Smart Shopping Trolley Using IoT

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***Abstract*— The modern age of technology, in which most customer needs to wait in the supermarket for shopping because it is a highly time-consuming process. A huge crowd in the supermarket at the time of discount offers or weekends makes it difficult to wait in long queues because of a barcode-based billing process. In this regard, the Internet of Things (IoT) based Smart Shopping Cart is proposed, which consists of Radio Frequency Identification (RFID) sensors, an Arduino microcontroller, a Bluetooth module, and a Mobile application. RFID sensors depend on wireless communication. One part is the RFID tag attached to each product, and the other is the RFID reader that reads the product information efficiently. After this, each product's information is shown in the Mobile application. The customer easily manages the shopping list in the Mobile application according to preferences. Then, shopping information is sent to the server wirelessly and automatically generates a bill. This experimental prototype is designed to eliminate the time-consuming shopping process and quality of service issues. The proposed system can easily be implemented and tested at a commercial scale under a real scenario in the future. That is why the proposed model is more competitive as compared to others.**

Keywords: ***IOT Technology, RFID, Smart Trolley, LCD.***

I. INTRODUCTION

The Internet of Things has brought a new uprising in industrial, financial, and environmental systems. In this era of the Internet of Things, interactions among physical objects have become a reality. Every object in this world is on the verge of being connected with the help of the Internet. In this project, let us try to focus on a Smart Shopping System using ultra-high frequency RFID tags, which have not been well implemented in the past. The major advantage of such a system is that people can avoid standing in long queues waiting for their turn to pay for items. So here RFID is introduced, meaning Radio Frequency Identification Tag, which uses electromagnetic fields to automatically identify and track tags attached to objects. This is a lengthy process, and it can utilize the trending cutting-edge technology of IoT to reduce time and solve the problems. The customer has to drop every product they wish to purchase into the shopping cart and then proceed to checkout at the billing counter. The billing process is quite tedious and time, and has created the need for shops to employ more human resources in the billing section. To decrease the time spent at billing, an RFID arrangement has been proposed. Each advanced mobile truck will be equipped with an RFID reader, a Raspberry Pi 3, an Arduino, and an LCD. That efficient truck can automatically read those items placed under it using another RFID reader. The system keeps track of the items associated with the RFID tags. The RFID reader retrieves the tag data when it is necessary to add or remove items from the trolley. To add items to the cart, the add items button should be clicked, and to remove an item, the subtraction button should be clicked. After finishing shopping, we moved to the billing section. The item's information is sent to the central billing server, which will calculate the total amount of purchased items and display it on the webpage. It will be easy to pay the amount directly without waiting.

II. SYSTEM MODEL

A smart shopping cart is a next-generation shopping cart that uses a combination of hardware and software to provide a seamless shopping experience for customers. The hardware components of a smart shopping cart typically include a touchscreen display, barcode scanner, RFID reader, weight sensors, and a payment system. The software components include a mobile application and a backend system that processes the data collected by the hardware.

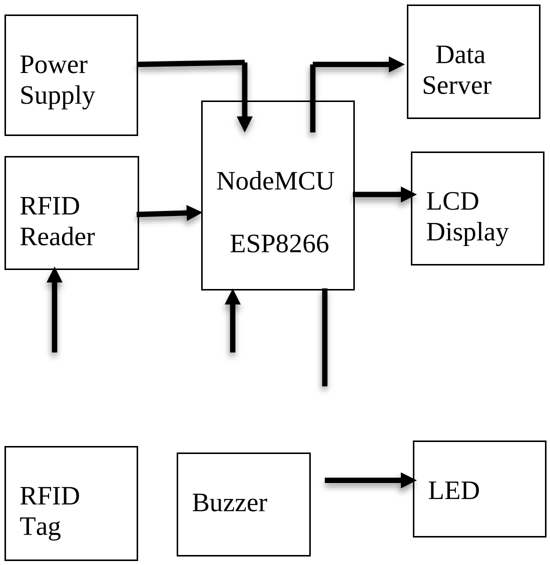
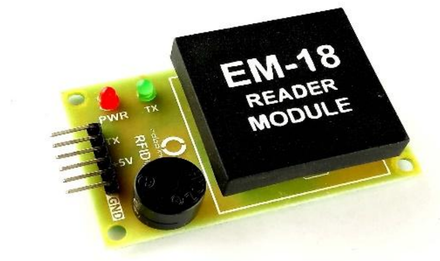


