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PROJECT REPORT

ON

Trolley Budget Scanner

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE

DIPLOMA IN COMPUTER ENGINEERING

SUBMITTED BY

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Computer Engineering Department

MAHARASHTRA STATE BOARD OF TECHNICAL

EDUCATION, MUMBAI

Academic Year **2024-25**

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PO 2. Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.

PO 3. Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

PO4.Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

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DECLARATION

I hereby declare that the project entitled **"Trolley Budget Scanner**" submitted for a diploma in Computer Engineering under MSBTE, is my original work and the project has not formed the basis for the award of any degree, association, fellowship or any other similar titles.

Signature of the Student:

Place:

Date:

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COMPUTER ENGINEERING DEPARTMENT

CERTIFICATE

This is to certify that the Project Report entitled **"Trolley Budget Scanner"** was duly submitted by the following students:

SUJAL BABUROA PATIL

(2209640183)

TEJAS TUKARAM HALVANKAR

(2209640216)

SHREYA SHANKAR AWARI

(2209640221)

Has been successfully completed in a satisfactory manner as a part of the project in partial fulfillment of requirements for the award of **Diploma in Computer Engineering** conferred by the **MSBTE.**

Project Guide	Project Co-ordinator
Mr. Urvesh Ghude	**Mrs. Sneha Koli**

HOD, Computer Dept.	Principal
Mrs. Smita Kuldiwar	**Dr.D.R.Suroshe**

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APPROVAL OF PROJECT

This report entitled **"Trolley Budget Scanner"** by the following students–

1. **SUJAL BABUROA PATIL - (2209640183)**
2. **TEJAS TUKARAM HALVANKAR -(2209640216)**
3. **SHREYA SHANKAR AWARI -(2209640221)**

Are approved for the Diploma of Computer Engineering.

Internal Examiner **External Examiner**

Date: - / /2024

Place:-SIOT, Kharghar, Navi-Mumbai

ACKNOWLEDGEMENT

It is a genuine pleasure to express our deep sense of thanks and gratitude to our **mentor** and **guide Mr. Urvesh Ghude**, lecturer, Diploma of Computer Department, Saraswati Institute of Technology. His dedication and a keen interest in the Field of Computer Engineering are responsible for the completion of our project. His timely advice, meticulous scrutiny, scholarly advice, and scientific approach have helped me to a very great extent to accomplish this project.

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ABSTRACT

The **Trolley Budget Scanner** is an advanced, budget-friendly shopping assistant designed to provide real-time expense tracking and eliminate the hassle of overspending. Built on an **Arduino UNO** platform, the system integrates a **barcode scanner**, a **16x2 LCD display**, and a **4x4 matrix keypad** to streamline the budgeting process. Shoppers can set a predefined budget using the keypad and scan items as they add them to their cart, with the system continuously updating the total cost. If the total approaches or exceeds the budget, an alert is triggered through an LED, preventing last-minute checkout surprises. The LCD display provides a clear view of scanned items, prices, and the remaining balance, allowing customers to make informed purchasing decisions. Additionally, a **removal feature** enables users to delete items if they exceed their financial limit, ensuring a flexible and controlled shopping experience. **By automating calculations and providing instant spending insights**, the Trolley Budget Scanner enhances convenience, reduces checkout delays, and empowers shoppers to stay within their financial goals, making it an essential innovation for modern retail environments.

Keywords- *Trolley Budget Scanner, Real-time expense tracking, Arduino UNO, Barcode scanner, 16x2 LCD display, 4x4 matrix keypad, Predefined budget, Automated calculations, Financial control, Shopping convenience, Smart shopping.*

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INTRODUCTION

CHAPTER 1 –

INTRODUCTON

1.1 Overview of The Project

The Trolley Budget Scanner is a smart and budget-friendly shopping assistant designed to help consumers track their expenses in real-time and avoid overspending. Built on an Arduino UNO platform, the system integrates a barcode scanner, a 16x2 LCD display, and a 4x4 matrix keypad to simplify the shopping experience by offering automated cost calculations and instant financial insights. Shoppers can set a predefined budget using the keypad before scanning items as they add them to their cart. Each scanned item's price is automatically retrieved and added to the total, which is displayed on the LCD screen along with the remaining balance. This continuous tracking allows shoppers to make informed purchasing decisions without the stress of manual calculations.

To ensure better financial control, the system is equipped with an LED alert mechanism that activates when the total cost approaches or exceeds the budget limit. This feature helps prevent unintentional overspending and allows users to adjust their purchases before reaching the checkout counter. If a shopper decides to remove an item due to budget constraints or a change in preference, the item removal feature enables them to delete it from the total calculation easily, ensuring flexibility in managing expenses.

1.2 Functional components of the project

The Trolley Budget Scanner consists of several key functional components that work together to enable real-time expense tracking and budget management while shopping.

1. **Arduino UNO** – The microcontroller that processes input from the barcode scanner and keypad, performs calculations, and controls output to the LCD display and LED alert.
2. **Barcode Scanner** – Reads item barcodes and retrieves corresponding price data to update the total cost dynamically.
3. **16x2 LCD Display** – Shows scanned item details, prices, total cost, and remaining balance, ensuring clear budget visibility.
4. **4x4 Matrix Keypad** – Allows users to set a predefined budget and access functions like item removal.
5. **LED Alert System** – Provides visual alerts when the total cost approaches or exceeds the predefined budget, preventing overspending.
6. **Item Removal Feature** – Enables users to delete scanned items if they exceed their budget, ensuring flexibility in shopping.
7. **Power Supply** – Provides the necessary electrical power to run the system, ensuring uninterrupted operation.

These components work in sync to automate budget tracking, offering an efficient and user-friendly shopping experience.

1.3 Existing System

The existing shopping system relies on manual price calculations or store-provided billing at the checkout counter, which often leads to overspending and financial mismanagement. Shoppers typically estimate their expenses mentally or use mobile calculators to track their spending, which is time-consuming and prone to human error. Supermarkets provide barcode scanners at self-checkout stations, but they only display the total cost at the end of the shopping process, leaving little room for budget adjustments.

