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Smart Shopping Trolley with Automated Billing Using Arduino

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***Abstract*—Shopping can be an exciting experience, but the long queues at checkout can often leave us feeling drained. customers have to wait in line to have each item individually scanned at the counter, which can be time-consuming, especially during peak shopping hours. This inefficiency not only leads to customer frustration but also affects the overall shopping experience.To tackle this issue, a solution is proposed: the smart shopping trolley with automated billing.This innovative approach allows customers to breeze through their shopping journey. With the smart trolley, shoppers can effortlessly select their items and complete their purchases without the hassle of traditional checkout lines. The trolley automatically generates bill, which is conveniently sent to the customer via app. The customer can make the payment using the app.This system incorporates various components, including an Arduino board, RFID reader for item identification, LCD display for user interaction, Wi-Fi module for connectivity, and sensors for theft detection and an app for the payment.This process not only reduces waiting times but also enhances overall efficiency,making shopping a more pleasant experience for customers.**

***Index Terms*—Arduino,RFID Display,RFID tag, LCD display,load cell,wifi module,IR sensor**

I. Introduction

Shopping typically involves visiting a store, examining products, selecting items, navigating through the billing section, enduring long queues, scanning products, calculating totals, and finally paying the bill, whether by cash, credit, or debit card. However, this process can often be tedious and frustrating for people, leading to irritation. To address these challenges and make shopping more enjoyable, RFID (radio frequency identification) technology offers a promising solution. Unlike traditional bar code systems, RFID provides several advantages, as outlined in Table 1.

Implementing RFID requires an Arduino UNO board to interface with the RFID reader and transmit data to your mobile app using Wi-Fi module. Although many people love shopping for new items to fulfill their needs and desires, some dislike it due to factors such as crowds, long queues, and difficulties in finding products.Additionally, the physical nature of paper receipts poses challenges, as they can easily be lost. To alleviate these issues and embrace emerging technology to attract more customers, this project has been developed.

	RFID	Bar Code
Rate of reading	More than one tag simultaneously	Single tag at a time
Read/write ability	Can read, write and modify	Only read
Line of sight	Not needed	Essential
Durability	High	Low- cannot be read if soiled
Security	High- hard to reproduce	Low- easier to counterfeit

Table 1:RFID Vs Barcode

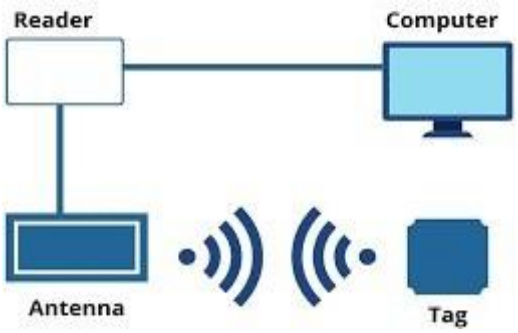

Fig. 1. RFID Working

The advantages of the proposed system are detailed below:
Efficiency: The system streamlines the checkout process by automatically calculating the total amount of items in the trolley, eliminating the need for manual scanning and calculation. This saves time for both customers and store staff.
Accuracy: Automated billing ensures accurate calculation of the total amount due, reducing the likelihood of errors compared to manual calculations. This helps to prevent discrepancies in the final bill.

Real-time information about the total amount to be paid, allowing them to budget and plan their purchases more effectively. This can lead to increased satisfaction and improved financial management. **Reduced Crowding:**With faster checkout times, the system helps to reduce congestion and crowding at checkout counters, creating a more pleasant shopping environment for customers **Improved Efficiency for Store Operations:** Automated billing reduces the workload for store staff, allowing them to focus on other tasks such as restocking shelves and assisting customers. This can lead to improved operational efficiency and productivity.

