD is connected at digital pins and it is used to display instructions for usage to the user. The system is simulated using Proteus for each step. Once the user completes the shopping, the finishing shopping statement will be shown on LCD, as shown in Figure 3.

Figure 3. *The overall circuit*

The system is tested for various conditions. Figure 4 shows the item scanned by RFID to get its price to calculate the remaining purchase price.

Figure 4. *System Implementation*

The final designed prototype of this project is shown in Figure 5 below.

Figure 5. *Final Designed Prototype*

5 Discussion

The main work of this paper was focused on the implementation of smart shopping trolleys. The purchase limit has been determined by the user by entering the desired amount to ensure that it will not exceed. In addition, it is possible to control the movement of the trolley by using the remote control where the user can control the movement to the right, left, forward and backward. In case of purchase limit is exceeded, the user will be alerted by the sound of the bell.

There are many works and studies that have been done. They are related to smart trolley shopping but have not been implemented in major business markets due to high cost comparing to normal trolleys. The Smart trolley will reduce the jam on counters and it is easy to control. The main peculiarity of this work lies in the movement of the trolley with the remote control. This feature is very easy and suitable for the elderly and women, also the ability of the user to write the amount expected which would save costumers' money and help them to achieve their target (Sentence structure; unclear).

The main drawbacks of this work is that it is very difficult to spread it (what is "it"?) in large and small markets because of its cost and manufacture.

The technical problems faced were

- The use of IR as it does not have enough ability to control the movement of the trolley because it has one indication in one direction. The movement and stopping of the trolley should be quick and not collide with any object facing it. This problem has been solved and replaced using the remote, which in turn controls the movement of the trolley and stopped and controlled by the user, as it is easy to use for all categories (Sentence structure; very unclear).
- Relay is considered as a switch but it is not enough to control the movement of the trolley. Relay is often used in control circuits where the current is small, and the voltage required to operate it must be high to make motor movement easy and fast. This component has been replaced by Motor Driver, which can control the movement of the wheels and the



distribution of voltage.

6 Conclusion

This paper provides the design and implementation of a smart trolley system capable to determine the purchase limit by entering the amount, indicate the exceeding of purchase limit by alarm from buzzer, calculate and display the total price of good kept in the trolley using RFID an. control the movement of trolley using the remote (sentence structure).

Smart trolley is important in our daily life. It simplifies the shopping process and can be very fast for all. Also, it helps us to make everyone rely on themselves, thus without requiring any help from the worker in the mall (Awati & Awati, 2012) This also leads to reducing the swarming and initiating control over many of the shopping centers in large shopping centers (Digambar & Khamitkar, 2018)

It is recommended to use this work in many large and small shopping centers in order to simplify shopping for (who?) and help them to easily control the movement of the trolley. When implementing (what?) in the real time, it is required to solve the battery problem to be sustainable for a longer period of time.

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