Directio-AR Assisted ShopMate

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***Abstract*—In the expansive aisles of hypermarkets, locating specific products often proves challenging, leading to impulsive purchases and budgetary oversights. This app emerges as an innovative solution, combining augmented reality technology with machine learning to transform the shopping experience. The application features an AR way point using ARcore that shows the route to be taken to help the users in locating specific products efficiently within the supermarket. Customers follow the AR way point, effortlessly finding their desired items, enhancing their shopping experience. Upon reaching products the products are identified using real time object detection using YOLO model. After detecting the products using object detection the app provides information tabs displaying vital details like specifications, prices, ingredients, nutritional contents etc. The app promotes mindful spending by integrating a dynamic cart feature, allowing real-time expenditure tracking to ensure adherence to budget constraints. The system redefines grocery shopping, empowering customers with precise guidance, informed choices, and a more efficient and enjoyable retail experience.**

***Keywords*—Augmented Reality, ARcore, Object Detection, YOLO**

I. INTRODUCTION

In the bustling aisles of today's hypermarkets, maneuvering through a maze of products often poses a formidable challenge. Shoppers frequently encounter difficulties in locating specific items, resulting in frustration,impulsive purchases, and potential overspending. Recognizing the pressing need for innovation in the realm of retail shopping, an ingenious solution emerges: a cutting-edge mobile application seamlessly integrating augmented reality (AR) technology with advanced machine learning algorithms to revolutionize the shopping experience.Picture yourself entering a supermarket armed solely with your smartphone. With this innovative app readily available, finding your desired products transforms into a seamless endeavor. The app's AR waypoint feature serves as a personalized guide, leading you through the aisles with remarkable precision and efficiency. No longer do you need to aimlessly wander amidst endless shelves; instead, you effortlessly follow the virtual path illuminated by the AR waypoint, swiftly navigating to your desired items.

As you approach each product, the app employs real-time object detection powered by the state-of-the-art YOLO (You Only Look Once) model. Instantaneously, the

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app identifies the products within your vicinity, eliminating the need for laborious manual searches. With a quick glance at your device, a plethora of information about each product becomes accessible.The app's intuitive interface presents informative tabs divulging crucial specifications, prices, ingredients, nutritional contents, and more. Armed with this comprehensive knowledge, you're empowered to make informed decisions that align precisely with your preferences and dietary requirements. Whether you're a health-conscious shopper meticulously scrutinizing nutritional labels or a discerning consumer comparing prices, the app equips you with the confidence to shop with precision.

With the dynamic cart feature, you can monitor your expenditures in real-time, ensuring adherence to budget constraints. As you populate your virtual cart with items, the app meticulously calculates your total expenditure, furnishing you with transparency and control over your shopping expenses.In essence, this innovative system redefines the grocery shopping experience, placing power firmly within the hands of the consumer. By harmonizing cutting-edge technologies such as augmented reality and machine learning, the app furnishes shoppers with precise guidance, informed choices, and an enhanced, more efficient retail experience.With this groundbreaking app, grocery shopping transcends the mundane – evolving into an immersive and empowering journey. Bid adieu to the vexation of aimless meandering and embrace a new era of streamlined, mindful shopping. Embrace the future of retail with this transformative application, where every aisle beckons as an adventure waiting to be embarked upon, and every purchase is a well-considered decision.EASE OF USE

