JOURNAL OF BASIC SCIENCE AND ENGINEERING

"IOT BASED SMART TROLLEY FOR AUTO-BILLING USING ARDUINO"

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Abstract—Technology is advancing in various fields such as artificial intelligence, machine learning, virtual reality, touch commerce, and the internet of things. The paper focuses on addressing customer needs and emphasizes the importance of time in the real world. However, people often spend a significant amount of time in supermarkets, facing issues like long queues at the billing section and difficulty in calculating the total cost of purchased items.To tackle these problems, the paper proposes a solution known as the "Smart shopping trolley with automated billing." The IoT kit includes components like RFID tags, an RFID reader, LCD display, and Bolt ESP8266. The process involves consumers placing items in the trolley, where the RFID reader scans the RFID tag of each item, displaying the value on a digital display panel. Once the consumer completes their shopping, the bill is sent to the counter section, saving time and allowing consumers to know the total cost of their purchased items early on.

Keywords—LCD display, RFID reader, RFID tag, Shopping Trolley, IOT, Smart Cart, e-Billing, Arduino

INTRODUCTION

Smart Shopping Trolley with Automated Billing using IoT revolutionizes the retail experience by integrating IoT technology.

Features include automated billing, RFID/barcode scanning for item identification, and real-time inventory management.

User authentication ensures personalized access and payment options, with a mobile app for convenience.

Data analytics enable smart recommendations, while secure payment gateways ensure seamless transactions.

Customer support and efficient checkout processes enhance the overall shopping experience.

Energy-efficient design incorporates low-power sensors and automated lighting for optimal system performance.

The Smart Shopping Trolley with Automated Billing using IoT revolutionizes traditional shopping by integrating IoT technology. This innovation streamlines the retail experience, making it smarter, more efficient, and less burdensome for customers. By incorporating IoT into shopping trolleys, a seamless interaction between customers and the shopping environment is established, leading to automated billing processes that captivate customers' interest.

Traditionally, customers select items and then endure long queues for billing. However, with the Smart Shopping Trolley, the process is simplified. Customers only need to choose their items, and billing can be performed directly on the trolley, reducing their workload and enhancing engagement.

Equipped with various sensors and communication modules, these trolleys automatically recognize newly added items. Real-time data is then communicated with a centralized system, enabling automatic billing and transaction processing.

In the era of IoT, physical object interactions have become real, revolutionizing systems but also introducing disputes in data management, wireless communication, and real-time decision-making. Initially, paper bills were common, later replaced by barcode scanners. However, with the advent of RFID tags, a digital storage device for identification, a more efficient smart trolley billing system emerged.

RFID tags are scanned by readers via electromagnetic induction, requiring no power consumption. Customers scan product RFID tags using a reader in the trolley, updating the system's memory with product prices. This eliminates the time-consuming barcode scanning process, which relies on manual labor and has limited range.

Shopping malls are popular due to their convenience, but overcrowding leads to long queues at billing counters. To alleviate this, a device placed on trolleys allows customers to scan product barcodes using a camera. The bill, including product details and prices, is displayed on the screen, updated with each scan. At checkout, customers provide their trolley number to the cashier, who processes payment based on the displayed bill.

- **Automated Billing:** Implement a system that automatically calculates and generates bills based on the items placed in the trolley.
- **RFID or Barcode Scanning:** Use RFID tags or barcodes on products and a scanning mechanism on the trolley to identify items added or removed.

- **Inventory Management:** Keep track of available products, update inventory in real-time as items are added or sold, and send alerts for restocking.
- **User Authentication:** Allow users to log in using credentials or biometric authentication to access personalized features and payment options.
- **Mobile App Integration:** Develop a mobile application for users to interact with the system, view their shopping history, manage payments, and receive notifications.
- **Smart Recommendations:** Utilize data analytics to provide personalized product recommendations based on user preferences and shopping history.
- **Payment Gateway Integration:** Integrate secure payment gateways to facilitate seamless and secure transactions for customers.
- **Customer Support:** Include features for customers to contact support, provide feedback, and resolve any issues they encounter during their shopping experience.
- **Efficient Checkout Process:** Streamline the checkout process with options for self-checkout or assistance from store staff, reducing waiting times for customers.
- **Energy Efficiency:** Incorporate energy-saving technologies such as low-power sensors and automated lighting to optimize energy usage within the system.

Aim

The aim of the Smart Trolley System project is to create an efficient and personalized shopping experience by implementing real-time inventory management, streamlining operations, supporting sustainabilityefforts,ensuring scalability and future readiness, empowering local businesses, leveraging data-driven insights, prioritizing customer satisfaction and retention, and fostering continuous innovation.

