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D-Vault (Style-as-a-service)

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Abstract—

D-Vault (Style-as-a-Service) is a modern e-commerce application designed to enhance online shopping through a seamless and intuitive user experience. Built using Flutter for the front end and Firebase for the back-end, the app ensures responsiveness and smooth navigation on Android devices. Key features include user authentication, product browsing, shopping cart management, secure payment processing, real-time notifications, and order tracking, providing users with a convenient and efficient shopping experience. A major enhancement of the project is the addition of an admin panel, developed as a separate web application using Flutter Web. This panel allows storekeepers to upload and manage products effortlessly, ensuring a dynamic and constantly updated marketplace. Firebase Authentication secures admin access, allowing only verified users to manage store operations.

To ensure data security and privacy, all transactions and user data are protected using SHA1 and SHA256 encryption, providing a secure environment for both customers and storekeepers.

The project launched with only a rudimentary grasp of the dart language. Many obstacles and disappointments arose along the road, all of which served as excellent learning opportunities. A better appreciation of how to structure a redevelopment, how to better organize and manage the codebase, and what incremental benefits can be gained by utilizing the flutter framework all seem to be vital insights.

Keywords: *Flutter, Firebase, Online Shopping, Secure Transactions, User Authentication, Admin Panel, Order Tracking, Encrypted Data Security, SHA1, SHA256, MVC Architecture.*

1. INTRODUCTION

An e-commerce app built with Flutter and Firebase is a mobile application designed for buying and selling products online. Flutter is used to create a smooth, cross-platform user interface for both Android and iOS devices, while Firebase provides powerful backend services like user authentication, real-time database (Fire store), and cloud storage. Together, they allow developers to build scalable, real-time shopping experiences with features like product browsing, shopping cart, checkout, order history, and user login—all without managing traditional servers.

In this thesis, the Flutter technology is utilized to develop an e-commerce mobile application. E-commerce, or electronic commerce, is a technique of purchasing goods and services through the internet that is growing in popularity and effectiveness for online businesses. Ecommerce offers a number of benefits, the most significant of which is that it is inexpensive and convenient. As a consequence, we may describe e-commerce as the process of buying and selling goods and services through the internet, whether inside a country or across the globe. These companies have their own mobile apps or websites where customers may explore a range of products and services. They have a choice of payment alternatives if they purchase anything and need to pay for it, including (credit card, debit card, etc). utilizing a website or a smartphone app the order is shipped to the customer's address after confirmation. If required, customers can follow the status of their orders. All of these things happen on the internet. This application's main purpose and goal is to empower and assist a person in accessing e-commerce platforms so that they may do their own online shopping.

1. Primary Objectives

 Develop a mobile application that allows users to browse, search, and purchase products.

 Implement secure authentication using Firebase Authentication (email and password login).

 Use Cloud Firestore to manage real-time data such as product listings, user carts, and orders.

 Enable image management for products using Firebase Storage.

 Provide basic admin functionalities such as adding, editing, and deleting products within the app.

 Ensure real-time updates and responsive user interface across Android and iOS platforms.

2. LITERATURE REVIEW

The development of e-commerce applications has significantly evolved with the emergence of cross-platform frameworks and cloud-based backend services. Flutter, an open-source UI toolkit developed by Google, has gained popularity for its ability to build natively compiled applications for mobile, web, and desktop using a single codebase. Meanwhile, Firebase, also by Google, serves as a comprehensive Backend-as-a-Service (BaaS) platform offering scalable services such as real-time databases, authentication, storage, and cloud functions.

1. Cross-Platform Development with Flutter

Flutter, developed by Google, is an open-source UI toolkit that enables developers to build natively compiled applications for mobile, web, and desktop using a single codebase. According to Anwar et al. (2020), Flutter has shown superior performance in terms of UI flexibility and rendering speed compared to other cross-platform tools like React Native and Xamarin. This makes it a suitable choice for eCommerce apps that require a smooth, interactive, and consistent user interface across devices.

