Smart Trolley Shopping for Automatic Billing & Assistance for Visually Impaired

Jabeena Shaik[1]

Department of ECE
[1]Assistant Professor, PBR VITS, Kavali, Andhra Pradesh-524201

Sk. Javedbasha[2], P. Madhu Tarun[3], G. Manoj Kumar[4], V. Hemanth Kumar[5], B. Venkata Sai[6]

Department of ECE
[2,3,4,5,6]UG Students, PBR VITS, Kavali, Andhra Pradesh-524201

Abstract **-** Billing products from the mall is difficult because people must wait in line for an extended time. Several strategies have been proposed to improve the visually impaired's fashion while minimizing contact in these pandemic times. We devised an innovative idea of a "Smart Shopping Cart for Automatic Billing and Assistance for the Visually Impaired." This project includes an RFID reader, a Liquid Crystal Display, an Arduino AT Mega 2560, and an ultrasonic sensor. When a customer places a product in the tram, an RFID reader reads the product's code and adds the price to the list. Assistance for blind people is also provided, ensuring that blind people have no difficulty moving around Mart. A speaker with preloaded audio is installed, and the final bill is displayed on the LCD and the billing computer.

Index Terms: Smart Shopping Cart, Visually Impaired, RFID reader, blind people, LCD.

I. INTRODUCTION

An embedded system product is a specialized computer system designed to perform specific functions within a more extensive system. These systems are typically embedded in a larger device or product and control or manage various aspects of the device's operation. It significantly improves the intelligence and comfort of our human lives. Visual impairment is the leading cause of regret in the world. According to World Health Organization (WHO) statistics from 2012, 285 million people are visually impaired. The world is challenging. There are 39 million blind people and 246 million with low vision. Approximately 90% of them reside in developing countries. A shopping mall provides daily necessities such as food, clothing, and electrical appliances. Customers every once in a while complain about missing product information and wasting time at the billing counters. The ancient billing system requires continuous improvement to improve the quality of the shopping experience for customers. The number of large and small shopping malls has increased worldwide due to increased public demand and spending. Special discounts are available during festival seasons. The shopping mall is highly crowded during holidays, etc. Due to rising public demand and spending, the global number of large and small shopping malls has increased. Many supermarkets use traditional shopping methods and barcode scanning, wasting labor and material resources.

Additionally, long wait times for payment and the exhaustion of pushing a trolley make clients suffer greatly and may cause passenger volume to decrease. As a result, the need to help reduce customer check-out queues and free people from pushing shopping carts has become an urgent issue to address. As a result, the paper proposes a system for reducing and potentially eliminating total customer waiting time while avoiding using human resources. The system detects obstacles and is primarily intended for blind people. The system also assists in locating the required products in the shop. It uses QR code technology to identify the product and determine the item's and person's position. The rate and name of each product purchased by the individual are added to the bill, which is also displayed on the LCD and announced over the speaker. This tram is capable of billing. The Internet of Things connectivity allows the rate to be compared to the outside market price, and the shopkeeper has full access to the details of the product purchased by the person. Blindness is defined as total or near total loss of vision. The term "visually impaired" refers to people with various conditions that affect their vision clarity and visual field. Common visual impairments include cataracts, glaucoma,

nearsightedness, farsightedness, corneal clouding, childhood blindness, blindness from birth (genetic defect), partial blindness, and astigmatism. As a result, it is safe to assume that visual impairment does not always imply blindness and that it is a far more common occurrence than previously thought.

II. LITERATURE

We know that only a few papers on RFID-enabled automated shopping trolleys for supermarkets have been published.