Objectives

1. The primary goal is to develop a prototype of an automated motorized shopping cart, leveraging IoT innovations for a centralized and automated billing system using RFID technology.
2. The objective is to create a reasonable and profitable smart shopping cart aimed at enhancing the shopping experience by providing a technology-oriented, time-saving, and commercially viable solution.
3. The prototype aims to trail shoppers autonomously while possessing built-in intelligence to navigate and avoid obstacles efficiently.
4. By integrating RFID technology, the system facilitates centralized and automated billing, streamlining the checkout process for customers and enhancing operational efficiency for retailers.

Problem statement

The shopping cart system incorporates trolleys equipped with RFID readers, along with individual RFID tags attached to every product within the supermarket.

As customers place items into the cart, the RFID reader installed on the trolley identifies the unique RFID number associated with each product.

This seamless integration allows for automatic tracking and identification of items added to the cart, enhancing the efficiency of the shopping process.

Goal of the Study

The Smart Trolley System addresses several key challenges in traditional shopping experiences, including inefficient checkout processes, limited real-time inventory visibility, manual inventory management leading to stockouts or overstocking, and minimal opportunities for personalized customer engagement. These issues result in longer wait times, suboptimal inventory practices, reduced customer satisfaction, and missed revenue opportunities for retailers. The project aims to develop a solution that streamlines checkout processes, optimizes inventory management through real-time tracking, enables personalized customer interactions, and enhances overall efficiency and customer satisfaction in retail environments.

RESEARCH METHODOLOGY

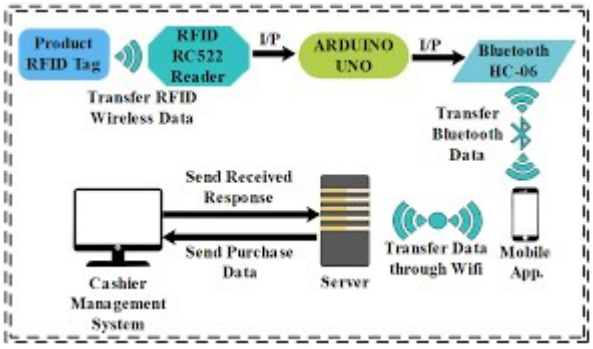
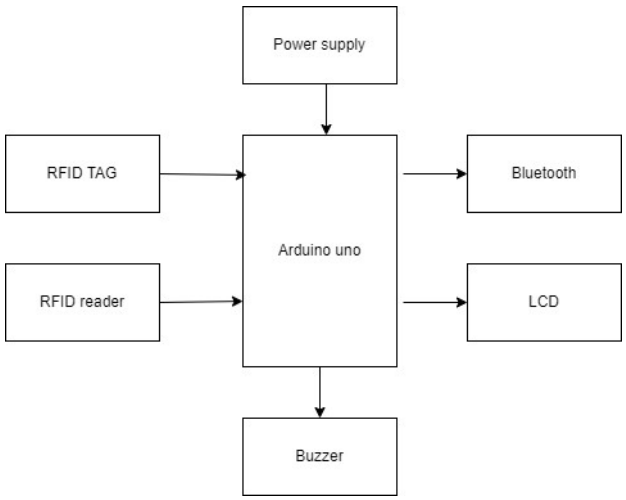


Figure1.1: Smart Trolley System Architecture

Figure1.2: Block Diagram



ArduinoUNO

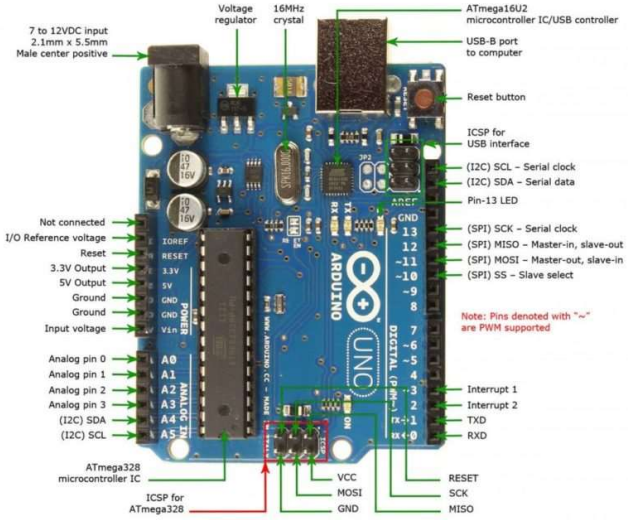


Figure1.3: Arduino Uno

- **Microcontroller:** Features the ATmega328P microcontroller, renowned for its low-power consumption and high performance.
- **Digital I/O Pins:** Equipped with 14 digital input/output pins, ideal for interfacing with a diverse array of sensors and actuators.
- **Analog Inputs:** Offers 6 analog inputs, facilitating the measurement of analog signals like temperature, light, and pressure.
- **Clock Speed:** Operates at a clock speed of 16 MHz, thanks to a quartz crystal, providing rapid processing capabilities.

