Smart shopping cart with automated billing machine

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Abstract : The increased demand for fast and automated billing in retail atmosphere has encouraged the development of smart card with barcode-based checkout systems. This work presents an economical solution utilizing an Arduino UNO barcode scanner, 16 x 2 LCD display, push buttons, and USB host module to allow product identification and billing. The barcode scanner will read the code present on the product and sends the data to Arduino UNO through the USB host module, where the values which are scanned will be processed to restore the relevant product details that are saved in memory. The LCD display provides the product details like name, price, and weight of the product scanned to the user, while the buzzer will provide instant confirmation of successful scanning. The proposed system demonstrates efficient performance with high accurate scanning, less billing time, and very less human involvement compared to manual checkout methods. The experimental results confirm that the proposed prototype offers a great user convenience and can be successfully implemented it for smart retail shops and other billing-related applications.

IndexTerms **- Automated billing system, Barcode scanner, Arduino Uno, USB host module, I2C LCD display.**

I.INTRODUCTION

In recent years, retail shopping environment vs supermarkets face challenges such as long billing queues, increased waiting time, and also manual billing errors. Traditional checkout times require customers to wait at the billing counter, so this will affect customer satisfaction and reduce overall store productivity. To address these problems, automated shopping or smart shopping solutions integrating embedded systems, sensors, and automated billing mechanisms are emerging as effective alternatives. To address these problems, automated shopping solutions are being introduced which presents a smart shopping cart with an automated billing system that allows customers to scan the product. The system automatically retrieves product information, updates the total bill, and displays item details. This reduces the need for manual checkout by speeding up the checkout process. By shifting the billing operation from the counter to the shopping cart, the proposed system minimizes queues at the billing points and enhances the shopping experience. The technologies used are Audino Uno, Mitocontroller, Barcode Scanner, USB Host Module, 16x2 LCD Display, Buzzer, and Embedded C Programming.

II.RELATEDWORKS

[1] AI driven smart shopping cart with real time tracking and inventory forecasting for enhanced retail efficiency

AI driven smart shopping cart system designed to enhance retail efficiency and customer experience through real-time data analysis and using machine learning. The old shopping cart or the traditional shopping cart had lacked capabilities for tracking, inventory management, and the personalized customer interaction. The proposed system addresses these gaps with a multi-layer architecture that integrates person-specific tracking, reinforcement learning for navigation, and also long-short-term memory networks for demand forecasting, and also has seamless point-of-sale integration of automated billing. This architecture comprises real-time data capture, edge computing for low latency decisions, and cloud processing for customer profiling and inventory management. The experimental results demonstrated notable improvements in tracking accuracy, navigation efficiency, inventory forecasting, and also customer satisfaction, highlighting AI's transformative potential in retail.

[2] IoT-based smart trolley with integrated RFID reader and advanced billing system.

The RFID based smart trolley withadvanced biillng system is an alternative for the barcode scanner which is used to scan each item at the billing counter. This proposed system has a RFID reader that is integrated with electronic gear which is mounted on the trolley. There is an RFID tag on each item in the store. The information from the RFID reader scanning of this tag is processed by a microprocessor and shown on LCD panel. As the items are added to the basket, the prices are immediately added to the final bill. The bill is updated and displayed in the real-time on the LCD display available. The technology makes it simple to remove items from the card by automatically modifying the charge when an item is removed. When compared to the traditional techniques, this smart trolley system greatly expedites the checkout process, making shopping more convenient and effective for the customers. It also improves overall service quality by reducing crowds at the cashier counts and reducing the bill time and it improves the shopping experience

[3] Automated billing in supermarket using smart shopping cart

This particular system includes motion sensor, Liquid Crystal Display, RFID reader, push buttons, Zigbee and switches. In case the user is willing to avail the services provided by the smart trolley then the start button must be pressed. When a user places some product in the trolley then the code of the particular product will be identified by the utilization of RFID reader and further the product's cost will be added to the list and the sensor will identify the motion of the product for fault identification and the buzzer will be turned on in case of fault detection. Finally, the counter with the least number of queues will be identified and then display it on the cart LCD. Then, the final bill will be sent to the counter with the least waiting list using zigbee.

[4] Customer oriented service smart shopping cart

The system will offer a preliminary development of the smart shopping cart (SSC) that can be used in the smart mall system. The SSC can offer the customer the efficient user friendly interface so that the shopping experience can be efficiently promoted. In the present system, with the function of face recognition on the user interface, the SSC can recognize the customer and further offer the related shopping information based on the purchase history. With the use of RFID tags, the SSC can automatically identify the various products which are being added in the cart & display its information on the user interface. Finally, the automatic billing service can be accomplished by the SSC and the stored shopping data will be transmitted to the cloud server of the mall..