Sainath (2014) used barcode technology that customers used to scan products to implement an automated shopping trolley for a supermarket billing system. The bill will be forwarded to the central billing system, where the customer can pay by displaying a unique id. The limitation of barcode scanning necessitates scanning with a line of sight and should be kept within its limits.[1]

Budic (2014) used RFID technology to create a cash register line optimization system. The RFID-enabled system was created for smart shopping. RFID is used to scan products, and the data is saved in a database, where it can be paid online or via a centralised bill. It also employs a web application to track all purchases. It necessitates the administration of a web application server. There are no safeguards in place for the product that the client unintentionally drops into the tram.[2]

Dhavale Shraddha (2016) created an IOT-based intelligent trolley for a shopping mall that used RFID technology for billing during purchases and IOT for bill management through an ESP module. The payment data will be sent to the server, and the central billing unit will process the payment. The ESP module will act as a short-range Wi-Fi chip for wireless communication. However, there are some drawbacks, such as distance and interference. If there are many customers, the server will be busy, and internet connectivity must be consistent for the process to complete.[3]

Hsin-Han Chiang (2016) established an idea of an automatic billing system and programmed shopping trolley where they used face recognition for client authentication. It is not a simple straightforward method because face recognition of shoppers during shopping hours will be difficult and incorrect because malls can be crowded. Many mistakes are possible when using recognition for authentication.[4]

RFID-enabled intelligent devices Narayana Swamy (2016) created an interactive kiosk cart with a wireless sensor node and smart, automated shopping using RFID technology. They used a different website for billing administration and user interaction. Each user with a unique id connects to the web server for bill payment and invoice information. The use of the Internet is required for this service. As a result of the high load, the method may fail due to internet instability, and server error issues may arise.[5]

Prateek Aryan (2014) proposed a smart shopping cart with automatic billing and Bluetooth, in which billing is completed using a trolley and then transferred to the user's Android mobile via Bluetooth. Every customer cannot be expected to own a Smartphone, and Bluetooth may have limited range and connectivity issues.[6]

Suganya (2016) developed a model of automatic shopping with Arduino and an android application, which again requires the network to be constantly connected. Each client may or may not have Android-powered mobile devices. Billing is delayed as a result of network instability.[7]

III. EXISTING SYSTEM

Billing products from the mall is complex because people must wait in line for an extended period for billing. On weekends, the crowds are so dense that paying a bill can take more than 30 minutes. Our smart team can reduce this to 2 minutes, saving even more time. Customers can weigh their options and purchase products that meet their needs in such stores.

The disadvantage of this method is that employees scan product barcodes while customers wait in line. Daily activities such as reading signs and navigating can be challenging for visually impaired people. This includes going to supermarkets and other stores to get necessities. As a result, visually impaired people may require the assistance of a reader to read the product

Fig.1. Existing System.

As a result, living independently is nearly impossible for a visually impaired person. Even if some people,

such as older people, can perform routine tasks, they may have difficulty reading small letters and sentences.

This includes going to supermarkets and other stores to get necessities. As a result, visually impaired people may require the assistance of a reader to read the product.

IV. PROPOSED SYSTEM

By overcoming these constraints, we created the novel concept of a "Smart Shopping Cart for Automatic Billing and Visually Impaired Assistance." An RFID reader, an LCD, an Arduino AT Mega 2560, a Node MCU, a DF Player, and a servo motor are all included in this project.

When a customer places a product in a trolley, an RFID reader reads the product's code and adds the price to the list. Blind assistance is provided to ensure that blind people have no difficulties, and a speaker with preloaded audio is installed to announce the price and name of the item when it is added. Finally, the LCD and the billing computer will display the final bill. Each bill is given a unique id, which is saved in our database for future use.