Another common method is the use of budgeting apps on smartphones, where users manually enter prices or scan barcodes. However, these apps require internet access and may not always provide accurate price updates, leading to inconsistencies. Additionally, traditional shopping methods do not offer real-time alerts or item removal options to help users stay within their budget.

Without an automated system for tracking expenses in real-time, shoppers often experience last-minute checkout surprises when they realize they have exceeded their budget. This results in time-consuming product returns or additional financial strain. The lack of instant cost monitoring and budget enforcement makes existing shopping systems less efficient and prone to overspending, highlighting the need for an improved, real-time expense management solution like the Trolley Budget Scanner.

1.4 Proposed System

The proposed system, **Trolley Budget Scanner**, is designed to provide real-time expense tracking and efficient budget management while shopping. Unlike the existing system, which relies on manual calculations or delayed cost updates at checkout, this solution ensures continuous tracking of expenses as items are added to the cart.

Built using an **Arduino UNO**, **barcode scanner**, **16x2 LCD display**, and **4x4 matrix keypad**, the system allows users to set a predefined budget before shopping. As they scan item barcodes, the system automatically retrieves the price and updates the total cost, displaying real-time information on the LCD screen. This enables shoppers to monitor their spending instantly and make informed purchasing decisions.

To prevent overspending, an **LED alert** is triggered when the total cost nears or exceeds the set budget, ensuring financial control. Additionally, a **removal feature** allows users to delete items from the list if they exceed their budget or change their purchase preference, adding flexibility to the system.

By automating calculations and offering instant spending insights, the Trolley Budget Scanner enhances shopping convenience, reduces checkout delays, and prevents financial strain. It is an innovative and practical solution that empowers budget-conscious consumers, making shopping more efficient, stress-free, and financially responsible.

1.5 Advantages of Proposed System

The **Trolley Budget Scanner** offers several advantages over traditional shopping methods, making the shopping experience more efficient, budget-friendly, and user-friendly.

1. **Real-Time Expense Tracking** – Continuously updates the total cost as items are scanned, eliminating the need for manual calculations or estimates.
2. **Predefined Budget Control** – Allows shoppers to set a budget before shopping, helping them stay within their financial limits.
3. **Overspending Prevention** – An LED alert warns users when their spending approaches or exceeds the budget, reducing the risk of unintentional overspending.
4. **Instant Price Visibility** – The 16x2 LCD display provides real-time information on scanned items, prices, total cost, and remaining balance, ensuring transparency in expenses.
5. **Item Removal Feature** – Enables users to delete items if they exceed their budget or change their purchase decisions, adding flexibility to the shopping process.
6. **Automation and Accuracy** – Eliminates human errors in cost calculations and reduces reliance on mental estimations or mobile calculators.
7. **Time Efficiency** – Speeds up the shopping process by preventing last-minute checkout surprises and reducing the need for price verification at billing counters.
8. **User-Friendly Operation** – Simple interface using an Arduino-based system with a barcode scanner, keypad, and display makes it easy for shoppers to use without technical knowledge.
9. **Reduced Checkout Delays** – Shoppers are already aware of their total bill before reaching the counter, minimizing the need for returns or adjustments at checkout.

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CHAPTER 2
LITERATURE SURVEY

CHAPTER 2-

LITERATURE SURVEY

2.1 Literature Survey

Feature	Existing System	Proposed System (Trolley Budget Scanner)
Expense Tracking	Manual calculations or mobile apps	Real-time automated tracking
Budget Setting	No predefined budget feature	Users can set a predefined budget
Cost Updates	Displayed at checkout or manually calculated	Continuous updates on LCD screen
Overspending Alerts	No alert system	LED alert when budget exceeds
Item Removal	Requires manual adjustment before checkout	Items can be removed dynamically
Ease of Use	Requires effort to track expenses	User-friendly interface with automation
Time Efficiency	Longer checkout process due to adjustments	Reduces checkout delays
Accuracy	Prone to human error in calculations	Automated, accurate expense tracking
Dependency on Internet	Budgeting apps may require the internet	Fully offline system using Arduino
Financial Control	Users often exceed budgets	Encourages smart spending habits

The **Trolley Budget Scanner** effectively overcomes the limitations of traditional shopping methods by providing **real-time expense tracking, automated budgeting, and enhanced financial control**. Unlike the existing system, which relies on manual calculations and delayed cost updates, this solution continuously displays total spending on an LCD screen, allowing shoppers to monitor expenses instantly. The **predefined budget feature** ensures financial discipline, while the **LED alert system** prevents overspending by notifying users when they near their budget limit. Additionally, the **item removal feature** offers flexibility, enabling users to adjust their purchases dynamically. Operating **offline without internet dependency**, the system is **accurate, user-friendly, and eliminates checkout delays**, making shopping more efficient and budget-conscious.

By integrating a **barcode scanner, 4x4 matrix keypad, and Arduino-based automation**, the Trolley Budget Scanner simplifies the shopping process, reducing human errors and making cost tracking effortless. Unlike budgeting apps that require manual entry and internet access, this system functions independently, ensuring **seamless performance in any retail environment**. Its **user-friendly interface** allows shoppers to set budgets, scan items, and remove products with ease, promoting smarter financial decisions. With **instant price updates and automated calculations**, it eliminates last-minute surprises at checkout, making it an **ideal solution for budget-conscious consumers** who seek convenience, accuracy, and control over their spending.

2.2 Problem Statement

In the current shopping environment, most customers face challenges in managing their expenses while shopping, primarily due to the lack of a real-time budget tracking system. Traditional shopping methods rely heavily on manual estimation, where users either calculate costs mentally or use mobile calculators to keep track of their spending. This often leads to inaccuracies, miscalculations, and ultimately overspending, especially when shopping in bulk or without a clear plan.

Though some shoppers use budgeting apps, these solutions often require internet connectivity, manual data entry, and may not provide accurate or updated prices for products. Moreover, they are not integrated with hardware-based systems, making them less practical in real-world, fast-paced shopping scenarios.