[5] Enhancing smart city retail with an iot driven smartshopping cart

The “Smart Billing enabled Shopping Cart” is an Internet of Things invention that will transform the shopping experience. It uses the ESP32 CAM, QR codes, and Arduino IDE. This project intends to improve and streamline the purchasing experience in a future where efficiency and convenience are critical. Traditional shopping carts no longer meet the modern consumer’s needs, which require laborious human data entering. This paper aims to develop a shopping cart that minimizes errors, streamlines data entry, and speeds up checkout. Users may scan products with a mobile app using the ESP32 Cam to affix QR codes to each item. It calculates the total cost and produces an itemised receipt. The work shows notable increases in user satisfaction and shopping efficiency.

[6] Smart line following shopping cart with billing system using RFID

A smart solution called the Smart Shopping Cart, which uses IoTtechnologyto make the shopping experience more efficient.. This system eliminates the need for standing in queues by allowing customers to scan products with an RFID system and placethem in a smart cart. The cart, equipped with a Node MCU and an LCD screen, displays the total price of the items as they are added customers can also see their total bill on a web server, which helps them keep track of their purchases more easily. To improve the shopping experience even more, the smart cart is designed as a robot that can follow a set path in the store.

III.RESEARCH METHODOLGY

The proposed system consists digital electronic circuit consisting of an Arduino as an embedded system has been developed that allows for a product to be identified and automatically recorded by scanning a barcode. An external regulated power supply provides power to each component of this system (the USB host interface, Arduino UNO, LCD display, and buzzer). The USB host interface receives data from the barcode reader; when a barcode is scanned, the barcode data will be sent to the Arduino. Once the Arduino has received the barcode data, it will look up the details of that item from the memory where the product information is stored. The LCD display will show the name of the item purchased, its price, and the total bill amount. A buzzer will sound when the barcode has been successfully scanned. Using this integrated system configuration will provide quick, precise and user-friendly billing without entering the information manually.

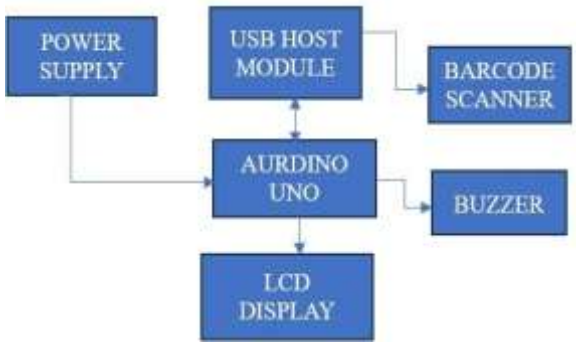

Fig.1Block diagram of proposed system

The system utilizes embedded hardware architecture to automate the billing process via barcode item identification. All modules within the system are powered using regulated DC power supplies to maintain system stability. Communication between the

barcode scanner and Arduino UNO occurs through the USB host module. The barcode scanner operates using a USB protocol; therefore, it cannot be directly connected to the microcontroller. When aproduct is scanned by the barcode scanner, the scanner reads an encoded product ID for that particular product and transmits this data via a USB host module to the Arduino UNO. The Arduino receives the scanned ID and matches it with the associated product from the stored product database or retrieves the associated product name/price from the stored product database. The Arduino will then display the matched ID along with other relevant details such as total purchases made based upon that scanned product on a 16x2 LCD display thus allowing customers to be up-to-date on what they are purchasing immediately after making their purchases. The user will also receive an audible beep from the buzzer upon each successful scan to enhance the user experience without users needing to continuously monitor the screen while checking out. This configuration of integrated hardware will provide smooth scanning, quick response time, and dependable billing providing the perfect solution for retail or smart card applications.

The five push buttons that are located on the right-hand side all connect from a digital input pin of an Arduino to the ground with the other side being a resistor to make sure that when the Button is not pressed (idle) the Digital Input pin reads a high state and when the button is pressed it will have a low state (or vice versa). These push buttons can be used for menu navigation to provide user input for the Arduino to change what is shown on the LCD depending on which button is pressed. The B1 button connects to digital input 7 and is named “Next”, so when the Cart push button is pressed you will be navigating through the Cart list. The B2 button connects to digital input 8 and is named “Total”, and whenever you press this button, the Cart List will be shown. The B3 Button connects to digital input 11 and is named “Ok” and when this button is pressed on a Cart item, a description of that item will be displayed, and if you long press this button, the item will be deleted from the Cart. The B4 Button connects to digital input 9, named “Clear” which clears the cart after you finish with the shopping and after you have completed your checkout. The B5 button connects to digital input 10, named “Checkout” and whenever this button is pressed, you will be in the process of checking Out.