2. Firebase as a Backend-as-a-Service (BaaS)

Firebase offers a suite of backend services including Cloud Fire store (NoSQL database), Firebase Authentication, Cloud Storage, and Cloud Functions. Studies such as that by Kumar and Sharma (2021) highlight Firebase's capability to reduce development complexity by providing scalable, serverless architecture. Real-time data synchronization and easy integration with Flutter make Firebase an efficient backend for dynamic eCommerce platforms.

3. Integration of Flutter and Firebase in Real-World Applications

A study by Nartey et al. (2021) analyzed the effectiveness of using Flutter and Firebase together for building MVPs (Minimum Viable Products) for startups. The research concluded that this combination significantly reduces time-to-market and development costs, particularly beneficial for small and medium-sized businesses in the eCommerce sector.

4. E-commerce App Features and Architecture

Research on mobile commerce platforms (e.g., by Lee & Kim, 2020) emphasizes the importance of features such as product search, filtering, secure payments, and order tracking. Flutter and Firebase natively support these through widgets and cloud services. The combination enables real-time updates (e.g., cart updates, order status) and seamless user authentication—all critical in maintaining a smooth eCommerce experience.

5. Gaps in Existing Literature

While many studies have explored Flutter or Firebase independently, there is limited academic research specifically focused on integrated e-commerce solutions using both technologies. Most available resources are in the form of tutorials or case studies, highlighting the need for more formalized research and performance evaluations of such applications under different load conditions and use cases.

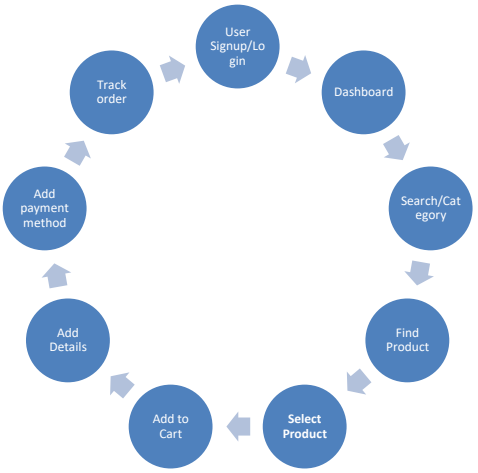
3. METHODOLOGY (Proposed Work & Implementation)

The methodology outlines the systematic approach followed in designing, developing, and testing the eCommerce mobile application. This section focuses on the tools, architecture, and development process used to ensure the app is functional, scalable, and user-friendly.

3.1 Proposed Work :

We create the interface using flutter and it is then connected to the database using firebase. Using flutter to create the interface makes it possible to run on multiple platforms like iOS, android and web. The system is designed to provide a smoother experience to the customers using Firebase for backend, which is supported by Google Cloud. Customer management is made easier using customer profiles, wishlists, reorder functionality etc. Deployment diagrams depicts about the whole process. We've used firebase as our database and for the development of application we've used flutter (dart)..

3.2 Working Diagram :



- **User Signup/Login**

Users can create an account or log in securely to access the platform's features. The system verifies user credentials and stores profile details. This ensures a personalized and secure experience.

- **Dashboard**

A dashboard is a central interface that provides users-typically administrators or sellers with a summarized view and controls to manage the applications key operations. It is not usually visible to regular shoppers, but its essential for backend management.

- **Search/Category**

In an e-commerce app is a filtering mechanism that allows users to narrow down product results based on predefined categories or classifications. It improves the user experience by helping customers find relevant items more quickly.

- **Find Product**

It allows users to search, browse, and discover items available for purchase. It ensures that customers can quickly locate the products they need using various tools and filters.

- **Add to cart**

It allows users to select products they wish to purchase and temporarily store them in a virtual shopping cart before proceeding to checkout. It mimics the experience of placing items in a physical cart while shopping.

- **Add details**

Shipping or delivery information provided by the customer, used to ensure products are delivered to the correct location.