Another significant problem is the absence of a predefined budget alert system. Customers are not informed when their spending crosses a particular threshold, resulting in last-minute product returns or unexpected bills at the checkout counter. Furthermore, the inability to remove items and recalculate costs dynamically adds to the inconvenience.

The lack of such integrated tools also leads to delays at billing counters, causing inconvenience to shoppers and store management. Hence, there is a need for a system that offers **real-time expense monitoring**, **predefined budget alerts**, **offline functionality**, and the ability to manage cart items directly—ensuring better control, convenience, and smarter financial decisions while shopping.

2.3 Specifications

The Trolley Budget Scanner system is developed using a combination of hardware and software components that work together to deliver a real-time expense tracking solution for budget-conscious shoppers. This section outlines the detailed technical requirements for successfully designing and implementing the system.

Hardware Requirements:

- **Arduino UNO Microcontroller:** Acts as the central processing unit of the system, handling all input/output operations, processing data, and running the embedded code that manages item scanning, budgeting, and display.
- **Barcode Scanner:** Used to scan the barcodes on product packaging and retrieve the associated price information stored within the system.
- **16x2 LCD Display:** Provides the user with real-time visual feedback of scanned items, individual prices, total amount spent, and the remaining budget.
- **4x4 Matrix Keypad:** Allows the user to input the predefined budget before shopping begins and to perform functions such as item removal.
- **LED Alert System:** Triggers a visual alert when the total expense approaches or exceeds the predefined budget, helping the user avoid overspending.
- **Breadboard and Jumper Wires:** Used to connect all the components during the prototyping phase of the project.
- **Power Supply:** Provides necessary power to run the Arduino and peripheral components. This can be supplied via USB or an external battery pack for portability.

Software Requirements:

- **Arduino IDE:** Used for writing, compiling, and uploading code to the Arduino UNO. It provides the development environment for creating embedded programs in Arduino C.
- **Embedded C / Arduino C Language:** Programming language used to write the logic for barcode reading, budgeting, item management, and display updates.
- **Serial Communication Libraries:** Required for enabling interaction between the Arduino and the barcode scanner for data transfer.
- **Price Database Logic (Hardcoded or Mapped):** As the system is offline, item names and prices are pre-defined and matched based on scanned barcodes using lookup tables or conditionals.
- **No Internet Dependency:** The entire system functions offline, making it suitable for all retail environments, regardless of internet availability.

This combination of hardware and software ensures a compact, efficient, and practical solution for real-time budget management during shopping.

CHAPTER 3
SCOPE OF THE PROJECT

CHAPTER 3

SCOPE OF THE PROJECT

3.1 Scope of the Project

The **Trolley Budget Scanner** project is aimed at simplifying the shopping experience by giving users a smart and affordable tool to monitor their expenses in real-time. This system particularly targets environments like supermarkets, grocery stores, and retail outlets where customers often lose track of their spending due to the absence of real-time tracking mechanisms.

This project focuses on **offline operation**, which is a significant advantage in areas where internet connectivity is limited or unavailable. By utilizing simple and cost-effective components such as the **Arduino UNO**, **barcode scanner**, **16x2 LCD display**, and **4x4 matrix keypad**, the system can be implemented even in low-budget retail settings.

The scope includes the ability to:

- Set a **predefined budget** before shopping begins.
- Scan multiple items using a **barcode scanner** to retrieve their prices.
- Display item information, total cost, and remaining balance in real time.
- Trigger an **LED alert** if the budget is about to be or has been exceeded.
- Provide an **item removal option**, allowing users to delete items from the cart and recalculate expenses dynamically.

This system does not rely on cloud storage, external servers, or mobile applications, making it highly **portable, reliable, and standalone**. It is also suitable for educational use, allowing students and beginners to understand embedded systems, automation, and real-world application development.

The **future scope** includes integrating:

- Wireless communication to sync with store billing systems.
- A price database (EEPROM or SD card) to store hundreds of product prices.
- A mobile interface using Bluetooth or Wi-Fi for expanded control and flexibility.
- Rechargeable battery support for a fully mobile and portable shopping assistant.

In addition to assisting individual shoppers, this project also holds potential benefits for **retail store management**. By integrating this system into shopping trolleys, store owners can promote faster checkouts, reduce queue congestion, and even collect anonymous data on customer purchasing patterns in future versions. This project can also be extended into an **academic learning tool**, introducing students to embedded systems, I/O interfacing, and real-world programming logic through practical, problem-solving applications. The scope of this system therefore lies not only in enhancing user convenience, but also in contributing to the **technological advancement of retail systems** and **education in automation.**

3.2 Limitations of the Current Scope

While the Trolley Budget Scanner fulfills its core objective of real-time expense tracking and budget control, the current version of the system has some limitations. These are primarily due to hardware constraints, simplicity of design, and the scope of a prototype-level project.

- The system supports only a **limited number of pre-coded items and prices**, as it lacks a dynamic database or external memory for large-scale product handling.
- **Prices must be hardcoded or manually mapped**, which means price updates require changes to the source code.
- The system does not support **wireless connectivity** (e.g., Wi-Fi or Bluetooth), so data cannot be transmitted to mobile apps or billing systems.
- The display is limited to a **16x2 LCD**, which restricts how much information can be shown at once (no item names, just prices and totals).
- The barcode scanner used is basic and may not support all formats or damaged barcodes effectively.
- The system has no **user authentication or data logging**, meaning each session starts fresh without user-specific history or reports.

Despite these limitations, the current model serves as a reliable proof of concept and lays the foundation for future development into a more robust and scalable product.

CHAPTER 4
METHODOLOGY

CHAPTER 4-
METHODOLOGY

4.1 Methodology Followed

The Trolley Budget Scanner project followed a **phased development methodology**, combining both theoretical planning and practical implementation. The primary goal was to develop a system that is low-cost, portable, and capable of offering real-time budget monitoring to users during shopping. The entire process was divided into several systematic stages to ensure efficiency and minimize errors.