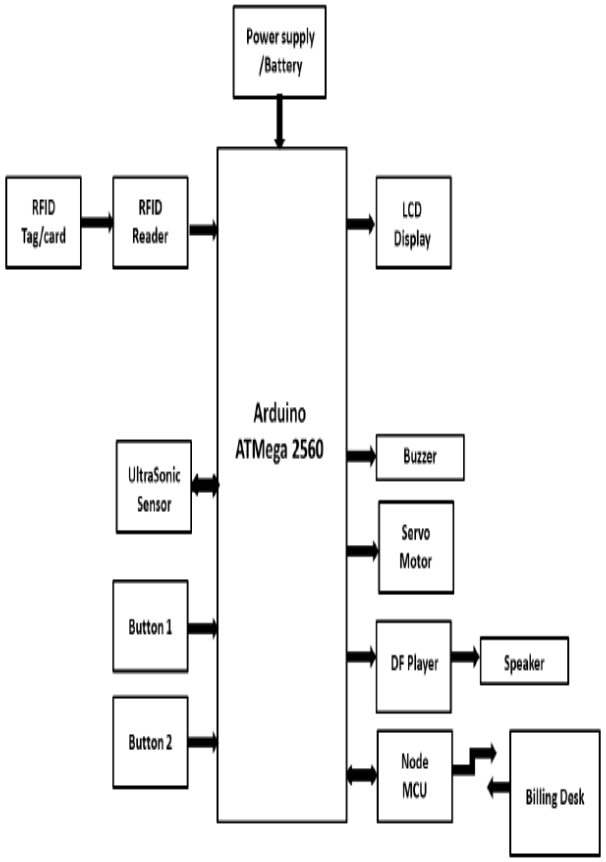

Fig.2. Proposed System.

The Arduino is chosen as the system's primary controller. All components are linked to the Arduino board, which houses an ATmega microcontroller. An RFID reader will scan the product and the cost of a new product added to the list. It will be displayed on the LCD. The ultrasonic sensor detects an obstacle and alerts them without colliding with anything. It will help through audio from the speaker. The total number of items in the trolley and their price are displayed on the LCD. Finally, the entire data set is sent to the billing computer, which prints the bill in 2 minutes.

Here, a buzzer and a speaker are used to generate sound and audio about the product and any obstacles. The DF player will send our audio through the speaker, which will be connected to the Arduino. The servo motor assists with the precise door opening. The billing desk is notified when the final bill button is pressed via NodeMCU.

A. Flow chart

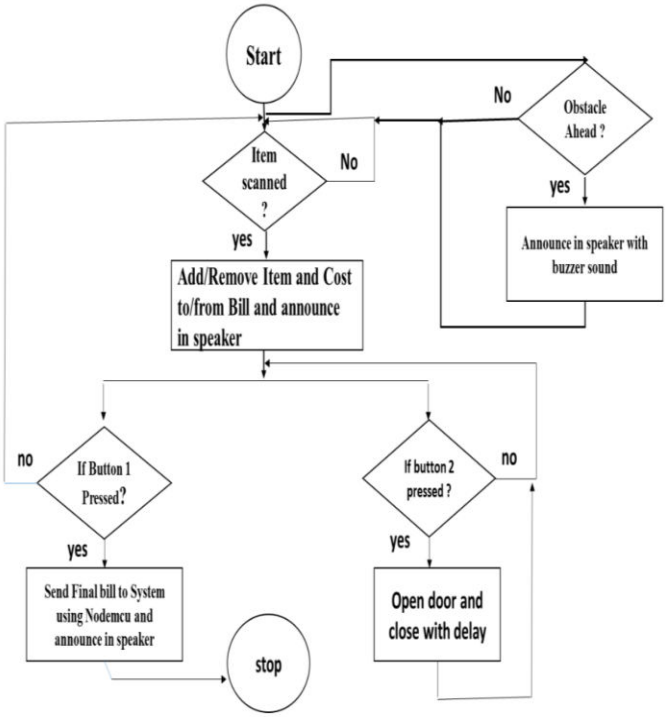

Fig.3. Flow chart.

The above flowchart depicts the project's workflow. When the Arduino board is turned on for the first time, it will determine whether or not the product has been scanned. It will be added to the cart if it is scanned. If the user does not want that product, they can open the door, collect it, and recheck it, and the product will be removed from the cart database. When the user presses button number one, the final bill is generated, displayed on the LCD, and shared with the billing desk. A module that detects obstacles will also be included; whenever an object approaches the user, it will emit sounds through the speaker, and that person will be alerted.