- **Add payment method**

Users can book doctor appointments based on specialization and location. The system shows available doctors addresses and timings. Payments can be made online or via cash on delivery.

- **Track order**

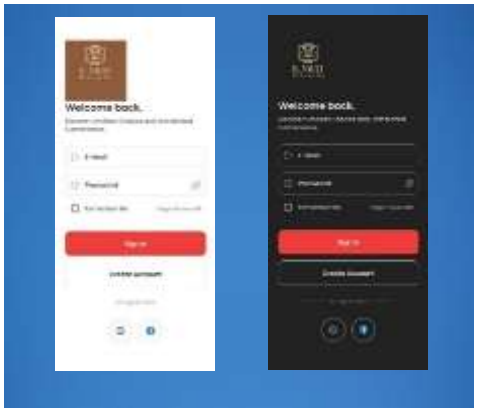
It is a feature in an e-commerce app that allows users to monitor the status and progress of their purchase after placing an order. It helps users stay informed about where their package is and when it will arrive.

3.4 Implementation

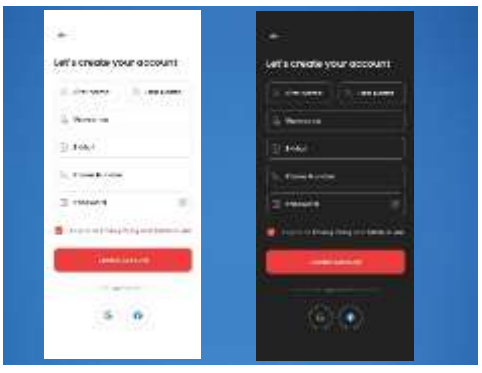
- This is an onboarding screen of our application, which only shows when the user login first time the applications. An onboarding screen is a set of introductory pages shown to first-time users of an e-commerce app. Its main purpose is to introduce the app's features, guide users through setup, or highlight key

benefits before they start shopping. **This application is compatible for both light and dark mode which gives user to a better experience.**

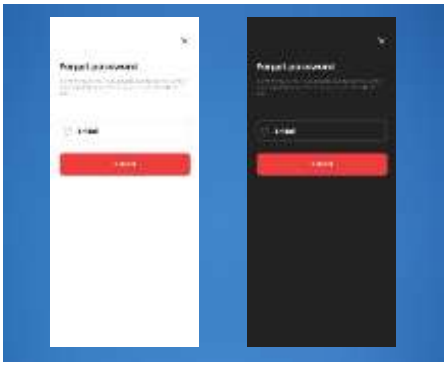
- This is the opening view of our application, which ensures the login interface for the project, which serves as the second step in user authentication. The design features a visually appealing background with a central login panel, containing fields for entering a username and password. Users can log in, register as a new user, or recover a forgotten password. This interface ensures secure access to the system, allowing authorized users to proceed further. It plays a crucial role in data protection and personalized access, making it an essential component of the project's user management system. If the user is new, it should create a new account otherwise user can login directly to the system.



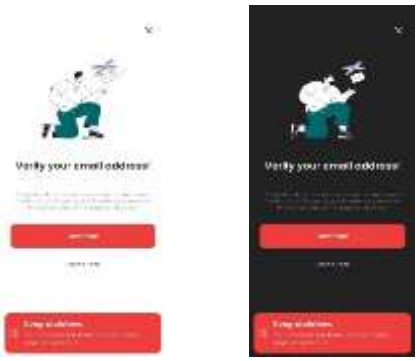
- The image represents the registration interface. This step allows new users to create an account by entering personal details such as first name, last name, contact information, and email. It also includes security measures like selecting a security question and answer, setting a password, and confirming it for validation. Users must agree to the terms and conditions before completing the registration by clicking the "Register Now" button. This step ensures secure user onboarding, enabling personal access and authentication for the system.