The purchase procedure for a smart shopping cart system is depicted in the flowchart: Following Start and initial Set-up, the system loads product data into its database and displays a "ready to scan" prompt. When a barcode input is received, the controller searches the database for that code; if the product is found, it displays the product details. The shopper can then add the displayed item to the cart, and the system returns to the ready state so that scanning can continue indefinitely until the user presses the Bill button, at which point it displays the cart items and, finally the total cost, completing the transaction (END).The system works by first setting up the hardware and then uploading a product database to the local storage; the Arduino always remains in a state of “ready to scan”, gets barcode strings from the scanner via serial, and locally checks the database for a corresponding product code. If there is a match, the controller shows the product details on the I2C LCD and gives the customer the option (through the button) to add the product to the cart; in case of no match, it shows “No product”. The in-memory cart array gets each added item appended to it, and the running total is modified. The system goes back to scanning more items until the user hits the "Bill" button, then the Arduino shows the cart contents and the total amount for payment or further processing. Along the way, the code takes care of button debouncing, error detection for improperly formed barcodes, and (if desired) saving the persistent data to EEPROM or SD for recovery and logging.

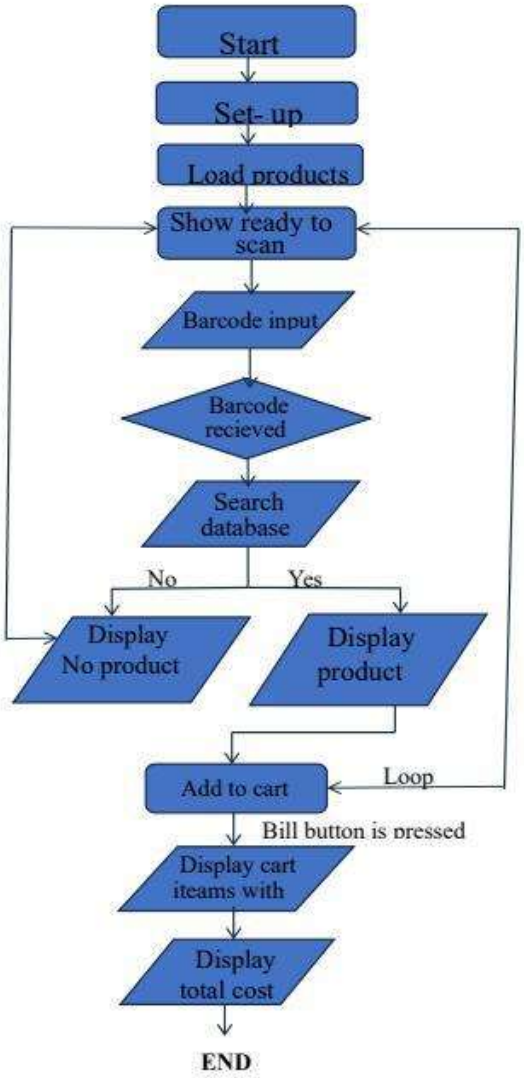

Fig.2 Flowchart

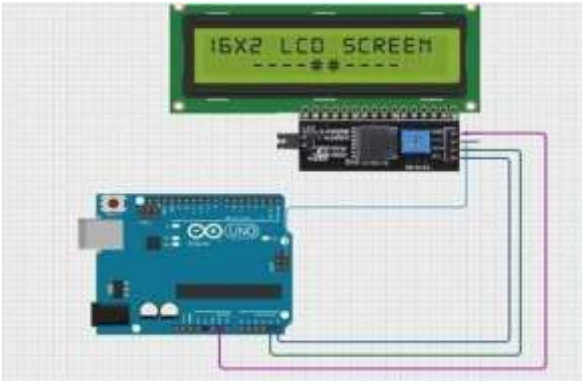

Fig.3(a)Ardunio & LCD Display Interfacing:

The interface of the Arduino with the LCD, as previously mentioned in this document, provides an easy-to-read visualinterface for the end user. It allows for a single source of control over the scanned binary data collected by the barcode scanners, while also generating a visual output. Additionally, due to using the 12C interface with only two signal lines, this solution does not require the multiple data connections associated with parallel-based connection systems. In this implementation, the data and clock lines of the 12C interface (SDA and SCL, respectively) are connected directly to the Arduino's A4 and A5 pinouts. The Arduino provides 5V and GND power to the interface via power connections between the 12C interface module and the Arduino. Therefore, the 12C-enabled LCD display requires only four connections (SDA, SCL, 5V, and GND) for the entire interface to function correctly. The integration of the two devices gives them both a reliability level of their own and, as such, provides the capability for real-time monitoring of product details, product prices, and other end-user instructions being communicated on-screen, in the form of visual output from the Arduino.