- **USB Connection:** Includes a USB connection for easy programming and seamless connectivity to computers.
- **Power Jack:** Features a power jack for versatile power options, enabling operation via external sources like batteries or AC adapters.
- **Flexibility:** Being open-source, users have the freedom to customize both hardware and software according to their requirements.
- **Widely Used:** The Arduino UNO enjoys widespread adoption across diverse fields such as robotics, home automation, and IoT, owing to its user-friendly design and accessibility.

RFID Reader

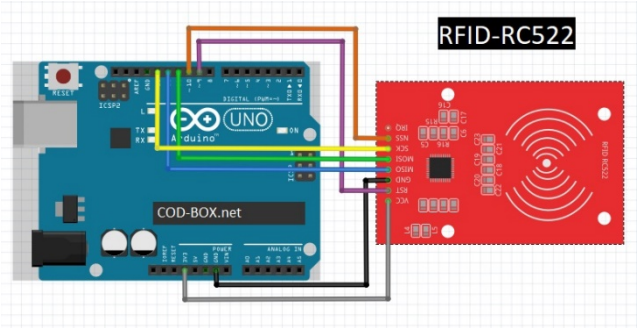


Figure1.4: Arduino Interfacing with RFID

Compact Design: The RFID Reader EM18 Board is compact and lightweight, ensuring easy integration into various systems and applications.

RFID Reading Range: Capable of reading RFID tags within a range of up to 10 cm, depending on the type of tag utilized.

Serial Interface: Utilizes the FTDI Basic Programmer to establish a serial connection, enabling seamless data exchange with computers or other devices.

User-Friendly: Designed for ease of use, requiring no specialized knowledge or skills for operation.

Cost-Effective: Combining the EM18 board with the FTDI Basic Programmer offers a low-cost RFID reading solution, ideal for budget-conscious users.

Power Supply: Operates on a 5V DC power supply, simplifying integration into existing systems.

LED Indicator: Features an LED indicator for visual feedback during tag reading processes.

Liquid Crystal Display (LCD)

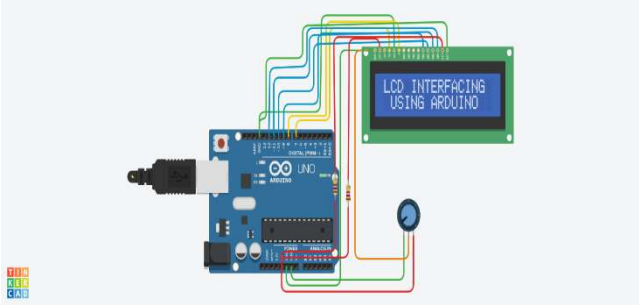


Figure1.5: Arduino Interfacing with LCD

LCD (Liquid Crystal Display) is a type of flat panel display predominantly driven by liquid crystals. Widely employed in cell phones, televisions, computers, and instrument panels, LCDs offer versatile applications for both consumers and enterprises.

Buzzer

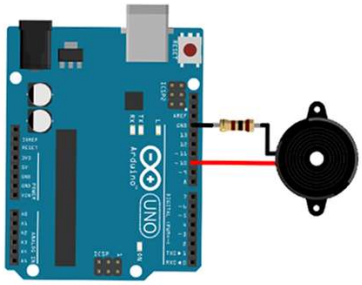


Figure1.6: Arduino Interfacing with Buzzer

We have provided the specifications of the active buzzer module below:

- It operates at a voltage range of 3.3V–5V DC.
- This buzzer module has a current rating of 30 mA at 5V DC.
- The resonance frequency of this buzzer is between 2500Hz ± 300Hz.
- It has a small size: 3.3 x 1.3 x 1.2 cm.

System Feature:

External Interface Requirements

User Interfaces

Home page

open camera page detects object page result page

Hardware Interfaces

The entire software requires a completely equipped computer system including monitor, keyboard, and other input output devicesArduino required.