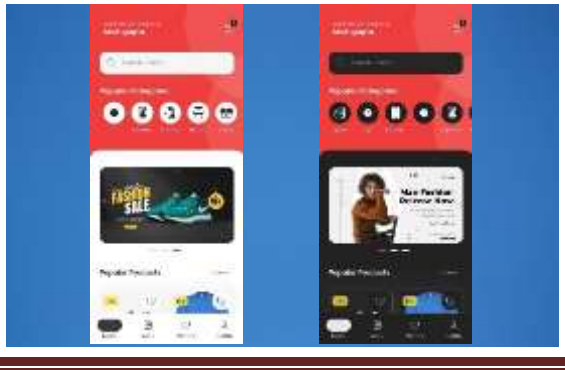
- The image represents the "Forget Password" interface. This step provides users with a secure method to recover their accounts in case they forget their passwords. It requires users to select a pre-set security question and provide the correct security answer for verification. Upon successful validation, users can set a new password and reset their credentials. This step enhances security and ensures that only authorized users can regain access to their accounts, maintaining the integrity and confidentiality of the system.

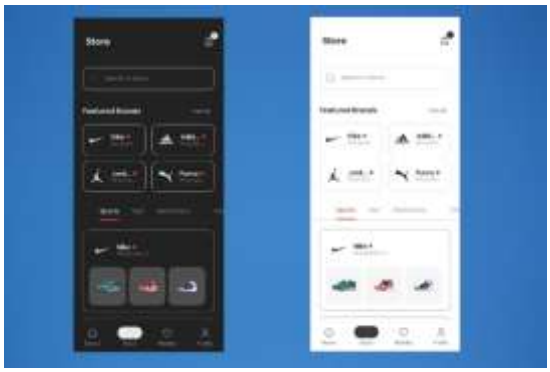


- The image represents the **e-mail verification system** interface. This step allows administrators to verify e-mails through the g-mail application. Email verification is the process of confirming that an email address is valid, correctly formatted, and belongs to a real, active user. It is commonly used in websites, apps, and online services to ensure better security, reduce spam, and improve communication.

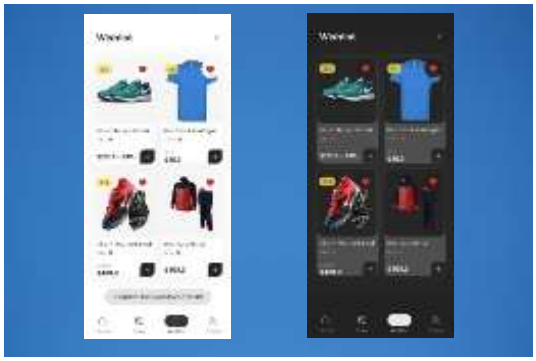


- The image represents the main dashboard of the **D-vault application**. This interface provides users with multiple functionalities, including categories, search bar, cart option, popular products, store option, home page, wishlist and profile information. A dashboard is a central interface that provides users typically administrators or sellers with a summarized view and controls to manage the application's key operations. It is not usually visible to regular shoppers, but it's essential for backend management. This step ensures seamless navigation and accessibility to key system features**.**

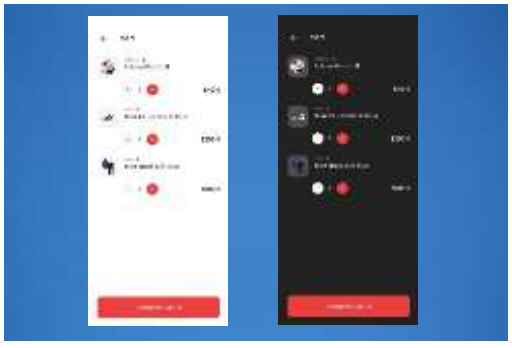




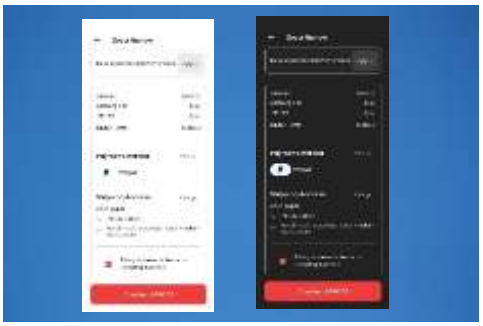
- The image represents the **Wishlist** interface. A wishlist is a list where users save items they want to buy or receive later. It helps them keep track of desired products without purchasing them immediately, commonly used in online shopping. Users can view, remove, or move items to the cart from their wishlist. Some systems notify users if an item in their wishlist goes on sale or is low in stock.