A. Background

In the dynamic realm of retail, traditional shopping encounters various hurdles, particularly in expansive hypermarkets and supermarkets. Shoppers often grapple with the overwhelming array of products, leading to frustration, inefficiency, and potential overspending. Recognizing these challenges, a team of forward-thinking technologists and retail experts embarked on a mission to reimagine the shopping journey.Inspired by cutting-edge technologies such as augmented reality and machine learning, the team sought to seamlessly integrate these innovations into the retail landscape. Through extensive research and development, they conceptualized a revolutionary mobile application aimed at alleviating the common frustrations of grocery shopping. Prioritizing precision and efficacy, the team endeavored to create a tool that not only guides shoppers to their desired items but also furnishes them with valuable insights to make informed purchasing decisions. Leveraging augmented reality, the app transforms supermarket aisles into navigable pathways illuminated by virtual waypoints, offering users an engaging and interactive experience.Complemented by real-time object detection capabilities, the app enables shoppers to effortlessly locate products and access detailed information with a simple scan of their smartphones. Moreover, the integration of machine learning algorithms ensures continuous enhancement of accuracy and efficiency, ultimately elevating the overall shopping experience. With a dedication to innovation and user-centric design, the team behind this groundbreaking app aims to redefine the grocery shopping paradigm. By empowering shoppers with intuitive tools and knowledge, they strive to facilitate smarter, swifter, and more mindful shopping experiences for all..

B. Relevance

Hypermarkets stand as vital hubs for meeting consumers' diverse shopping requirements, underscoring the need to tackle challenges related to locating products and accessing information effectively. This paper introduces an innovative mobile application that harnesses augmented reality (AR) technology and machine learning to transform the shopping experience within hypermarkets.The incorporation of AR waypoints within the app furnishes users with precise navigation assistance, alleviating the struggle of finding specific items amidst the vast aisles of hypermarkets. By overlaying virtual pathways onto the physical store layout, users gain the ability to navigate efficiently, reducing the time and energy typically expended with conventional shopping methods.Furthermore, integrating real-time object detection powered by the YOLO (You Only Look Once) model enriches the app's functionality by swiftly identifying products as users approach them. This feature not only streamlines the shopping journey but also ensures that users can readily access comprehensive information about each item through intuitive information tabs.Additionally, the app's dynamic cart functionality cultivates mindful spending habits by allowing users to monitor their expenses in real-time. By offering transparency and control over their shopping budgets, this feature encourages responsible financial management and aids users in adhering to budgetary constraints.In summary, this pioneering system reimagines the grocery shopping experience by merging state-of-the-art technologies to empower consumers with accurate guidance, informed decision-making, and heightened efficiency. Through its seamless integration of AR, machine learning, and budget management features, the application represents a significant breakthrough in retail technology, ultimately enhancing the overall shopping experience for hypermarket consumers..

II. RELATED WORKS

A. Mobile Indoor Navigation System In ios platform using augmented reality

The Mobile Indoor Positioning System for iOS revolutionizes indoor navigation with augmented reality (AR) and advanced algorithms. As a result, users can easily enter the starting and ending locations, activating the system that integrates the phone's accelerometer, compass and digital camera.rules are central, hastily calculating the shortest route between locations for real-time guidance, outpacing options in terms of responsiveness. Augmented truth complements the consumer experience through ways to preserve directional guidance on live digital camera feeds. This useful visual resource makes navigation intuitive and engaging, guiding users along a calculated path.The image processing strategy examines digital camera images in real time to confirm the user's location, postponing the need for a pre-assembled map database.This innovation integrates mapless environments or those that are subject to change.This utility relies on 19 key factors stored in its database to first calculate the route.At every moment, a brand new goal will always guide customers to their destination.However, the device's accuracy can be hindered by external factors such as light and magnetic interference, which affect the sensor's reliability.Additionally, calculating the step length required for consumer movement may also lack universality.In short, the mobile indoor navigation system for iOS provides dynamic, real-time, and extremely precise driving capabilities.Thanks to AR, superior algorithms and image processing, it constitutes a pioneering answer to indoor navigation.Despite the limitations, the ambition continues to innovate to optimize efficiency, making it indispensable in navigating complex interior spaces.