Fig.1: Block Diagram

a) Node-MCU:

The microcontroller utilized in the proposed model is the Node-MCU, an open-source platform for electronic projects. It employs the ESP8266-12E as the main controller, which is a wireless SOC with high integration. This microcontroller can embed Wi-Fi capabilities into systems or operate as a standalone application. It operates at 3.3V with a recommended input voltage range of 4.5- 10V. The Node MCU features 11 digital input/output pins, 1 analog pin, a compact size of 49mm*26mm, and a clock speed of 80 MHz. It can function within a temperature range of -45° C to -125° C. The Node MCU supports a simplified programming language called "Lua Script" and can also be programmed using Arduino IDE in C or C++. This microcontroller offers a cost-effective solution for developing IoT applications as it eliminates the need for a separate Wi-Fi module.

b) RFID Reader :



Radio frequency Identification, i.e., RFID, is a wireless identification technology that uses radio waves to identify the presence of RFID tags. Just like Bar barcode reader, RFID technology is used for the identification of people, objects, etc., and presence. In barcode technology, we need to optically scan the barcode by keeping it in front of the reader, whereas in RFID technology, we just need to bring the RFID tags within the range of the readers. Also, barcodes can get damaged or unreadable, which is not the case for most of the RFID tags. RFID is used in many applications, like an attendance system, in which every person will have their own separate RFID tag, which will help identify the person and their attendance. RFID is used in many companies to provide access to their authorized employees. It is also helpful to keep track of goods and an automated toll collection system on the highway by embedding a Tag (having a unique ID) on them.

c) RFID Tag :

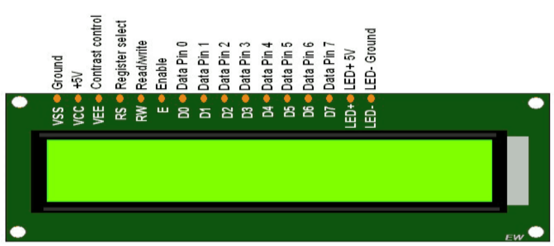
RFID tags are made up of an integrated circuit (IC), an antenna, and a substrate. The part of an RFID tag that encodes identifying information is called the RFID inlay. There are two main types of RFID tags:

- Active RFID. An active RFID tag has its power source, often a battery.

- Passive RFID. A passive RFID tag receives its power from the reading antenna, whose electromagnetic wave induces a current in the RFID tag's antenna.

There are also semi-passive RFID tags, meaning a battery runs the circuitry while communication is powered by the RFID reader. Low-power, embedded non-volatile memory plays an important role in every RFID system. RFID tags typically hold less than 2,000 KB of data, including a unique identifier/serial number. Tags can be read-only or read-write, where data can be added by the reader or existing data overwritten. The read range for RFID tags varies based on factors including the type of tag, the type of reader, the RFID frequency, and interference in the surrounding environment or from other RFID tags and readers. Active RFID tags have a longer read range than passive RFID tags due to the stronger power source. Smart labels are simple RFID tags. These labels have an RFID tag embedded into an adhesive label and feature a barcode. They can also be used by both RFID and barcode readers. Smart labels can be printed on demand using desktop printers, whereas RFID tags require more advanced equipment.

d) 16X2 LCD :



A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It uses very small amounts of electric power and is therefore suitable for use in battery-powered electronic devices. For an 8-bit data bus, the display requires a +5V supply plus 11 10 lines. For a 4-bit data bus, it only requires the supply lines plus seven extra lines. When the LCD is not enabled, data lines are tri-state, which means they are in a state of high impedance (as though they are disconnected), and this means they do not interfere with the operation of the microcontroller. The LCD (Liquid Crystal Display) screen is an electronic display module and finds a wide range of applications. A 16-2 LCD is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven-segment and other multi-segment LEDs. The reason being: LCDs are economical, easily programmable, have no limitation of displaying special and even custom characters (unlike in seven displays), animations, and so on. In this system. We are using these 16-2 LCDs to display various customer information messages. It is possible by interfacing these LCDs to the corresponding core controllers. This LCD has two registers to operate the LCD module, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to the LCD to do a predefined task, like initializing it, clearing its screen, setting the cursor position, controlling the display, etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value (8 bits) of the character to be displayed on the LCD.