V. HARDWARE AND DESCRIPTION

A. ARDUINO MEGA

Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins, 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The board is designed to be compatible with most shields designed for the Arduino Duemilanove or Diecimila. The ATmega2560 microcontroller is a powerful 8-bit AVR-based microcontroller with 256KB of flash memory for program storage and 8KB of SRAM for data storage.

It also includes 4KB of EEPROM for non-volatile data storage. The Arduino Mega is a popular choice for projects requiring many input/output pins, such as robotics, home automation, and data acquisition. Its larger size and increased number of pins make it more versatile than other Arduino boards but also make it more expensive and power-hungry. Like other Arduino boards, the Mega can be programmed using the Arduino Integrated Development Environment (IDE), a free software tool for writing and uploading code to the board. The IDE includes several libraries and example code to help get you started with your project.

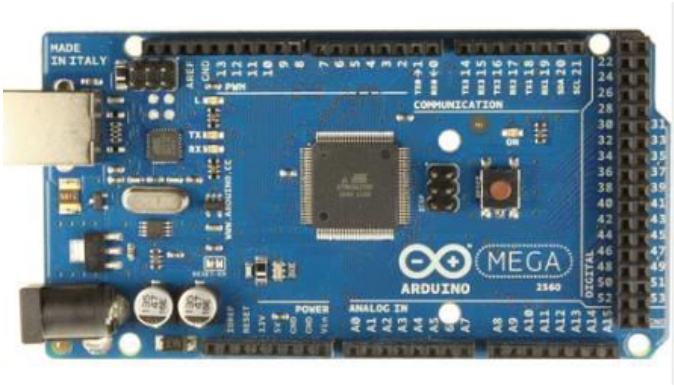

Fig.4. Arduino Mega board

The Mega2560 PCB's maximum length and width are 4 and 2.1 inches, respectively, with the USB connector and power jack extending beyond the former dimension. The board can be attached to a surface or case using three screw holes. The distance between digital pins 7 and 8 is 160 mil (0.16"), which is not an even multiple of the other pins' 100 mil spacing.

B. NODE MCU

NodeMCU is an open-source firmware and development kit that helps developers build Internet of Things (IoT) applications. It is based on the ESP8266 Wi-Fi module and includes a Lua interpreter on the chip. NodeMCU allows developers to easily program their IoT devices using the Lua scripting language, without having to deal with the low-level details of the ESP8266.

NodeMCU boards come with built-in Wi-Fi and are equipped with several GPIO pins, which allow developers to connect sensors, actuators, and other devices. Additionally, NodeMCU can be programmed using the Arduino IDE, making it easier for developers who are already familiar with the Arduino ecosystem to get started.

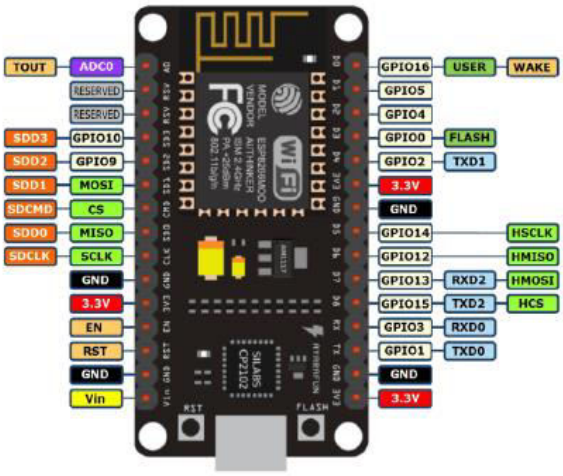

Fig.5. Node MCU

NodeMCU is a popular choice for DIY IoT projects and is widely used for prototyping and experimenting with IoT applications. It is also used in commercial IoT products, providing a cost-effective and flexible solution for connecting devices to the Internet. It comprises a 32-bit Tensilica L106 microcontroller (MCU) and a Wi-Fi transceiver. It has 11 GPIO pins (General Purpose Input/Output pins) and an analog input. You also get Wi-Fi communication, which means you can connect to your Wi-Fi network, connect to the Internet, host a web server with actual web pages, allow your smartphone to connect to it, and so on.