The development began with a **problem definition and requirement analysis** phase, where the limitations of the current shopping systems were studied and key features for the new system were identified. This included the ability to scan items, track expenses live, set a user-defined budget, provide alerts, and support item removal.

Following the analysis, the **design phase** involved preparing conceptual layouts such as block diagrams and flowcharts. During this phase, the interaction between input devices (barcode scanner, keypad), output devices (LCD, LED), and the microcontroller (Arduino UNO) was planned. Decisions were made regarding pin connections, power distribution, and signal handling between components.

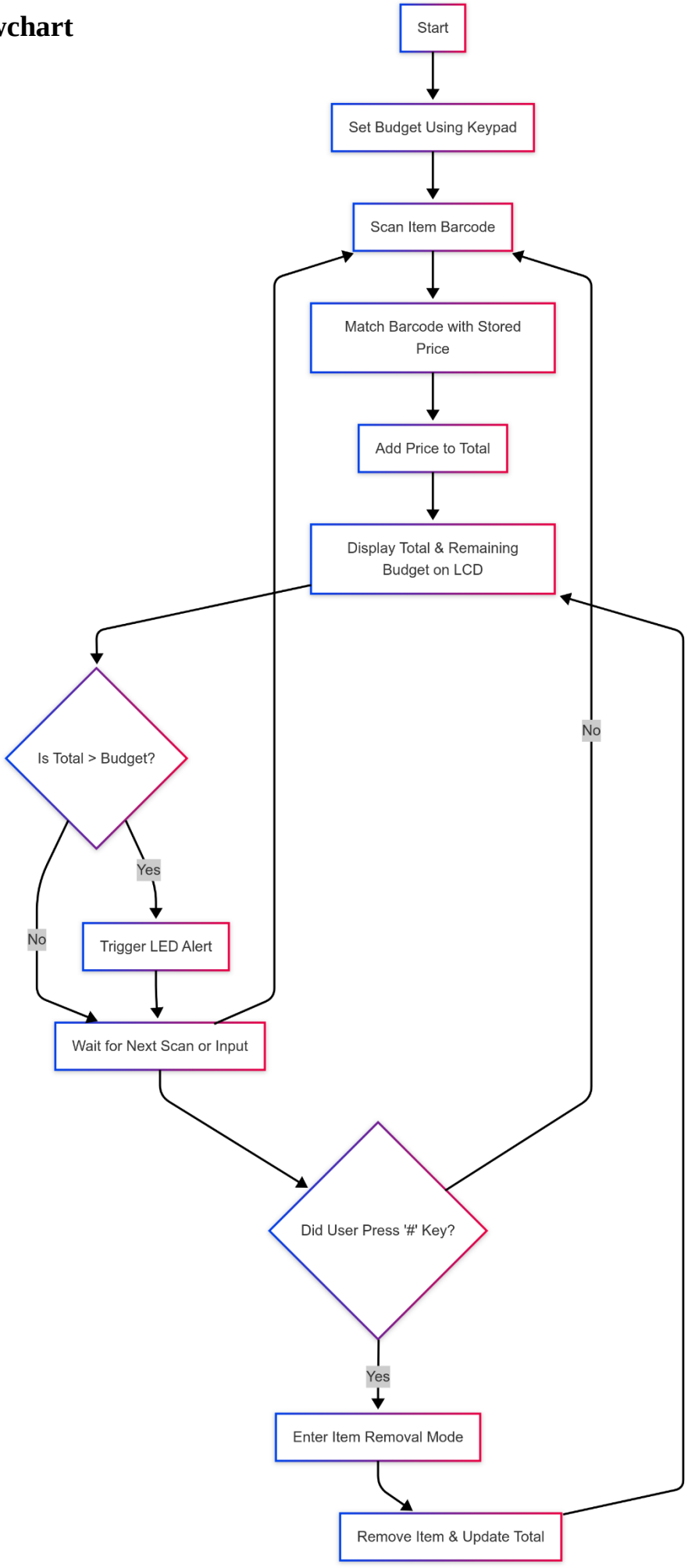
In the **hardware selection and integration phase**, components were sourced and tested individually. This included verifying the barcode scanner's output format, the LCD display's response with I2C or parallel interface, and ensuring that the keypad matrix was correctly mapped to detect numeric input. All these components were then mounted on a **breadboard for prototype assembly**.

The **software development phase** was carried out using the Arduino IDE. The program was written in **Arduino C**, incorporating logic for barcode identification, price mapping through conditionals, budget subtraction, LED alert triggering, and LCD updates. The code was structured in a modular way, enabling easy debugging and testing.

Once the initial integration was complete, the system was passed through a **multi-level testing phase**. Unit tests were conducted on individual modules (scanner, keypad, display), followed by integration testing and system testing. Several test cases were executed, including over-budget scenarios, rapid multiple item scans, and item removals. Necessary optimizations were made to improve display refresh rates, input handling, and responsiveness of alerts.

Finally, after successful validation, the system was documented, and the project was prepared for presentation with **diagrams, code explanation, and real-time demo capability**. The methodology used in this project ensured a balance between practical hardware interfacing and robust software logic, resulting in a fully functional and reliable prototype.