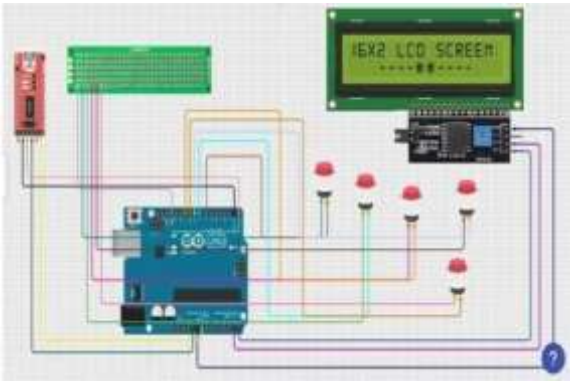

Fig.3(b)Interfacing Barcode Scanner and Buttons to Arduino

The Smart Shopping Cart System is primarily built around the Arduino Uno, which serves as the central processor for the entire system. The Barcode Scanner communicates to the Arduino via UART (TX/RX pins) when the user scans a product. The Push Buttons are connected to Digital Input Pins on the Arduino and can be used to add/remove/reset items on the shopper's account. A 16×2 LCD Module connects to the I2C interface of the Arduino using only two lines (SDA/SCL) plus power & ground this makes wiring easier; all modules and boards receive 5 volts with regulated supply from the Arduino.

IV.RESULT AND DISCUSSION

The proposed smart shopping cart with automated billing system was implemented using barcode scanner, a USB host module, Arduino UNO, 16x2 LCD display, and push buttons. The analysis of the system performance was done based on accuracy of scanning, response time, and user convenience. The experimental results illustrated that the system was able to read the barcode values of the product and collect the product details with consistent performance. A total of 50 test scans were performed with different product barcodes, out of which 48 scans were successfully identified and 2 scans were not identified due to improper placement of barcode and partially damaged barcode labels, which resulted in an accuracy rate of 96%. This indicates that the barcode quality influences the efficiency of the identification. The system took an average of 1.8 seconds to scan the barcode and display the product details on the LCD. Thequick response made sure that the product addition during the shopping activities went smoothly. With every new scan, the system also recorded the total billing amount dynamically. The billing algorithm's reliability was confirmed by the absence of competition error in accumulated billing. Further, there were no noticeable fluctuations or display delays in the LCD display and it gave clear and steady data visualization.

Fig.4(a)LCD module displaying system status message
“Scanner Ready” after successful initialization

Fig.4(b) LCD interface displaying scanning prompt and
real- time cart item count.

Fig.4(c)LCDdisplayingproductname,price,andup-
dated bill amount after barcode scan

When using the 16x2 LCD module, you will see the words "Scanner Ready" displayed initially as in Fig 4(a). This is the visual interface of the automated billing system, allowing users to see the status of their items at any time. The display provides user instructions (for instance, 'scan product') and provides information about how many total items have been scanned into the system (for instance, Cart: 0) as in Fig 4(b). After users scan their items, the system updates the total number of items scanned and the total amount that users have to pay .By providing a clear interface to guide users through each step, the display promotes more user-friendly experiences, lowers the risk of inaccurate billing, increases user confidence when using the automated billing system, and provides continuous real-time feedback to users. As you scan your item barcode, the LCD shows both the name of the product and the price that corresponds to that item in the system's database (for example, TPAK Rs. 185.00), and displays the full amount due for all items at that time (Rs. 500.00). Therefore, with each item you scan, the LCD will update both the cart count and the total due amount. The display will show Cart: 1 Rs. 185.00 and summarize your purchases and bill total to date as in Fig 4(c).

Fig 4(d) Barcode scanner mounted in the proposed system

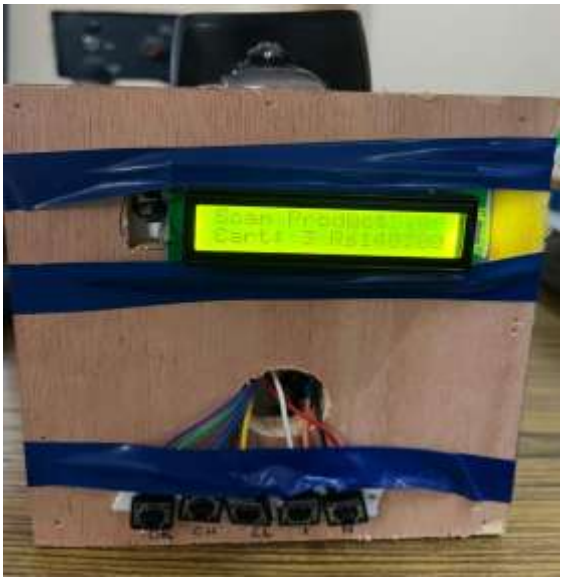

Fig 4(e) Working of prposed prototype

V. ACKNOWLEDGMENT

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