B. A low cost augmented reality system for wide area indoor navigation

The Low-Cost Augmented Reality System for Wide Area Indoor Navigation proposes an affordable and user-friendly solution for indoor navigation challenges, particularly for the visually impaired. Traditional GPS and Machine Learning are less effective indoors, leading to the development of this innovative Augmented Reality (AR) system. Using virtual anchors, the system guides users through a smartphone application, leveraging the device's camera and sensors. Tested in various environments, the system's scalability and adaptability show promise for revolutionizing indoor navigation.The iterative, user-centered methodology covers research, design, development, testing, and evaluation. Emphasizing universal accessibility, the design integrates AR, computer vision, and sensor fusion for optimization on low-cost devices. While the system excels in affordability, user-friendliness, and scalability with applications in transportation, healthcare, and education, ongoing research is needed to address accuracy, accessibility, and security challenges. Despite limitations, the Low-Cost AR System holds potential in reshaping indoor navigation for a diverse user base

C. Indoor navigation using augmented reality

This research addresses the limitations of being inner navigation systems by proposing a cost-effective and user-friendly result that leverages augmented Reality(AR) technology and Visual simultaneous Localization and Mapping(SLAM). The developed smartphone operation utilizes AR Core technology, barring the need for fresh structure and icing wide vacuity. The integration of AR enhances inner positioning delicacy and provides an fortified interface for stoners. The methodology employs Visual SLAM technology, starting with the accession of visual data through sensors and posterior point birth and shadowing to construct real- time maps of inner spaces. The AR inner navigation system, executed using Unity 3D, AR Core SDK, and AR Foundation, is demonstrated through a practical illustration at Dhanalakshmi College of Engineering. The app allows stoners to handpick locales, calculates optimal paths, and presents an AR Navigation Path for intuitive guidance. The architectural design encompasses the integration of AR technologies within the Unity 3D frame, optimizing the system's functionality. The user interface design facilitates indefectible commerce, allowing stoners to choose destinations and follow AR Navigation Paths. The performance phase details the creation of a mobile operation with venue menus, database integration, and the use of characteristic for position data. In conclusion, the proposed inner navigation system successfully combines Visual SLAM technology and AR, offering an effective and immersive result for navigating inner spaces. The study emphasizes a regular integration of attack, software, and user interface design, contributing to a realistic and accessible advancement in inner navigation systems

D. INSUS: indoor navigation system using unity and smart-phone for user ambulation assistance

The INSUS (Indoor Navigation System using Unity and Smartphone) offers a groundbreaking solution to indoor navigation challenges. Utilizing augmented reality (AR) on smartphones and Simultaneous Localization and Mapping (SLAM), INSUS provides users with directional arrows in a camera view, eliminating the need for additional infrastructure. Deployed at two universities, the prototype garnered positive feedback for its adaptability and user-friendly experience.INSUS's methodology encompasses thorough exploration of indoor navigation systems, emphasizing wireless signal-based localization, Visual SLAM, 3D modeling, efficient path planning algorithms, user-friendly AR interfaces, and REST API communication. This holistic approach addresses indoor complexities, promising an enhanced user experience. The synthesis of techniques reflects a forward-looking approach, showcasing innovation and a commitment to overcoming challenges. INSUS holds potential as a comprehensive solution, with

avenues for refinement based on user feedback and evolving technology.

III. METHODOLOGY

A. System Design

The AR supermarket navigation app integrates cutting-edge technology to enhance the traditional grocery shopping experience.The app leverages QR code scanning at the entrance to identify entrance coordinates and allows users to select products they wish to locate. Using AR technology, the app overlays virtual markers and directional cues onto the real-world environment, guiding users through the store efficiently.

The app integrates TensorFlow for object detection, enabling the identification of selected products and displaying detailed information such as ingredients, price, and ratings. Users can conveniently add items to their cart directly through the app. The admin panel provides easy access to users' carts with unique IDs, streamlining the checkout process.

This solution not only simplifies navigation within hypermarkets but also enriches the shopping experience by providing valuable product information. It offers customization options for users and data-driven insights for retailers, ultimately enhancing customer satisfaction and driving business growth. The app sets a new standard for retail, positioning hypermarkets as centers of innovation and excellence in the market.