Software Interfaces

The system can use Microsoft as the operating system platform. System also makes use of certain GUI tools. To run this application, we need python and above as Windows platform.

Communication Interfaces

Communication using python APIs

Safety Requirements

To ensure the safety of the system, perform regular monitoring of the system so as to trace the proper working of the system. An authenticated user is only able to access system.

Security Requirements

Any unauthorized user should be prevented from accessing the system. Password authentication can be introduced.

Software Quality Attributes

Accuracy: -

The level of accuracy in the proposed system will be higher. All operation would be done correctly and it ensures that whatever information is coming from the

Center is accurate. Result is organic results. Reliability

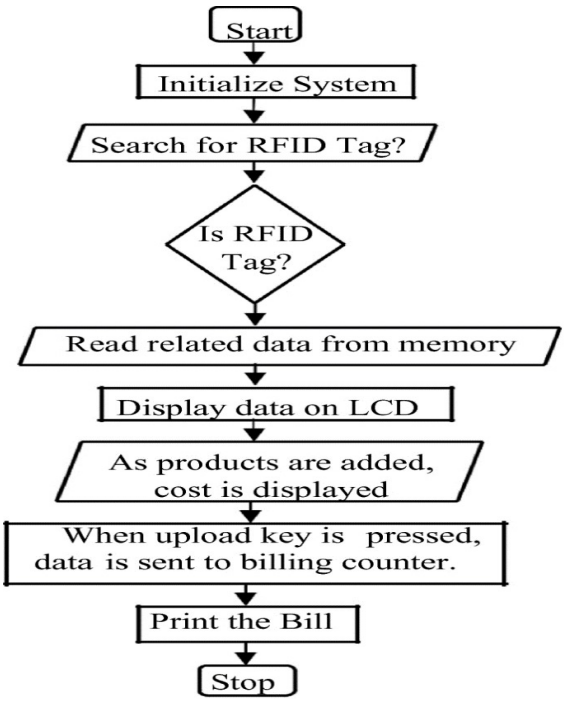
The reliability of the proposed system will be high due to the above stated reasons. The reason for the increased reliability of the system is that now there would be proper storage of information and Recommending location model.

Software Requirements (Platform Choice)

- Operating System - Windows
- Front End - HTML, CSS, Bootstrap
- Language - Python.

Hardware Requirements

- Processor - I3/I5/I7
- Speed - 3.1 GHz
- RAM - 4 GB (min)
- Hard Disk - 20 GB
- Key Board - Standard Windows Keyboard
- Mouse - Two or Three Button Mouse
- Monitor – SVGA
- Arduino



Flow Chart

Figure1.7: Flow Chart

Implementation Details

Hardware Selection and Setup:

Choose a microcontroller or single-board computer (e.g., Raspberry Pi, Arduino, or ESP32) as the core of the system. Assemble the hardware components, including sensors, communication modules, power supply, display, buttons, and any optional peripherals. Secure these components within the trolley's chassis.

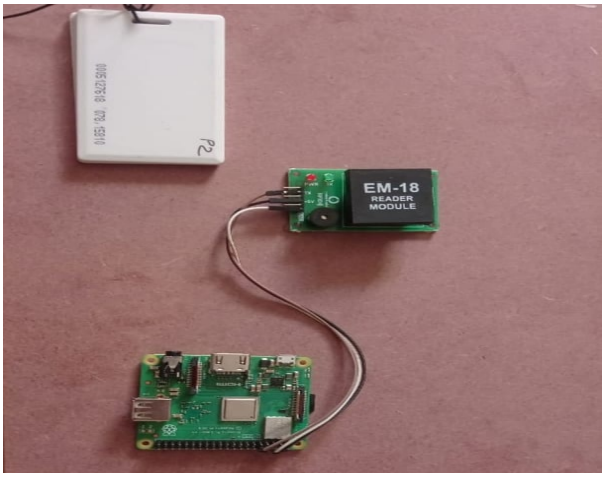


Figure1.3

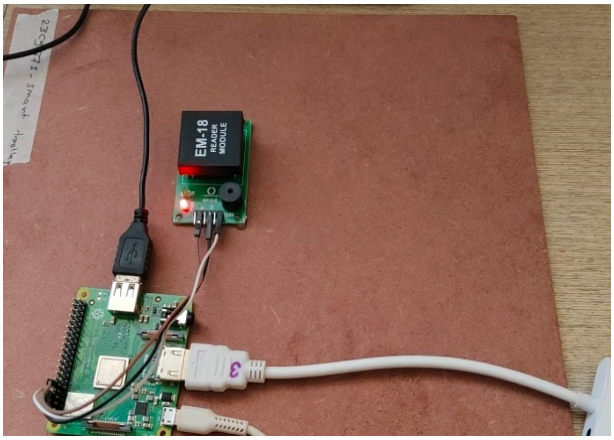
User Interface Development:

Design and implement the user interface using a touchscreen display or other suitable display technology. Develop user-friendly screens to start and manage shopping sessions, display items, and show the running total.