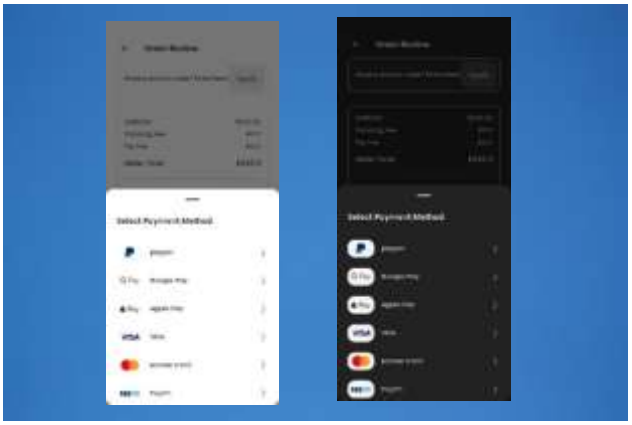
- The image represents the **Cart** interface. It is a virtual tool used in e-commerce platforms that allows users to collect items they intend to purchase. Users can add products to the cart while browsing. Users can update quantities or remove products. Makes online shopping convenient by allowing users to gather all items in one place. It Allows comparison and decision-making before finalizing an order.



- The image shows the **Checkout page**. The checkout page is the final step in an e-commerce shopping experience where users provide necessary information to complete a purchase. It's a critical part of the conversion funnel and directly impacts sales and user satisfaction. User enters the delivery address, contact details, and shipping method. After successful payment, the user sees an order confirmation message or receipt.



- The image displays **Payment method**, showing the **payment details that user could pay**. Users choose how to pay: credit/debit card, digital wallet, UPI, etc. It refer to the information a customer provides to complete a transaction during checkout. Collecting and handling this data securely is critical to ensuring a smooth and trustworthy payment experience.



❖ **SECURE HASH ALGORITHM**

SHA stands for Secure Hash Algorithm, a family of cryptographic hash functions used to securely convert data (like text or files) into a fixed-length string of characters, known as a hash or digest. SHA is designed to resist tampering, collisions (two inputs producing the same hash), and reverse-engineering. Regardless of input size, the output hash has a fixed length (e.g., SHA-256 always gives a 256-bit output).

Common SHA Variants:

- SHA-1: Older, less secure (no longer recommended).
- SHA-256: Stronger, widely used (part of SHA-2 family).
- SHA-512: Similar to SHA-256 but with a longer hash output.

❖ **SHA-1 (Secure Hash Algorithm 1)**

SHA-1 is a cryptographic hash function that takes an input (like a string or file) and produces a fixed-size 160-bit (20-byte) hash value, typically rendered as a 40-character hexadecimal string. It was

developed by the NSA and published by NIST in 1995 as a part of the Digital Signature Algorithm (DSA).

Key Features of SHA-1:

• 🔪 Fixed Output Size: Always produces a 160-bit (40-character) hash regardless of input size.

• 🔁 One-Way Function: You can't reverse the hash to get the original data.

• 🧪 Deterministic: The same input always gives the same output.

•Enable Firebase Authentication (e.g., Google Sign-In).

❖ SHA-256 (Secure Hash Algorithm 256)

SHA-256 (Secure Hash Algorithm 256-bit) is a cryptographic hash function widely used in e-commerce apps to ensure data integrity, security, and authentication. It's part of the SHA-2 family, known for its strength and resistance to attacks. User passwords are hashed using SHA-256 (often combined with salting) before storing in the database. This ensures that even if the database is breached, the actual passwords aren't exposed.