B. Proposed Architecture

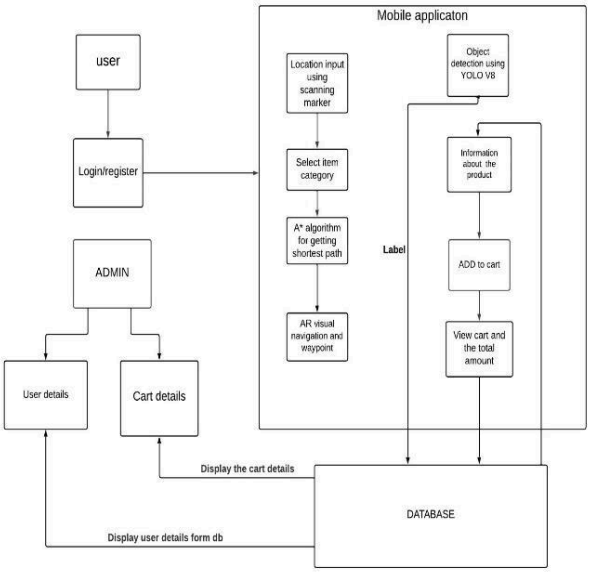

Fig 1.Architecture Diagram

C. Modular Design

This AR-shopmate system consists of mainly four modules : The Navigation module , The product detection module , Add to cart module and the Admin Panel. The Navigation module caters to enhancing the shopping experience by providing real-time directions and information, guiding customers to specific aisles or products. The product detection module caters to enhancing the shopping experience by enabling quick and accurate identification of products while Add to cart module provides users with a dynamic and intuitive shopping experience, allowing them to easily add desired items to their cart, view their selections using the customer ID feature, and proceed with checkout at their convenience.The admin panel offers comprehensive oversight and control, empowering administrators to effortlessly manage users, products, and inventory within the app. With intuitive functionalities, administrators can efficiently view and modify user details, monitor product listings, and seamlessly add or remove items to ensure a smooth and tailored user experience.

IV. IMPLEMENTATION

A. Creating Main Application.

Developing the main application revolves around utilizing Flutter as the primary development environment due to its versatility and user-friendly interface, complemented by Unity's robust features and capabilities.The app mainly has three Feature that are AR navigation,Object detection and providing informations and Add to cart feature.In the AR navigation module, the environment creation process begins with the creation of the environment floor plan using Unity, followed by the generation of the NavMesh to define walkable and non-walkable areas within the environment, ensuring accurate navigation. Subsequently, target markers and QR codes are strategically placed within the environment, serving as reference points for navigation. Scripts are then added to link these markers and QR codes, establishing a coherent navigation system. To provide visual guidance to the user, a line renderer component is employed to display AR waypoints, effectively guiding the user to their desired location within the environment. This comprehensive approach to environment creation and waypoint visualization ensures seamless and intuitive navigation for users within the AR environment.

Integration between a Flutter app and a Unity project is achievable through the flutter-unity-widget package.This creates a bridge between the two allowing you to control the Unity view from your Flutter app and exchange data. This is useful for AR-VR experiences or embedding interactive Unity elements within your Flutter app.For the object detection module, the process began with the collection of various product images, which were then labeled to create a custom dataset. Subsequently, the YOLOv8 model

underwent training using this custom dataset, resulting in a trained model that was saved for future use. Following training, the trained model was converted into the TensorFlow Lite (TFLite) format to ensure compatibility with mobile devices. Finally, the TFLite model was seamlessly integrated into the Flutter app, enabling real-time object detection functionality for users. This comprehensive workflow ensured the development of an efficient and accurate object detection system within the Flutter application, enhancing its overall functionality and user experience.