C. RFID READER

An RFID (Radio Frequency Identification) reader is a device that uses radio waves to read and capture information stored on RFID tags. An RFID tag contains a small microchip and an antenna, which can store and transmit data to the RFID reader via radio waves.MQ131 Sensor. RFID readers can be used for various purposes, including tracking inventory in retail stores, monitoring assets in manufacturing plants, tracking goods in supply chain logistics, and tracking livestock in the agriculture.

There are two main types of RFID readers: handheld readers and fixed readers. Handheld readers are portable and can be carried around, while fixed readers are typically installed in a specific location, such as a warehouse or a production line. RFID readers communicate with RFID tags using various frequencies, including low frequency (LF), high frequency (HF), ultra-high frequency (UHF), and microwave frequencies. The type of frequency used depends on the application and the distance between the reader and the tag.

Fig.6.RFID Reader.

Overall, RFID technology has revolutionized the way businesses and industries track and manage their assets and inventory, making the process more efficient and accurate.

D. RFID SMART TAG

RFID (Radio Frequency Identification) smart cards are a type of contactless smart card that use radio frequency technology to communicate with a card reader. RFID smart cards contain a tiny microchip and an antenna, which are embedded in the card. The microchip stores information, such as personal identification details, banking information, and access control information, while the antenna transmits and receives data between the card and the reader.

Fig.7.RFID Smart Tag.

RFID smart cards are used in a variety of applications, including payment systems, access control

systems, and public transportation. They offer several advantages over traditional magnetic stripe cards, such as faster transaction times, increased security, and improved durability. Additionally, RFID smart cards can be read from a distance, without the need for physical contact, which makes them more convenient for users.

E. 20x4 LCD DISPLAY

A 20x4 LCD (Liquid Crystal Display) display is an alphanumeric display that can show up to 20 characters per line, with 4 lines in total. Each character is typically made up of a 5x8 pixel matrix, and the display can be backlit for improved visibility.

These types of displays are commonly used in a variety of electronic devices, such as printers, digital scales, and industrial equipment. They are also popular in hobbyist projects and DIY electronics, as they are relatively easy to interface with microcontrollers and other electronic components. To use a 20x4 LCD display, you typically need to connect it to a microcontroller or other control circuit, which sends commands and data to the display. The control circuit communicates with the display using a set of signals, including a clock signal, data lines, and control signals such as enable and RS (register select).

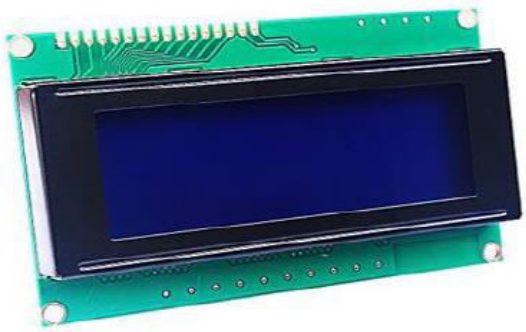

Fig.8.20X4 LCD Display.

Once the display is properly connected and configured, you can send text and other information to the display using a variety of commands, such as "clear display", "move cursor", and "write character". The display can also be configured to show custom characters or graphics, allowing for more advanced visualizations.

F. SERVO MOTOR

A servo motor is a type of rotary actuator or motor that is capable of precise control of angular or rotational position, velocity, and acceleration. It is designed to provide high torque and accuracy, making it suitable for various applications in robotics, automation, and other industrial and commercial settings.

The operation of a servo motor is based on feedback control. A control signal, typically in the form of a pulse width modulation (PWM) signal, is sent to the motor, and the motor responds by rotating to a specific position based on the signal. The rotation is monitored by a sensor, typically an encoder, which provides feedback to the control system.