II. Methodology

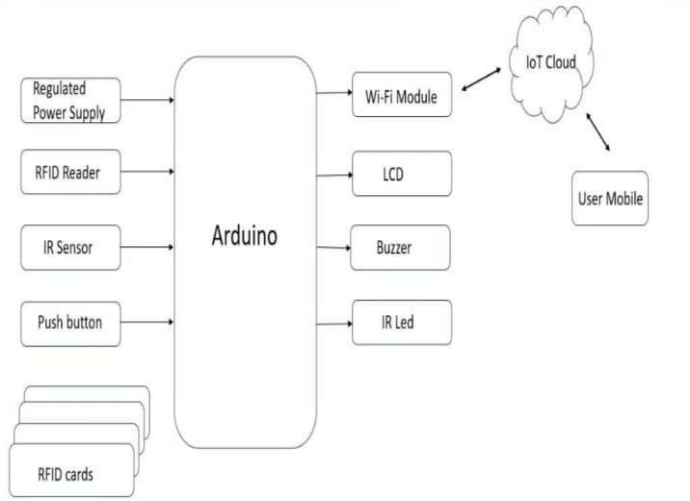

Fig. 2. Block diagram

A. Arduino UNO

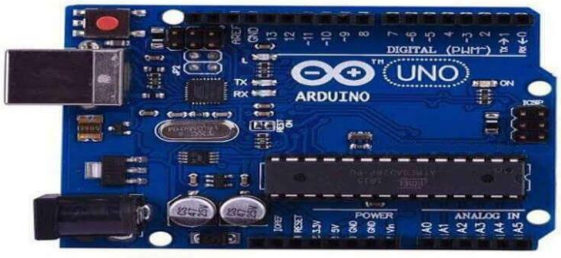

Fig. 3. Arduino board

The Arduino UNO is a microcontroller board that utilizes the ATmega328P. It is equipped with 14 digital input/output pins, among which 6 are capable of functioning as PWM outputs, along with 6 analog inputs. Additionally, it features a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

The Arduino UNO is an affordable, adaptable, and user-friendly programmable microcontroller board, available as open-source, making it suitable for a wide range of electronic endeavors. It is capable of seamless integration with other Arduino boards.

B. RC522 Reader

Fig. 4. RC522 Reader

The diagram depicted in following figure illustrates the RFID card reader setup. Positioned on the shopping cart, the RFID reader is designed to identify any nearby tags. Each tag is assigned a distinct and unique number. Once the reader captures this number, it transfers it to the Arduino module for subsequent communication and processing. The RFID reader is specifically connected to the Arduino UNO's serial rxd pin (pin 0).

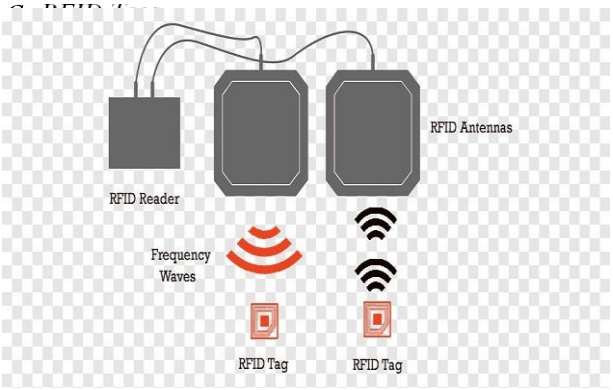

Fig. 5. RFID Tag

RFID tags are compact electronic devices designed to store data and establish communication with other devices via radio waves. RFID tags serve as a tracking system employing radio frequency technology to locate, identify, monitor, and interact with both objects and individuals. Essentially acting as intelligent labels, RFID tags possess the capability to store diverse

D. LCD

information, including serial numbers, brief descriptions, and extensive data pages.

Fig. 6. LCD

The conventional 16 × 2 character LCD is utilized, which is widely favored in conjunction with Arduino microcontrollers. This type of LCD display is considered the most suitable due to several reasons. Firstly, it is cost-effective and easily programmable. Secondly, unlike seven-segment displays and other multi-segment LEDs, LCDs have no limitations in displaying special or custom characters, animations, and more. The LCD consists of two registers: the Command register, which stores instructions for predefined tasks such as initialization, screen clearing, cursor positioning, and display control, and the Data register, which holds the ASCII values of characters to be displayed.