B. AR Navigation Module

The supermarket navigation app introduces an innovative approach to shopping convenience through QR code-enabled AR navigation. Upon scanning a QR code at the supermarket entrance, the user's location is established, facilitating seamless tracking as they move through the store. With the option to input their desired product category, users are guided with AR visual cues towards the designated aisle. Utilizing fixed product placement mapping, the app ensures accurate navigation, optimizing the shopping experience without the need for real-time location tracking. Through intuitive interface integration and real-time updates, users effortlessly navigate the store, enhancing efficiency and satisfaction.

1. QR Code Scanning and Location Retrieval:

- When a user scans the QR code at the entrance using the app, the software retrieves the coordinates of the user's current location.

- Similar QR codes placed at different locations within the supermarket facilitate continuous location updates, ensuring accuracy even if the user moves away from the entrance.

2. Fixed Product Placement:

- The locations of the products within the supermarket are set as target markers

3. User Input and Category Selection:

- After the initial scan, the user is prompted to enter the category of the product they are looking for.

- The app utilizes this input to determine the user's destination within the supermarket.

4. AR Path Visualization:

- Using Augmented Reality (AR) technology, the app overlays virtual visual cues, such as arrows or directional markers, onto the user's real-world environment.

- These visual cues guide the user along the optimal path to reach the desired product category, enhancing navigation efficiency and user experience.

5. Real-time Updates and Interaction:

- As the user progresses through the supermarket, the AR navigation module continuously updates the visual cues to reflect the user's changing location.

- Users can interact with the AR interface, zooming in/out or rotating the map for better orientation.

6. Seamless Integration and User Guidance:

- The AR navigation module seamlessly integrates with the app's user interface, providing intuitive guidance without obstructing the user's view.

- Users can follow the AR visual path to easily locate their desired products, enhancing overall shopping experience and efficiency.

C. Product Information

The Product Information Module seamlessly integrates object detection technology, backend processing, database management, and user interface design to provide users with comprehensive information about scanned products, within the mobile application. Users initiate the scanning process via the app, capturing images of products using their device's camera, which are then processed in real-time by YOLO model to accurately identify and localize the products. Upon detection, the app sends the captured product image and corresponding bounding box coordinates to the backend server through API requests, where the server identifies the scanned product and retrieves detailed information from the Firebase database. Finally, the app presents the retrieved product information in a user-friendly interface, empowering users to make informed decisions about the scanned products. This module enhances the user experience by providing seamless access to product details and facilitates interaction through features such as wishlisting or purchasing options.

1. Object Detection with YOLO:

- User initiates the product scanning process within the app,aiming the device's camera at the product.

- The app captures an image of the product.

- The image is processed through the chosen object detection model (YOLO), which has been integrated into the app.

- The object detection model identifies and localizes the product within the image, providing precise bounding box coordinates around it.

2. Backend Processing:

- The app sends the captured image along with the bounding box coordinates of the product to the server using an API request.

- Upon receiving the request, the server processes the data, recognizing that the object in question is a toothbrush.

- The server then interacts with the Firebase database, querying it for detailed information about the identified product.

3. Firebase Database Integration:

- Firebase serves as the backend database, containing a collection of product entries, each with attributes such as name, brand, and features.

- The server retrieves the relevant product data from Firebase by searching for the product's unique identifier or any other identifying characteristics.

- Firebase's real-time database capabilities ensure that the retrieved data is up-to-date and consistent.

4. Displaying Information in App:

- Once the server retrieves the product details from Firebase, it sends this information back to the app through the API response.

- The app formats the received product information and presents it to the user within the app's user interface.

- Users can view various details about the product, including its brand, features, and possibly user reviews, enhancing their understanding of the product.

- Additionally, the app may provide options for users to take further actions, such as adding the product to a wishlist or proceeding with a purchase.