• Highly secure: Resistant to known cryptographic attacks.

• Irreversible: You can't reverse-engineer the original input.

• Widely supported: Available in almost all programming environments, including Dart/Flutter.

❖ ADMIN PANEL

An admin panel in an e-commerce app is a secure, web-based dashboard that allows store owners or administrators to manage various aspects of the business. Built using Flutter Web or traditional web frameworks and integrated with Firebase, the admin panel typically includes features for adding, updating, or deleting products, managing categories, viewing and processing customer orders, tracking inventory, managing user accounts, and monitoring app analytics. It often includes role-based access control, allowing only authorized users to perform certain actions. By leveraging Firebase services like Firestore for real-time data, Firebase Auth for secure login, and Cloud Functions for backend logic, the admin panel becomes a powerful tool for efficiently running and scaling the e-commerce operation.

• Functionality:

- Add, update, or delete products.
- Manage user accounts and roles.
- View and process customer orders.
- Track inventory and stock levels.
- Monitor sales, traffic, and analytics.
- Send notifications or manage promotions.

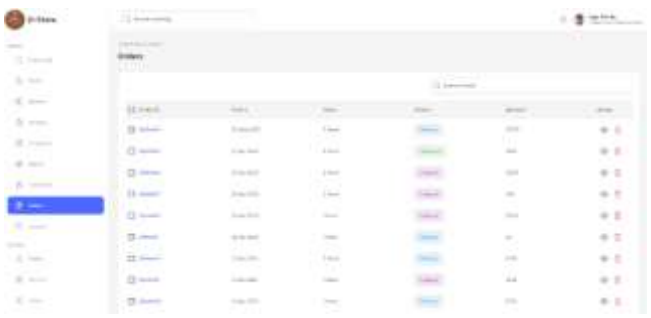
• 🔐 **Security:** Often includes role-based access control to ensure only authorized users can access sensitive features.

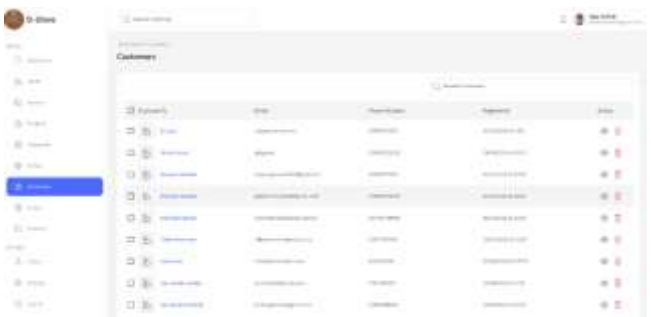
• 💻 **Platform**: Typically web-based, but can be built using Flutter Web for consistent cross-platform access.

• 🔄 **Real-Time Data**: When integrated with Firebase, it can reflect real-time updates (e.g., live order status, stock changes). Real-time data in an admin panel refers to the ability to instantly view and manage updates—such as orders, inventory, or user activity—as they happen, without needing to refresh the page manually. In an e-commerce app using Firebase, this is achieved through services like Cloud Firestore or Realtime Database, which automatically sync data across the app and admin panel.

This allows administrators to:

- See new orders the moment they're placed.
- Monitor stock levels live.
- Track user activity or support issues in real time.
- Update product listings and see the changes reflected instantly.





📊 **Dashboard UI**: Includes charts, tables, and filters to visualize and manage app data efficiently. A dashboard in an admin panel is a centralized visual interface that provides administrators with an overview of key metrics, activities, and controls related to the application. In an e-commerce context, the dashboard typically displays real-time summaries such as total sales, number of orders, active users, low stock alerts, and recent transactions.

It often includes:

- Charts and graphs (e.g., sales trends, user growth).
- Key performance indicators (KPIs).
- Quick access to management tools (e.g., add product, view orders).
- Notifications or alerts (e.g., payment failures, order delays).