The library commonly used for interfacing with LCDs is known as "Liquidcrystal.h", providing a range of functions including screen clearing, scroll selection, special character display, auto-scrolling, serial display, and text direction control. The LCD's contrast can be adjusted using a potentiometer.

E. Hx711 load cell

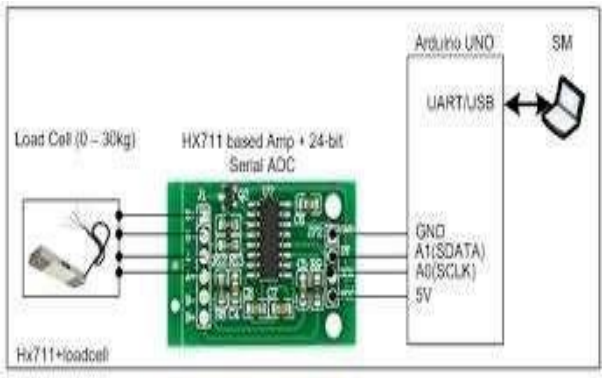

Fig. 7. Load cell

A load cell is a device designed to gauge mechanical force, particularly the weight of items. Presently, nearly all electronic weighing scales rely on load cells due to their exceptional accuracy in weight measurement. Load cells are utilized across various sectors where precision and exactness are paramount.

F. Wi-Fi Module

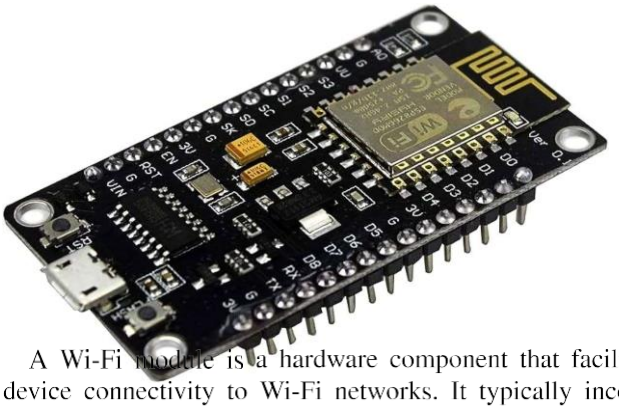

Fig. 8. Wi-Fi module

A Wi-Fi module is a hardware component that facilitates device connectivity to Wi-Fi networks. It typically incorporates a chip or module integrating Wi-Fi capabilities, enabling wireless transmission and reception of data over Wi-Fi networks. These modules are prevalent in diverse electronic devices, including smartphones, tablets, laptops, IoT devices, and embedded systems, enabling wireless internet access. They frequently feature integrated antennas and compatibility with standard Wi-Fi protocols, ensuring smooth integration across various products and applications.

G. IR Sensor

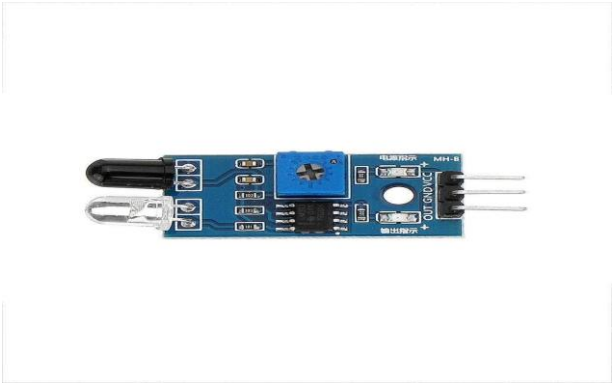

Fig. 9. IR Sensor

An IR sensor is an electronic device that emits light to detect objects in its vicinity. It can detect motion. Typically operating within the infrared spectrum, all objects emit some level of thermal radiation.

H. Buzzer

It serves as an output device responsible for producing sound or tones. Conversely, sensors function as input devices,

detecting environmental changes such as temperature or light and converting them into electrical signals. Conversely, the sound generator receives electrical signals to produce sound. A

Fig. 10. Buzzer

buzzer or beeper functions as an auditory signaling apparatus, available in mechanical, electromechanical, or piezoelectric variations (often shortened to "piezo"). Common applications of buzzers and beepers encompass alarm systems, timers, as well as auditory feedback for user interactions such as confirming a mouse click or keystroke.