D. CheckOut Module

The checkout module lets users add products to the cart and displays the total amount to be paid.The backend of a shopping cart module involves setting up a data structure, typically a database like Firebase, to store product information and cart details. API endpoints are created for functionalities such as adding, removing, updating, and retrieving items in the cart. Business logic handles these operations, updating the data structure accordingly. Calculations are performed to determine the total amount of the cart, considering product prices and quantities.Integration with product information ensures accurate total calculations.

1. Adding Products to Cart:

-The user can select the product and add it to the cart.

-The cart will display the item and the price of the item.

2. DataBase:

-A database is used to store information about the products in the cart.

-Firebase is used for this.

3. API Endpoints:

-API endpoints are there to interact with the shopping cart. These endpoints would typically include:

- Add to Cart: This endpoint would add a product to the cart. It would take parameters such as the product ID and quantity.

- Remove from Cart: This endpoint would remove a product from the cart. It would take parameters such as the product ID.

- Update Quantity: This endpoint would update the quantity of a product in the cart. It would take parameters such as the product ID and the new quantity.

- Get Cart: This endpoint would retrieve the current contents of the cart, including the list of products and the total amount.

4. Business Logic:

-logic to handle actions such as adding, removing, and updating products in the cart.

-It would typically involve updating the data structure that stores the cart information.

5. Calculations:

-logic to calculate the total amount of the cart.

-It involve summing up the prices of all the products in the cart, possibly taking into account quantities also.

E. Admin

The Admin Module provides administrators with a comprehensive platform to manage the system efficiently. Through secure login authentication, admins gain access to the admin dashboard, where they can seamlessly add and manage product details, view user information, and interact with user carts. Adding a new product involves inputting relevant details, which are validated and stored in the backend database, subsequently reflected in real-time on users' mobile apps via push notifications. Similarly, removing a product triggers instant updates across all user devices. Admins can view user details and cart contents, facilitating support and management tasks. Upon completion of tasks, admins can securely logout, ensuring system integrity and data security. Through this module, administrators can effectively oversee system operations, maintain product catalogs, and provide support to users, enhancing overall system functionality and user experience.

1. Admin Login:

- Admin accesses the admin login interface and provides valid credentials (username and password).

- The backend verifies the credentials and grants access to the admin dashboard upon successful authentication.

2. Add New Product:

- Admin navigates to the product management section within the admin dashboard.

- Admin selects the option to add a new product and fills in the required details (name, description, price, quantity).

- The backend validates the entered information and updates the product database with the new product details.

3. Remove Existing Product:

- Admin selects the option to remove a product from the product management section.

- Admin specifies the product to be removed, triggering a request to delete the product from the backend database.

4. View User Details:

- Admin accesses the user management section within the admin dashboard.

- The backend retrieves a list of registered users from the database and presents it to the admin.

- Admin can view user details such as username, email, and registration date.

5. View User Cart:

- Admin selects the option to view a user's cart and enters the user's unique identifier (ID).

- The backend retrieves the user's cart details from the database and displays them to the admin.

- Admin can view the contents of the user's cart, assisting users with their purchases or resolving any issues.

6. Logout:

- Admin completes their tasks and chooses to logout from the admin dashboard.

- The backend terminates the admin's session, logging them out of the system to ensure security.

- Admin is redirected to the login page for subsequent access.

V. RESULT AND DISCUSSION

The project aimed to develop an innovative mobile application combining Unity and Flutter for seamless indoor navigation and real-time object detection in supermarkets. The integration of Unity's robust AR navigation capabilities with Flutter's versatile UI toolkit allowed for the creation of a comprehensive solution that enhances the shopping experience for users.The AR navigation module utilized Unity's AR Foundation to overlay virtual markers and pathways onto the real-world environment, providing users with intuitive navigation guidance within indoor spaces. By leveraging AR technology, users could visualize optimal routes to their desired destinations, enhancing spatial awareness and efficiency while navigating through the supermarket.Powered by TensorFlow Lite models, the object detection module enabled real-time identification of products within the supermarket. Leveraging Flutter's seamless integration capabilities, users could scan products using their device's camera, receiving detailed information and recommendations based on the detected items. These feature empowered users to make informed purchasing decisions and explore product details effortlessly. The user can add products to the cart and view the product price, along with the total price of all items in the cart .The user ID functionality serves an additional purpose, benefiting receptionists at the supermarket. It can efficiently assist customers by entering their user IDs and accessing their cart details instantly. This feature helps to streamline the checkout process, allowing customers to bypass long queues and swiftly proceed with their purchases.