4.2 Flowchart



CHAPTER 5
DETAILS OF DESIGNS,WORKING AND PROCESSES

CHAPTER 5-

DETAIL OF DESIGNS, WORKING AND PROCESSES

5.1 Detail of Designs (14 B)

- **Block Diagram Explanation**

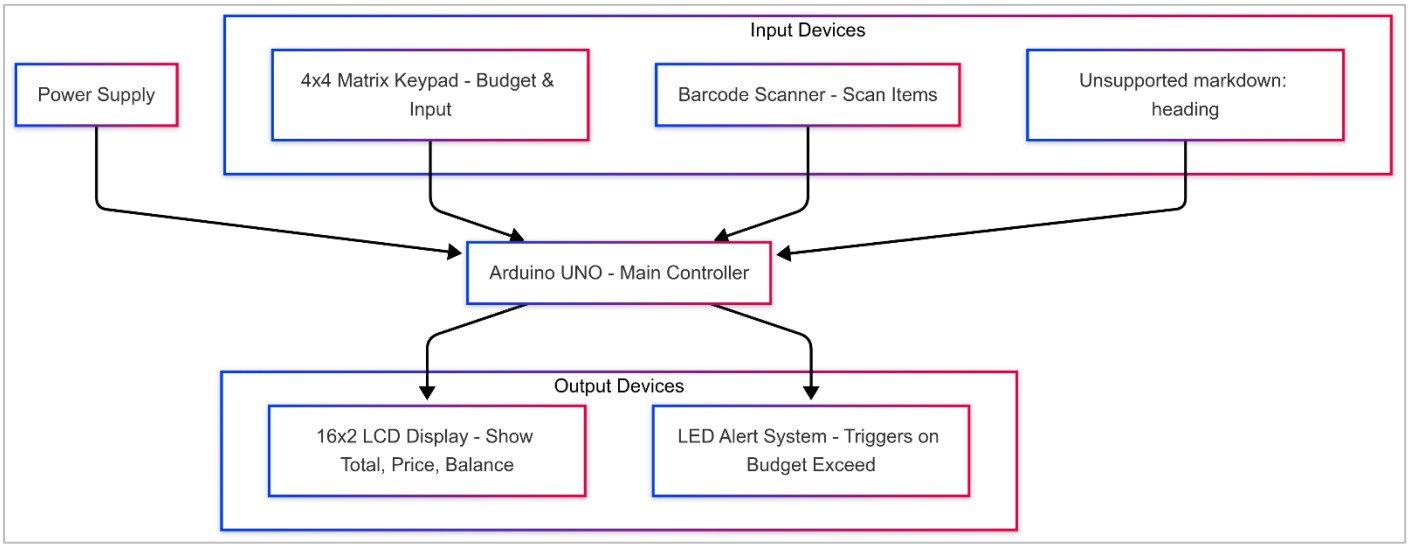
The block diagram represents the overall architecture of the Trolley Budget Scanner and how various components interact with each other. The system is built around an **Arduino UNO microcontroller**, which acts as the brain of the entire operation.

The **user inputs a predefined budget using the 4x4 matrix keypad**, which is then processed by the Arduino. The **barcode scanner** is used to scan the product barcodes, which are mapped to specific item prices in the Arduino's memory. Once scanned, the price is added to the total expense.

The **16x2 LCD display** shows the item's price, the total amount spent, and the remaining budget in real-time. If the total exceeds the predefined budget, the Arduino triggers an **LED alert system** to notify the user.

Additionally, if the user wants to remove an item, they can enter **item removal mode by pressing the '#' key on the keypad**. The system will then allow them to specify and remove an item, updating the total accordingly.

All components are powered via a **power supply**, either through USB or an external battery pack, ensuring portable operation.



5.2 Circuit :-

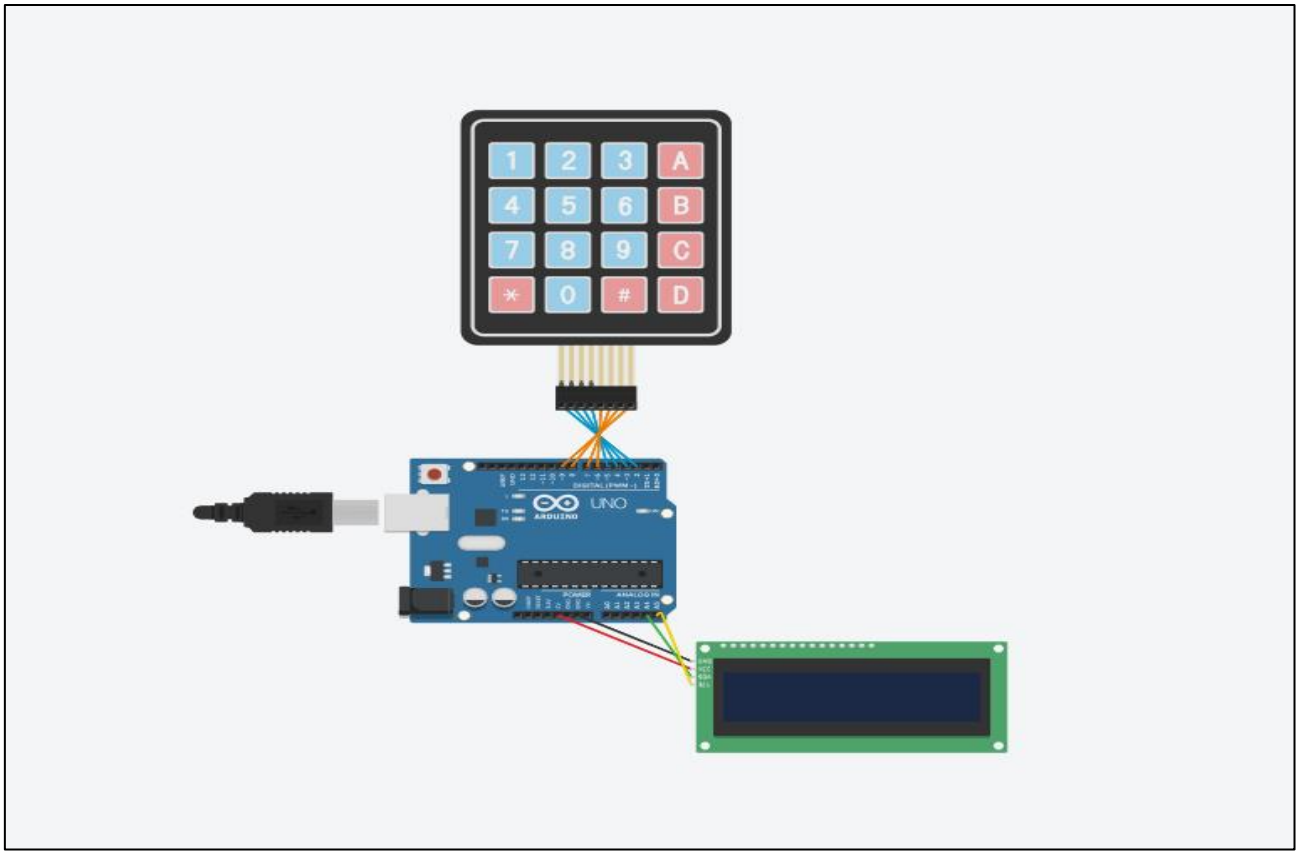
The circuit diagram outlines the physical wiring and connection of all hardware components used in the Trolley Budget Scanner system.