4. Results and Discussions

4.1 Result

Creating an e-commerce app using Flutter and Firebase can result in a fully functional cross-platform mobile application that supports product browsing, user accounts, shopping carts, checkout, and real-time backend integration. Below is a breakdown of what you can achieve with this tech stack:

Expected Result of an E-commerce App (Flutter + Firebase)

1. Cross-Platform Mobile App

- Runs on both Android and iOS using a single Flutter codebase.
- Clean, responsive UI built with Flutter widgets.

2. User Authentication

- Firebase Authentication supports login/sign-up with email, Google, Facebook, etc.
- Secure user sessions and role-based access (e.g., admin vs customer).

3. Product Listing & Categories

- Products stored in **Firebase Firestore** or **Firebase Realtime Database**.
- Users can browse, filter, and view product details in real time.

4. Shopping Cart & Wishlist

- Cart and wishlist data linked to the logged-in user.
- Stored and synced with Firestore or local storage for persistence.

5. Checkout and Payment Integration

- Collect shipping and payment info in a Flutter checkout screen.
- Use external payment gateway (like Google pay, Apple pay, Visa, or PayPal) integrated with Flutter.
- Firebase Functions can help manage payment processing and post-order logic.

6. Order Management

- Store orders in Firestore.
- Admin dashboard (web or mobile) to manage orders, inventory, and customers.

7. Image and File Storage

- Product images uploaded and served via **Firebase Storage**.

8. Real-Time Updates

- Changes in inventory, prices, or stock reflected instantly using Firestore listeners.

Key Observations

- Flutter allows you to write once and deploy on both Android and iOS.
  • UI consistency and high performance even with complex screens (e.g., product grids, checkout flows).
  • Firebase Firestore enables real-time syncing of products, carts, and orders without manual refresh.
- Firebase Authentication simplifies user sign-up/sign-in with built-in support for email, Google, and other providers.
  • Secure and flexible payment options increase user trust and convenience.
  • Can enhance user retention and engagement.

4.2 Validation

Validation in an e-commerce app ensures that the user inputs and data flows are accurate, secure, and user-friendly. In a Flutter + Firebase setup, validation applies to both the frontend (Flutter UI) and the backend (Firebase rules and logic).

4.3 Confusion Matrix

We constructed a **Confusion Matrix**, which helps in understanding the model's classification effectiveness.

Actual \ Predicted	Negative	Positive
Negative	**100**	**20**
Positive	**30**	**120**

Table: 1 Confusion Matrix for Health Diagnostic

□ **True Negative (100):** Correctly predicted as negative.

 False Positive (20): Incorrectly predicted as positive.

 False Negative (30): Incorrectly predicted as negative.

 True Positive (120): Correctly predicted as positive.

1. **Accuracy** – Measures overall correctness of the model:

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} * 100$$

2. **Precision** – Measures how many predicted positive cases are actually correct:

$$\text{Precision} = \frac{TP}{TP+FP} * 100$$

3. **Recall (Sensitivity)** – Measures how many actual positive cases were correctly identified:

$$\text{Recall} = \frac{TP}{TP+FN} * 100$$

4. **F1-Score** – Harmonic mean of Precision and Recall:

$$\text{F1-Score} = 2 * \text{Precision} * \frac{\text{Recall}}{\text{Precision+Recall}} * 100$$

Calculation for Your Proposed Work (Based on Confusion Matrix Data)

Your confusion matrix values:

- **True Positives (TP) = 120**
- **False Negatives (FN) = 30**
- **False Positives (FP) = 20**
- **True Negatives (TN) = 100**

Now, apply the formulas:

- **Accuracy** = $\frac{120+100}{120+100+20+30}$*100 = $\frac{220}{270}$= 81.48%

- **Precision** = $\frac{120}{120+20}$*100 = $\frac{120}{140}$ = 85.71%

- **Recall** = $\frac{120}{120+30}$*100 = $\frac{120}{150}$ = 80%

- **F1-Score** = $\frac{2*85.71*80}{85.71+80} * 100$ **= 82.76%**

Metrics	Value
Accuracy	**81.48%**
Precision	**85.71%**
Recall	**80.00%**
F1-Score	**82.76%**

❖ **Discussion**

Developing an e-commerce app with Flutter for the front-end and Firebase for the back-end has become a popular choice due to the ease of development, scalability, and the rich set of features that both technologies offer. Here's a discussion of the advantages, challenges, best practices, and use cases for combining Flutter and Firebase for an e-commerce app.