The seamless integration of Unity and Flutter allowed for the development of a cohesive user experience. Unity's AR navigation seamlessly transitioned into Flutter's UI components, providing users with a fluid and intuitive interface. The combination of immersive AR navigation with real-time object detection offered users a comprehensive solution for navigating and shopping within the supermarket.The project successfully demonstrated the potential of combining Unity and Flutter to create innovative mobile applications. By leveraging Unity's AR navigation capabilities and Flutter's UI toolkit, the application offers users an immersive and intuitive shopping experience. Future research could focus on further enhancing the accuracy and efficiency of object detection algorithms and optimizing the integration between Unity and Flutter for seamless application development.

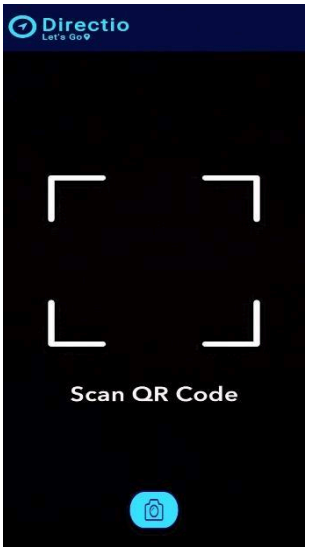

Fig 2.AR Navigation

Fig 3. Object Detection

Fig 4. Object Detection

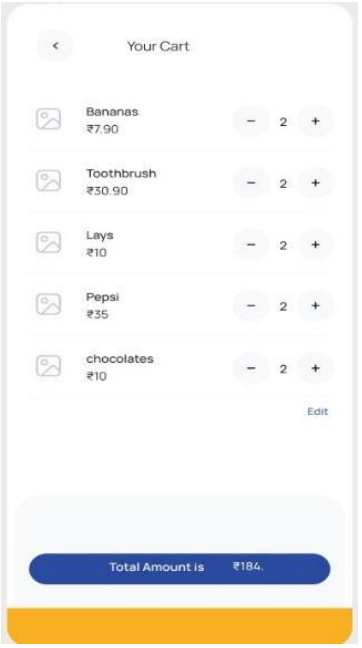

Fig 5. Cart

VI. CONCLUSION

In conclusion, the integration of AR navigation and real-time object detection modules within the mobile application presents a significant advancement in supermarket retail technology, offering a range of benefits to users. By utilizing Unity for AR navigation and yolo model for object detection, the app provides users with an intuitive and immersive shopping experience. Users can navigate through the store with ease, aided by AR visual cues, and quickly identify products through their device's camera, facilitating efficient and informed purchasing decisions.Furthermore, the inclusion of user ID functionality streamlines the checkout process, allowing receptionists to access cart details swiftly and expedite transactions. This feature not only saves users valuable time but also enhances overall convenience and satisfaction.Compared to other alternative solutions, this app offers several advantages. Firstly, its use of AR navigation provides users with a more interactive and engaging way to navigate the store, reducing confusion and improving efficiency. Secondly, the real-time object detection feature enables users to get product information easily, saving time and effort. Additionally, the integration of user ID functionality allows for faster checkout,bypassing queues enhancing the overall shopping experience.

Overall, this app represents a cutting-edge solution that leverages technology to streamline the shopping process, improve efficiency, and enhance user satisfaction in supermarket retail environments.

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