At the heart of the circuit is the Arduino UNO, which manages input from the keypad and barcode scanner, processes logic, and controls the outputs like the LCD and LED.

A 4x4 matrix keypad is connected to Arduino digital pins D2 to D9, allowing the user to input a predefined budget and access item removal mode using specific key presses.

The barcode scanner module is interfaced through Arduino's serial pins (TX and RX), enabling it to read barcodes and send corresponding item codes to the microcontroller.

The 16x2 LCD display, connected either through parallel pins or an I2C module (SDA to A4, SCL to A5), is used to display scanned item prices, total cost, remaining balance, and budget alerts.



5.3 GUI Design

The **Trolley Budget Scanner** project does not utilize a traditional graphical user interface (GUI) like software-based systems. However, it incorporates a **simple hardware interface** that effectively communicates with the user through a **16x2 LCD display** and a **4x4 matrix keypad**.

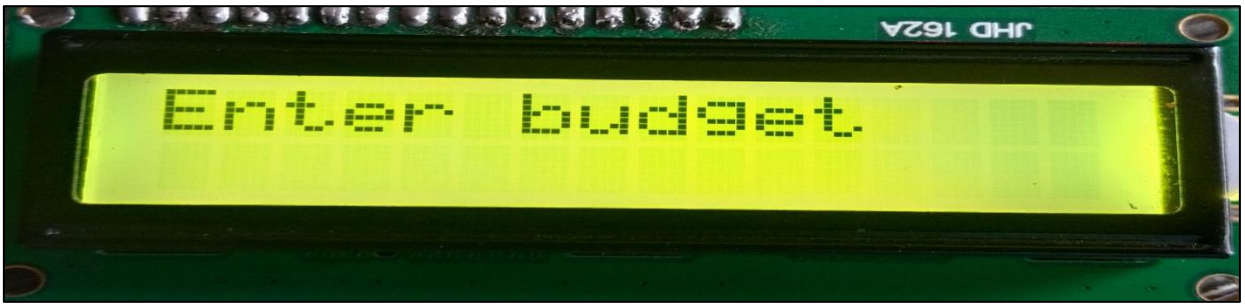
The **LCD display** serves as the primary medium for visual output, showing the following information in real-time:

- Current scanned item price
- Total cost of all items added
- Remaining budget balance
- Notifications such as “Budget Exceeded” or “Item Removed”

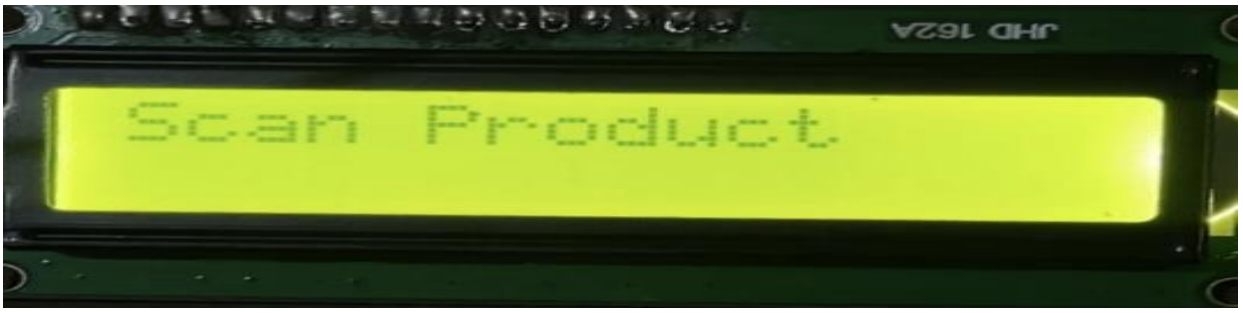
The user interface is designed to be **minimalistic, intuitive, and user-friendly**, allowing even non-technical users to interact with the system comfortably.

The user interface is designed to be **minimalistic, intuitive, and user-friendly**, allowing even non-technical users to interact with the system comfortably.

Enter Budget :



Scan Product :



Total Price:

5.4 Database Design

The **Trolley Budget Scanner** operates as an **offline embedded system**, and therefore does not use a traditional relational database. Instead, a **logical data structure is embedded directly into the Arduino code** to simulate database-like functionality.