III. METHODOLOGY

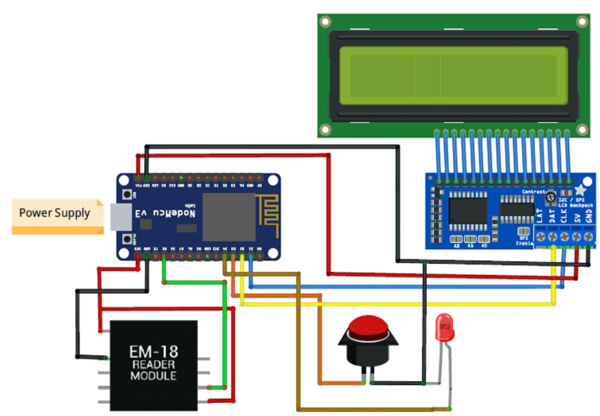


Fig.2: Connection Diagram of the System

We all have waited in a queue for payment in shopping malls and other places, it's very tiring and wastes a lot of time in the billing process. Today, we will build a smart shopping cart with an automatic billing system that not only reduces the waiting time but also makes the process very smooth and easy. Here we use RFID cards and RFID readers with NodeMCU to build the Smart Shopping Cart project. The cart information and total value will be displayed on the webpage as well as on the LCD. Each RFID card is associated with a certain product, and an RFID reader is installed in the cart, which reads the product details like Price and Product details and sends them to NodeMCU ESP8266. Then NodeMCU processes the available items and total value in the cart and sends them to the ESP8266 Webserver, which can be monitored on a web browser from anywhere in the world. Web servers are used to control or monitor sensor values using web browsers.

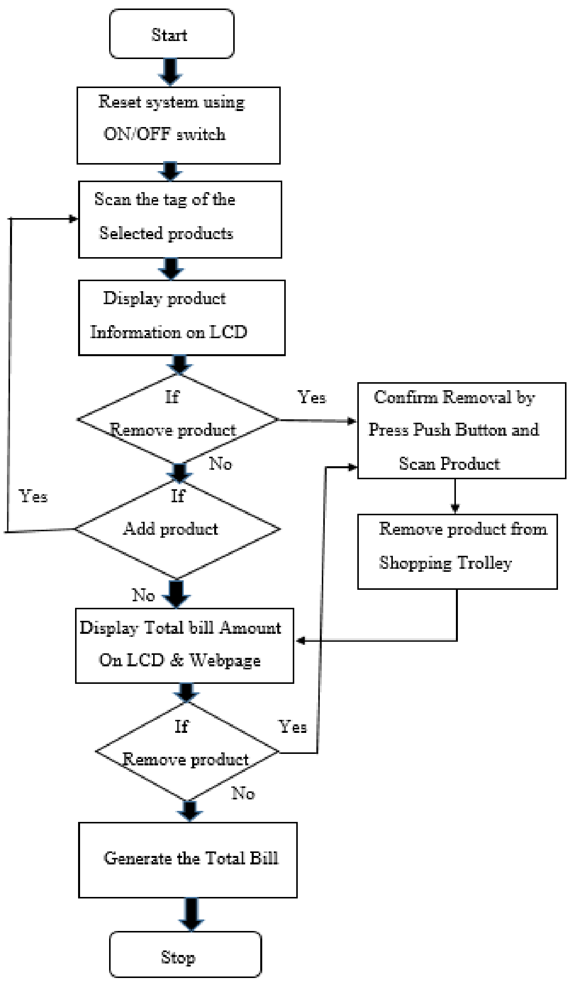


Fig.3: Flowchart of the System

Here is a basic flowchart of how a smart shopping cart might work:

- User enters the store and picks up a smart shopping cart.
- The smart shopping cart detects the user and logs them into the system.
- The user scans items as they shop and places them in the cart.
- The smart shopping cart keeps track of the items added and provides real-time updates on the total cost.
- The smart shopping cart can suggest related products or promotions based on the user's shopping history or preferences.
- The user can review their shopping cart and make changes as needed.
- When the user is ready to check out, they can pay using a mobile device or through the smart shopping cart's built-in payment system.
- The smart shopping cart can provide a digital receipt and email it to the user. After the user completes their purchase, the smart shopping cart automatically logs them out of the system.
- The smart shopping cart can then transmit data on the user's shopping habits, preferences, and purchases to the retailer's backend system for analysis.

Of course, the exact flowchart will depend on the specific hardware and software systems used for the smart shopping cart. But this provides a basic overview of how the process might work.

An empty smart trolley is provided to customers when they enter the mall. This trolley shows 0 items on the LCD. When the customer buys the product, the RFID tag is read by its reader, and the number of items and the price of the product will be updated. To remove the item from the cart list, the customer uses the Push Button. The number of items and cost will be deducted accordingly. When the shopping is done, the total cost will be displayed on the LCD panel and webpage as well.

A smart shopping trolley powered by IoT technology enhances the shopping experience by automating various processes, such as item scanning, billing, and payment. This technology streamlines the checkout process, reduces waiting time, and offers personalized shopping recommendations. By leveraging RFID, sensors, and wireless communication, these trolleys can identify items, calculate costs, and facilitate payment through various methods.

IV. RESULT

Fig.4: Front View of Smart Shopping Trolley

The image shows a prototype of a smart shopping cart system. This system uses RFID technology to automatically scan and track items placed inside the cart, displaying the details on a connected laptop. Key components visible in the image include:

Shopping Cart: A red plastic basket serves as the shopping cart, with an electronic module attached to its side.

Fig.5: Result of LCD

The image shows an electronic circuit board connected to an EM-18 RFID reader module and an LCD screen displaying "Milk Added. Price Rs: 24.00". This setup is likely part of a system designed for milk dispensing or management, possibly in a dairy farm or milk collection center. The system appears to use RFID technology to identify and record milk additions, and then displays the information, including the price, on the LCD screen.

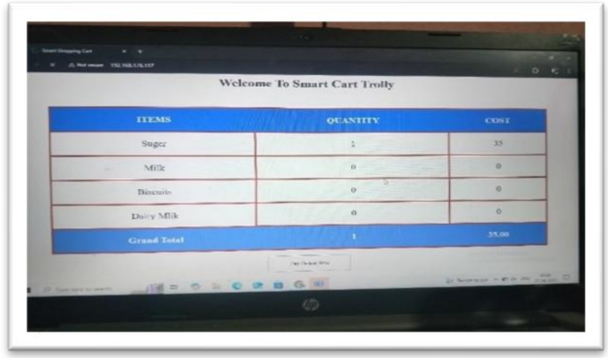


Fig.6: Result of Product list

The image shows a table displayed on a laptop screen, titled "Welcome to Smart Cart Trolley," which appears to be part of a smart shopping cart system. The table presents a list of items, their quantities, and costs. The table includes the following information: The image shows a screen displaying a "Smart Cart Trolley" interface, likely part of an IoT system for retail shopping. It presents a table with items, quantity, and cost, indicating that only "Sugar" has been added to the cart with a quantity of 1 and a cost of 35. The total is also 35. The IP address "192.168.176.157" is visible, suggesting a local network connection.

V. CONCLUSION

The work is done with the help of RFID technology with the help of an EM-18 reader, an RFID card, and Node MCU. The main aim of this smart trolley is to reduce the time wasted at the time of billing the product so that the customers get more benefit. It can be implemented where a huge amount of the rush in the mall can be reduced by replacing the normal trolley with the smart trolley, which takes less time in this world of automation. It can automate the whole trolley system so that the customer can quickly.

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