III. Working

The work flow of the proposed model is depicted in Fig 11.The model is designed in such a way that user can add items and also remove items as per their wish.To remove the items from the cart user has to scan the RFID card again then price of the item is decremented from total cost.

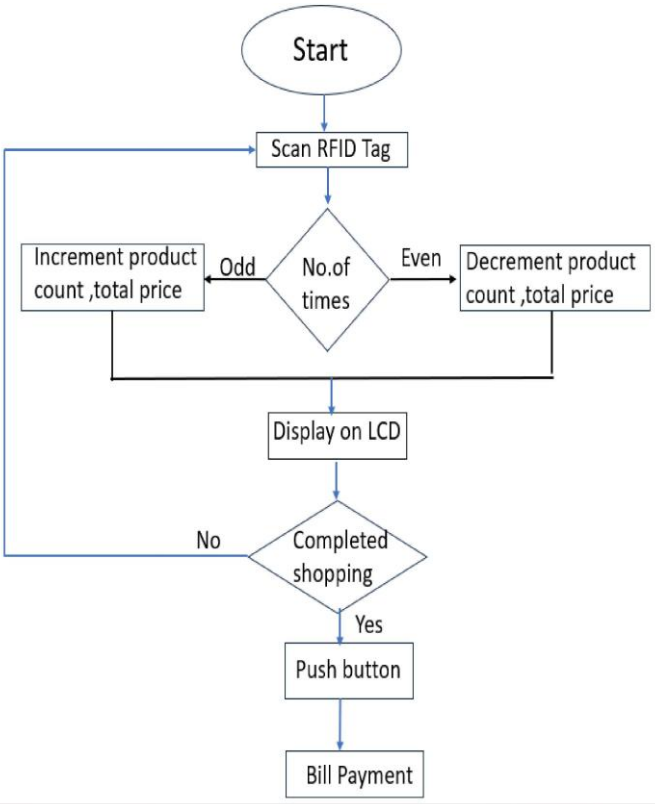

Fig. 11. Work Flow

IV. Result And Analysis

As a portable device, this product can be showcased through live demonstrations, exhibiting all described functions as follows:

Step 1: All the connections are made as shown in Fig 12.Arduino Uno is interfaced with LCD,RFID,Load cell,IR sensor and Wi-Fi module.

Fig. 12. Interfacing

Step 2: After connecting Arduino UNO to laptop and powering up the smart shopping trolley using push button, an initial message of welcome and scan the card is showcased on the LCD screen.

Fig. 13. Initializing

Step 3: Once powered on, the system is prepared to scan products. After the product is scanned the corresponding serial number,weight of the product,total number of products and total cost is displayed on LCD.If customer needs to remove an item then he/she can scan the tag again then price and product count is decremented.

Fig. 14. Scanning Process

Step 4: After completing shopping user needs to press push button which is provided within the trolley.Bill is generated

and sent to customer mobile through IoT cloud.

Fig. 15. bill generation

Step5: Customer needs to pay the bill through the app provided and then customer is allowed to take items from the cart.

Fig. 16. bill payment through app

Fig. 17. payment succesful

V. Conclusion

In summary, the smart shopping trolley stands out as a remarkable innovation in the retail sector, presenting a multitude of advantages for both retailers and shoppers. Through the integration of state-of-the-art technologies like IoT, RFID, and AI, these trolleys elevate the shopping journey by delivering instant product details, tailored suggestions, and effortless checkout procedures. The major difference between existing model and the proposed model is our smart shopping trolley is provided with theft detection.There is no need for manual checking of bill payment.The IR sensor and load cell provided within the trolley are responsible for theft detection.This is the major advantage in the proposed model.

Overall,embracing smart shopping trolleys holds the promise of transforming the retail realm, fostering heightened efficiency, personalized interactions, and enhanced shopping enjoyment for everyone involved. With ongoing technological advancements, we anticipate continued innovation in this domain, fundamentally altering the future of retail experiences.

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