Fig.9.Servo Motor.

G. ULTRASONIC SENSOR.

An ultrasonic sensor is a device that uses sound waves of high frequency to detect objects and measure distances. These sensors emit a short burst of ultrasonic waves and then measure the time it takes for the waves to bounce back after hitting an object. By using the speed of sound, the sensor can calculate the distance to the object. Ultrasonic sensors are widely used in robotics, automation, and security systems. They can detect obstacles, measure distances, and even identify the presence of liquids or solids in tanks or containers. Some common applications of ultrasonic sensors include parking assist systems in cars, object detection in industrial machinery, and distance measurement in medical equipment.

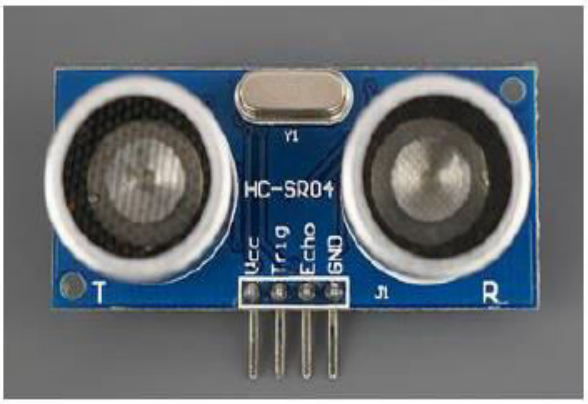

Fig.10. Ultrasonic Sensor.

Ultrasonic sensors come in different types and designs, including through-beam sensors, reflective sensors, and proximity sensors. They can also vary in sensing range, accuracy, and frequency.

H. PUSH BUTTON.

Push buttons are a type of switch that require physical pressure to activate or deactivate an electrical circuit. They are commonly used in a wide range of applications such as control panels, keyboards, remote controls, and industrial machinery. Push buttons can be momentary or latching.

A momentary push button will only make contact while it is being pressed, while a latching push button will remain in its last state until it is manually reset. Latching push buttons are often used for on/off switches, while momentary push buttons are used for functions such as start/stop, pause, or reset.

Fig.11. Push Button.

Push buttons come in a variety of shapes, sizes, and colors, and can be customized with symbols or text to indicate their function. They can also be illuminated to provide visual feedback or to make them easier to locate in low-light environments.

I. BUZZER.

A buzzer typically produces a continuous, loud, and often unpleasant sound. It is commonly used as an alarm or warning signal in industrial settings or emergencies. In general, the terms "buzzer" and "beeper" are often used interchangeably, and their specific meanings can vary depending on the context in which they are used.

Fig.12. Buzzer.

J.DF PLAYER AND SPEAKER.

DF Player is a small and low-cost MP3 module that is commonly used in electronic projects. It can play MP3 files from a microSD card and is controlled by an Arduino or other microcontroller through a serial interface. A speaker, on the other hand, is a transducer that converts electrical signals into sound waves. It is an essential component of audio playback systems such as music players, radios, and televisions.

When used together, the DF Player module plays MP3 files and sends the audio signal to the speaker for playback. This combination is commonly used in DIY audio projects such as MP3 players, sound effects generators, and voice recorders.

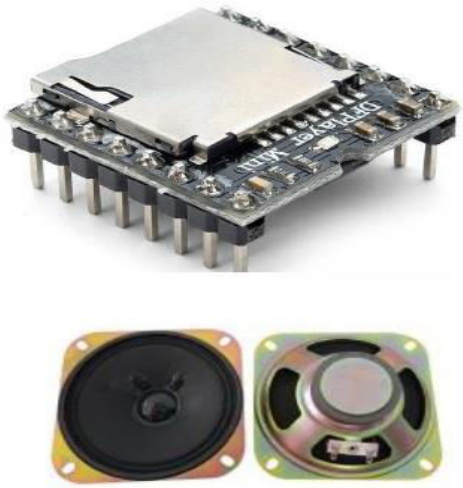

Fig.13. DF Player and Speaker.