IOT Communication:

Set up the IoT communication module (e.g., Wi-Fi, GSM) and establish a connection to the IoT cloud platform.

Implement code to securely send and receive data between the trolley and the IoT platform using MQTT or other suitable protocols.



Item Identification:

Depending on your choice of technology (RFID or barcode), write code to identify products as they are added to the trolley.

Capture and store product information (e.g., name, price) for billing. Using the RFID read we can read the RFID tags

Initialization:

Initialize the microcontroller (e.g., Raspberry Pi or Arduino). Set up the IoT communication module (e.g., Wi-Fi, GSM).

Connect to IoT Platform:

Establish a connection to the selected IoT cloud platform (e.g., AWS IoT, Google Cloud IoT). Authenticate and authorize the trolley to send and receive data.

User Interaction:

Activate the user interface (display and input mechanisms) for customer interaction. Provide options for customers to start a new shopping session or continue an existing one.

Item Identification:

Use RFID readers or barcode scanners to identify products added to the trolley. Capture product information, such as name, price, and quantity.

Weight Sensing:

Continuously monitor the weight of the trolley to detect item additions or removals. Update the shopping cart based on weight changes.

Billing and Cart Management:

Maintain a data structure to represent the customer's shopping cart. Calculate the total bill by summing the prices of the items in the cart. Display the cart content and the running total on the user interface.

Real-time Data Transmission:

Send data about items added or removed from the trolley, along with the current bill, to the IoT cloud platform.

Use IoT communication protocols (e.g., MQTT) for efficient data transmission.

Payment Processing:

When the customer finishes shopping, provide a payment option through the user interface. Integrate with a payment gateway to process the payment securely.

Transaction Logging:

Record transaction details, including items purchased, total amount, payment status, and timestamps.

Store this information in a database on the cloud or a local server.

Security Measures:

Implement security features to protect customer data, such as encryption of communication and data storage.

Error Handling:

Handle potential errors, such as communication issues, sensor malfunctions, or payment failures. Provide feedback and guidance to the customer in case of errors.

Customer Feedback and Completion:

Once the payment is successful, acknowledge the completion of the shopping session. Offer the option to print or email a receipt.

Shutdown and Cleanup:

Ensure that all systems are properly shut down and cleaned up after the shopping session ends. Disconnect from the IoT platform and prepare for the next customer.

RESULTS & DISCUSSION

CONCLUSION

- The Smart shopping trolley is revolutionizing the supermarket experience, introducing a new trend that enhances user convenience.

- The system aims to streamline shopping, reducing consumer shopping time and minimizing the wait at billing counters.
- By providing real-time updates on total bill amounts during purchases, customers are empowered with better knowledge and control over their expenses.
- Implementation of the system reduces the need for numerous salespersons at billing counters, optimizing operational efficiency.
- The introduction of the Bolt ESP8266 device enhances system monitoring and control, offering ease of use compared to other IoT devices.
- Bolt, being an advanced IoT platform, utilizes Wi-Fi network transmission, eliminating the need for additional transmitting sensors and devices.
- The cart system promotes efficient shopping experiences, ultimately boosting customer satisfaction.
- User-friendly APIs incorporated into the project enable easy item purchase and removal, further enhancing user convenience.

ACKNOWLEDGEMENT

It gives me an immense pleasure and satisfaction to present this Research Paper on **"IOT Based Smart Trolley For Auto-billing Using Arduino"**which is the result of unwavering support, expert guidance and focused direction of my guide **Dr. Neelam A. Kumar**and I express my deep sense of gratitude and humble thanks to **Prof.B. A. Shinde**H.O.D. for his valuable guidance throughout the presentation work. The success of this Research Paper has throughout depended upon an exact blend of hard work and unending co-operation and guidance, extended to me by the supervisors at our college. Further I am indebted to our principal **Dr. K. Sujatha Rao**whose constant encouragement and motivation inspired me to do my best.

Last but not the least, I sincerely thank to my colleagues, the staff and all other who directly or indirectly helped me and made numerous suggestions which have surely improved the quality of my work.

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