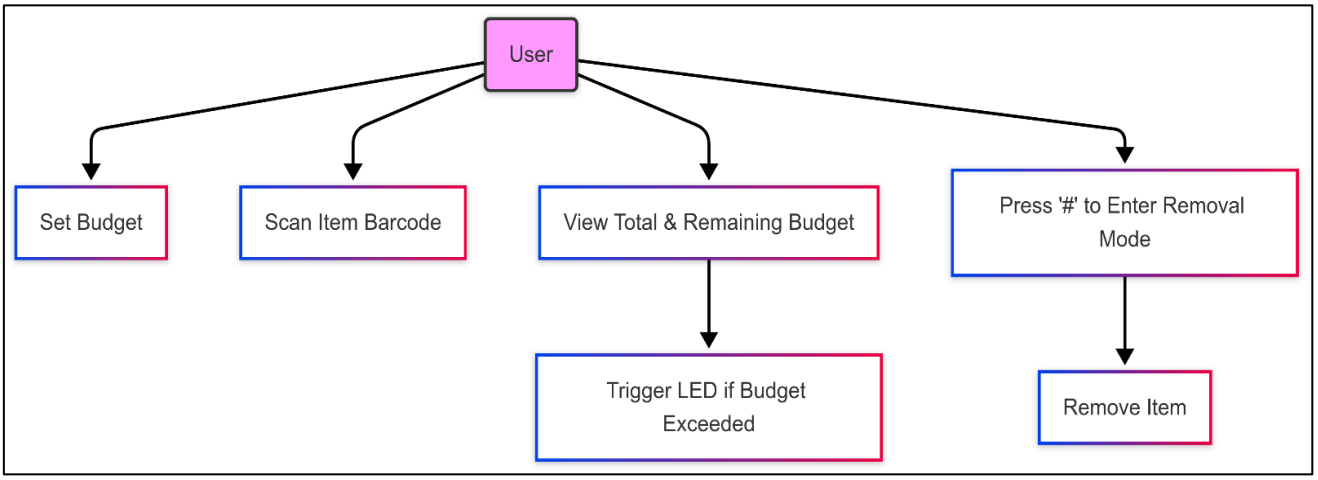
This internal data mapping allows the system to associate **barcodes with item prices**, enabling the Arduino to recognize scanned items and retrieve their corresponding prices during runtime. The data is typically stored using arrays, `if-else` conditions, or `switch-case` statements.

	barcode_id [PK] character varying (13)	product_name character varying (255)	price numeric (10,2)
1	4987176191205	Vicks	109.00
2	8901023003748	Tata Salt	22.00
3	8901030379844	Good Day	20.00
4	8901030702242	Surf Excel	10.00
5	8901030908316	Moti Soap	42.00
6	8901030970122	Rin	10.00
7	8901058000290	Maggie 70g	14.00
8	8901058008050	Maggie 280g	52.00
9	8901088136945	Parachute	138.00
10	8901138509231	Lip Balm	40.00
11	8901491100156	Amul Milk	28.00
12	8901526211715	Garnier	45.00
13	8901764362804	Juice	25.00
14	8902102163930	Exo Soap	10.00
15	8903105010382	Yardley	230.00
16	8906002460608	Parle-G	10.00
17	9900000364058	MED	50.00

5.5 UML Diagrams

Use Case Diagram:

This diagram represents the interaction between the **user** and the **functionalities of the system**. The user can perform multiple actions such as setting a budget, scanning items, checking the total, and removing items.



5.6 Working and Processes

The Trolley Budget Scanner functions as a standalone system designed to assist users in managing their expenses while shopping. The working of the system can be broken down into multiple phases:

1. Power On and Initialization

When the system is powered on, the Arduino UNO initializes all connected components — including the LCD display, keypad, barcode scanner, and LED alert system. A welcome message is shown on the display, and the system waits for user input.

2. Budget Input Phase

The user is prompted to enter a predefined budget using the 4x4 matrix keypad. Once entered, the budget is stored in memory and shown on the LCD. This becomes the maximum limit for the user's spending.

3. Item Scanning Phase

The user scans a product's barcode using the barcode scanner. The barcode value is matched with a predefined list of item codes and corresponding prices stored in the Arduino code (simulated database). The price of the scanned item is then:

- Added to the total cost
- Subtracted from the remaining budget
- Displayed on the LCD screen

4. Budget Monitoring and LED Alert

After each scan, the system checks if the total cost exceeds the budget. If so:

- The LED alert is triggered, flashing to notify the user that they have exceeded the set limit.
- The user can choose to continue scanning or remove items to go back within budget.

5. Item Removal Mode

At any point during the process, if the user presses the '#' key on the keypad, the system enters Item Removal Mode. The user can enter the code of an item they wish to remove. Once confirmed:

- The price of the removed item is subtracted from the total
- The remaining budget is updated
- Confirmation is displayed on the LCD

6. Final Checkout

Once the user finishes scanning all desired items, they can view the total expense and the balance left from the predefined budget. Since the system is offline, no billing is done — but the final cost is already calculated, reducing checkout time at the counter.

7. Power Off / Reset

After completion, the system can be manually reset or powered off. It then clears all stored values and returns to the initial state, ready for a new user session.

This entire process helps the shopper track their budget live, avoid overspending, and manage purchases dynamically, offering a smart, reliable shopping experience.

CHAPTER 6
RESULT AND APPLICATION

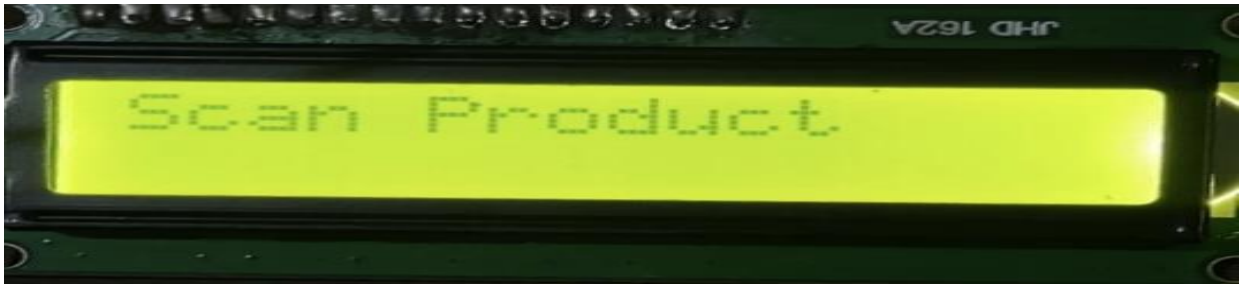
CHAPTER 6-

RESULT AND APPLICATIONS

6.1 Result :

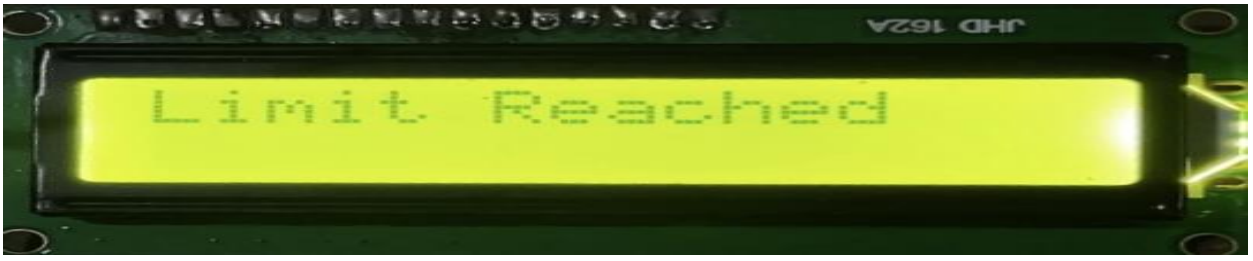
Enter Budget:

Scan Product:



Total Price:

Budget Reached:



6.2 Applications

The Trolley Budget Scanner system can be applied in the following areas:

- Supermarkets & Grocery Stores: Assists customers in tracking real-time expenses and staying within budget while shopping.
- College Campus Stores: Enables students to control spending efficiently without overstepping their limited monthly budgets.
- Bulk/Wholesale Retail: Useful for budget-conscious bulk buyers to calculate large purchases without human error.
- Smart Trolleys in Retail Chains: This system can serve as a core feature in future smart cart technologies in retail chains like Big Bazaar, Reliance Fresh, or DMart.
- Educational Projects: The system provides an excellent case study for embedded systems, IoT-based retail management, and budget-tracking automation.

6.3 Source Code

- **Arduino Code:-**

  https://github.com/SujalPatil21/Trolley-Budget-Scanner/blob/main/Arduino_code.ino

- **Python Code :-**

  https://github.com/SujalPatil21/Trolley-Budget-Scanner/blob/main/Python_code.py

CHAPTER 7
CONCLUSION AND FUTURE SCOPE

CHAPTER 7-

CONCLUSION AND FUTURE SCOPE

7.1 Conclusion

The Trolley Budget Scanner project successfully demonstrates the practical application of embedded systems in solving real-world problems such as overspending while shopping. Through the integration of affordable and accessible hardware components like the Arduino UNO, barcode scanner, 16x2 LCD, 4x4 matrix keypad, and LED alert system, a complete solution was developed that tracks shopping expenses in real-time.

This system helps users remain within their financial limits by continuously displaying the total amount spent and the remaining balance. The alert system acts as a preventive measure against exceeding the predefined budget. The manual item removal feature triggered through the keypad allows users to make immediate corrections in their purchase decisions, adding flexibility and control to the shopping experience.

Furthermore, the project emphasizes simplicity, cost-effectiveness, and offline functionality, making it suitable for a wide range of environments, including small retail shops and educational settings. From a learning perspective, the project has helped strengthen skills in microcontroller programming, sensor integration, and system design. The successful execution of the Trolley Budget Scanner highlights the potential of embedded systems in automating everyday tasks and creating smarter, user-centric technologies.

7.2 Future Scope

While the current implementation of the Trolley Budget Scanner meets its primary goal of budget tracking during shopping, there is significant potential to evolve this system into a more robust and scalable solution.

The most promising and planned enhancement is the development of a dedicated mobile application. This app will serve as a smart extension of the hardware system, allowing users to interact with the scanner through their smartphones.

Other possible upgrades include:

- Integration with external memory (EEPROM or SD card) for storing larger item databases.
- Upgrading from a 16x2 LCD to an OLED or mobile screen interface via the app.
- Supporting voice commands or audio alerts to enhance accessibility.
- Enhancing power management through rechargeable battery systems and energy-efficient sleep modes.

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8. Real-Time Expense Tracking Concepts – https://www.researchgate.net/publication/341620428_Real-Time_Budget_Monitoring_System_for_Smart_Shopping_Trolley

9. LCD & I2C Library Reference – https://github.com/johnrickman/LiquidCrystal_I2C

10. Data Sheets for Components Used –

- Arduino UNO: https://docs.arduino.cc/resources/datasheets/ABX00087-datasheet.pdf
- 16x2 LCD: https://cdn.sparkfun.com/datasheets/LCD/HD44780.pdf
- 4x4 Keypad: https://components101.com/switches/4x4-matrix-keypad
- Barcode Module (generic): https://www.sparkfun.com/datasheets/Sensors/Imaging/Barcode-Scanner-Module.pdf

Appendix-Assessment Sheet

PROGRESSIVE ASSESSMENT (PA) OF CAPSTONE PROJECT EXECUTION AND REPORT WRITING

Name of Student: Sujal Patil , Tejas Halvankar , Shreya Awari

Enrollment No: 2209640183 , 2209640216 , 2209640221

Name of Program: Computer Engineering

Semester: CO6I

Course Title and Code: Capstone Project Execution & Report Writing (22060)

Title of Capstone Project: "Trolley Budget Scanner"

A. POs addressed by the Capstone Project

a) Basic and Discipline specific knowledge.
b) Problem Analysis
c) Design / development of solution
d) Engineering Tools, Experimentation and Testing
e) Engineering practices of society, sustainability and environment.
f) Project Management
g) Life-long learning

B. COs addressed by the Capstone Project

a) Write the problem/task specification in existing system related to the occupation
b) Select, collect and use required information/knowledge to solve the problem / complete the task.
c) Logically choose relevant possible solution.
d) Consider the ethical issues related to the project (if there are any)
e) Prepare project proposal with action plan and time duration scientifically before beginning of project
f) Communicate effectively and confidently as a member & leader of team

Enrollment No	Student Name	Problem Indentification/ project Title	Punctuality and overall contribution	Project Diary	Execution of plan during fifth semester	Project report including documentation	Presentation	P.A Marks (25)
		10 Marks			5 Marks	5 marks	5 marks	25 marks
2109640183	Sujal Patil							
2109640216	Tejas Halvankar							
2109640211	Shreya Awari							

Name and Signature of Project Guide