VI. SOFTWARE AND DESCRIPTION

A.ARDUINO IDE

The Arduino Integrated Development Environment or Arduino Software contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus.

Fig.14. Arduino IDE.

B.BLINK APP

Blynk is an Internet of Things Platform aimed to simplify building mobile and web applications for the Internet of Things

Fig.15. Blink Application.

VII. RESULTS

The main goal was to design and build a trolly prototype for normal and blind users. The hardware and software worked together seamlessly. The results of the IOT-based Smart trolley showed its its working efficiency in grocery shopping. This design outcome reduces contact, saves time, and speeds up the billing process without a long queue.

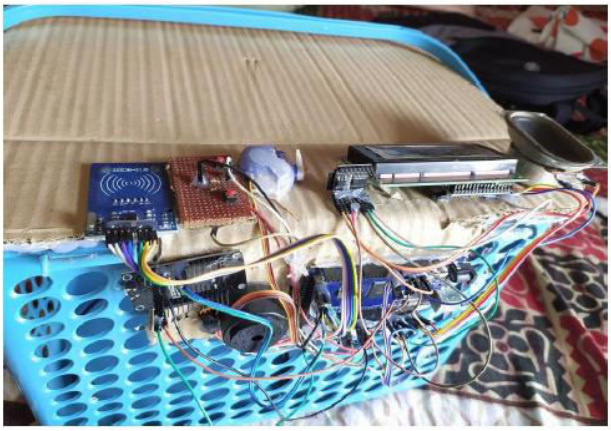

Fig.16. Outlook of smart trolley.

This smart cart is extremely simple to construct and use. The lighter it is, the easier it is to handle.

Fig.17. Welcome display of smart trolley.

Fig.18. Scanned Item not matched with database.

Total bill generated, and this bill was also sent to the billing desk for payment. If you press the final button, the open door will not function until the bill is paid.

Fig.19. Bill of Total Products.

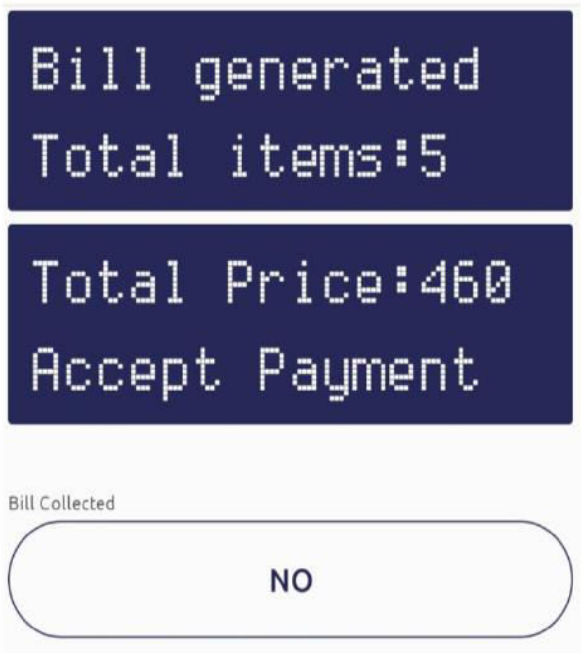

Fig.20. Final Bill in Blink App using Wi-Fi.

The voice system is also enabled, so that all product details can be heard through the speaker that they scanned. The billing system is also automated.

VII. Conclusion & Future Scope

In the prototype model developed, the intended objectives were met. The developed product is simple to use, inexpensive, and requires no special training. It is dependable, trustworthy, and time efficient. A blind user can shop with this project because it announces whenever there is an obstacle in front of the user and the names of items added to the cart with prices. The Future Scope of the Project we will introduce a Smart shopping trolley system that will reduce the customer's time in searching for the product's location. The customer only needs to say the product's name, and the cart will automatically direct them to the product's place in the shopping malls and marts.

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