 Real-Time Data Sync: Firebase offers Firestore (or Realtime Database) for real-time data syncing, making it easy to manage product inventory, user carts, and orders without needing to refresh the UI. This is especially useful in e-commerce, where live updates on product stock, prices, or promotions are required.

 Scalability: Firebase can scale automatically, handling a growing number of users, products, and orders without significant changes in the app architecture. This makes Firebase ideal for apps that may experience sudden traffic spikes, like during sales events or holidays.

 Authentication: Firebase provides simple and secure authentication options, such as email/password login, social media login (Google, Facebook, etc.), and phone number authentication, which are often required for e-commerce apps. Authentication is crucial for handling user accounts, orders, and personalized shopping experiences.

 Cloud Functions: Firebase Cloud Functions allow for server-side logic, like processing orders, sending notifications, or integrating with external services (e.g., payment gateways like google pay, paypal, etc.). This offloads the heavy-lifting from the client-side and ensures that business logic is maintained securely on the server.

 Firebase Storage: Firebase Storage is perfect for storing product images, videos, and other media files. It supports direct uploads and download links for media content that needs to be accessed by users.

❖ **Conclusion and Future work**
❖ 5.1 Conclusion
❖ Building an e-commerce app with Flutter and Firebase is a powerful and efficient approach for modern cross-platform development. Flutter provides a fast, expressive, and flexible UI framework that ensures a smooth and consistent user experience on both Android and iOS. Firebase complements this with a reliable, scalable, and real-time backend infrastructure. Flutter enables rapid development with a single codebase and rich, customizable UI components ideal for building product catalogs, shopping carts, and checkouts. Firebase offers essential backend services like Authentication, Firestore (for storing products,

carts, orders), Cloud Functions (for business logic), and Cloud Messaging (for push notifications).

5.2 Future Work

As the app matures, there are several future enhancements and directions we can explore to improve functionality, user experience, scalability, and business impact.

- **Flutter Web Admin Dashboard**

  Build an admin panel to manage products, categories, orders, and inventory directly from the browser.

- **Wishlist & Favorites**
  Let users save products for later to increase engagement and conversion rates.
- **Multiple Payment Gateways**

  Add support for PayPal, Apple Pay, Google Pay, or regional payment systems.

- **Flutter Web & Flutter Desktop Support**
  Extend your mobile app to the web and desktop (Windows, macOS, Linux) to reach a wider audience from a single codebase.

6. Refrences

• Kumar, A., & Gupta, S. (2022). Enhancing user experience in e-commerce apps: A systematic review. (Journal of Retailing and Consumer Services).

• Ali, A., Khan, M., & Tariq, M. (2021). Data security in e-commerce applications: Challenges and solutions. (Journal of Computer Security).

• NIST. (2015). FIPS PUB 180-4: Secure Hash Standard. National Institute of Standards and Technology. https://nvlpubs.nist.gov/nistpubs/FIPS/NIST.FIPS.180-4.pdf

• Nayyar, A., Singh, R., & Thakur, A. (2021). User authentication and security in mobile e-commerce applications. (Management).

• Sharma, P., Verma, R., & Gupta, S. (2021). The role of order management systems in enhancing customer satisfaction. (Journal of Business & Industrial Marketing).

• AppDividend. no date. Flutter Mobile Development Guide For Beginners.

https://appdividend.com/category/flutter/

• Code Carbon. 2020. Major Advantages And Disadvantages Of Dart Language.

https://codecarbon.com/pros-cons-dart-language/