

BongoFruits Bangladesh's First Smart Fruit E-Commerce Platform

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FINAL YEAR DESIGN PROJECT REPORT

**This Report Presented in Partial Fulfillment of the
Requirements for the Degree of Bachelor of Science in
Computer Science and Engineering**

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APPROVAL

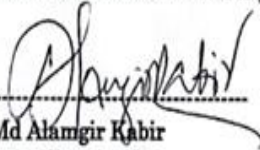
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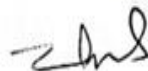
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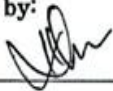
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We hereby declare that this project has been done by us under the supervision of **Most. Hasna Hena, Assistant Professor**, Department of Computer Science and Engineering, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

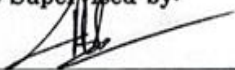
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ABSTRACT

The following project report explains the way Bongofruits was designed, constructed and tested. The new hybrid Bongofruits is a fusion of fruit e-commerce and educating people about money. The platform addresses two significant issues in Bangladesh the necessity to make local retail markets place modern and the necessity to make more people aware of their money. The architecture is a three-tiered structure that includes Customer, Seller and Administrator dashboards, each of which is aimed at a specific activity. The front end is coded in Flutter and the backend in Firebase Realtime Database. The site balances the usual shopping functions such as browsing and managing your cart, making secure payments, and tracking your order as it happens with gamified learning modules that simulate stock trading and win you points that you can use to learn more about money. The vendors obtain the enterprise-level solutions that can help to digitalize the traditional business processes, including the inventory, sales analytics, and order processing. The management of the platform is done through the administrators who will perform vendor checks, problems of users and system wide analytics to ensure that all is clear and safe.

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Chapter 1

Introduction

This chapter gives you the information you need to understand the Bongo-fruits project in its proper context. It talks about the current state of e-commerce and financial literacy platforms in Bangladesh, looks at similar apps, and talks about the technological and methodological approaches that will be used to design and build the system.

1.1 Introduction

Bongo-fruits is an online platform that has established Bangladesh that links the customer to the sellers of fruits within the country and informs them about money [1]. The platform provides virtual trading experiences and stock trading simulation [2] to fill the gap in the market between small fruit vendors and between those who lack access to practical financial education [3]. Bongo-fruits architecture comprises of three dashboards: Customer, Vendor, and Administrator and offers the seamless shopping experience, offers business management tools, and a safe and secure system [4]. The platform will establish one ecosystem that will enhance personal financial literacy and group financial engagement with the support of the Bangladeshi market and local money [5].

1.2 Motivation

Bongo-fruits proposal is based on real challenges that people in Bangladesh are encountering right now [6]. Millions of people depend on traditional fruit markets, which might be hard to discover, broken up, and not in touch with how people shop online [5]. Small businesses are crucial to the economy, but they don't always have the necessary tools to manage their operations [7]. This makes it hard to keep track of stock, grow, or figure out how much they are selling. But a lot of people have trouble learning about money, especially how to invest and manage their money [8]. This difference makes it tougher to be financially stable in the long run and to be a member of the economy as a whole [9]. Bongo-fruits wants to fill in these two holes with one platform that does everything. Buying fruit, which is something that every family does all the time, is a safe and fun method to learn about trading and investing [4]. This makes

learning about money less terrifying and more practical, interesting, and rewarding in everyday life [10]. The other purpose of the initiative is to let conventional fruit dealers feel comfortable about going digital [1]. Bongo-fruits delivers its providers business management tools that are hard to understand but easy to utilize [5]. These tools enable them do a better job, work faster, and reach more people. The marketplace is more reliable and works better as a whole, and sellers are happier [9]. The premise behind Bongo-fruits is that business and education should work together. The platform might help people and society as a whole buy intelligently, more meaningfully, and more importantly by bringing people together [1].

1.3 Objectives

Bongo-fruits Project Goals will be made to suit the increasing trends of digital transformation, adoption of e-commerce and financial inclusion in Bangladesh.

- I. Improve Customer Experience: Simple, low cost, and high quality fruit buying by using the digital commerce platforms.
- II. Add Financial Literacy Tools: Indemnify customers with financial literacy tools to master the art of investing and trading with help of gamification and digital education methods.
- III. Learning Modules: Educate people about money and its significance in business using simulations, virtual stock trading and reward based learning modules.
- IV. Empower Local Vendors Greater: Provide digital solutions to help fruit sellers operate their business and win the trust of their customers, thereby helping to become financially included.
- V. Establish Platform Operational Efficiency: Install a dashboard that administrators can use to monitor real-time operations, user activity, and vendor performance with technologies such as Firebase.
- VI. Use Analytics and Reporting Tools: Use advanced analytics and reporting instruments to make strategic decisions and include finances. Make the Platform affordable make sure the platform is not too expensive but able to generate long-term revenue that will support sustainable e-commerce development.

1.4 Methodology

The development of Bongo-fruits project is based on the Agile Development that is

intended to make things flexible and to continuously improve in the development process. Initially, we discuss with users, sellers and administrators to have a wide-range view of what they require, both in the e-commerce and instructional aspects. Then a competitive analysis is carried out to identify gaps in the market and feasibility study is carried out to determine whether the proposed features are feasible. We then begin to design the system, start-up of the structures of the platform, database structure, and user interfaces. To ensure the system is scalable, we have adopted a three tier architecture that is modular based on the use of microservices. The other features that we determine during this stage are the gamification which can include educational courses, virtual trading to complement the e-commerce features. The backend is developed in the development stage through APIs, connecting with the database and representing user logins, order management and virtual trading. To create the Android application as the front end, we use Flutter so that all the key functions work in harmony with each other. A lot of testing is involved in the phase, such as unit test, integration test, and performance test, to ensure that the platform is functioning as we need. The deployment phase sees a small group of users beta test the platform to provide feedback and correct any issue. Then, we deploy the backend and database to a cloud solution such as AWS or the Google Cloud to ensure that they can scale. Once all is ready and everything is going well, the app is uploaded to the Google Play store. Once the platform is launched we monitor its performance and request feedback; this way we can improve it. The infrastructure is updated frequently to accommodate more users to fix bugs, enhance functionality and add new features. On the front end, Flutter and Dart are going to be used and on the back end, either Node.js or Python (Django/Flask) will be used. The database is hosted in the cloud with AWS or Google Cloud and the database is implemented with MySQL/PostgreSQL or Firebase Firestore. CI/CD pipelines ensure that the changes are smooth and fast. The platform evolves with the passage of time and according to users feedback.

1.5 Project Outcome

The Bongo-fruits project will aim at achieving some significant objectives that fall within the short-term, as well as the long-term objectives of the project. Judging by the manner in which the project is to be designed and implemented, we can discuss its potential impact on users, business, education, and technology.

Improved user experience and interaction

The central objective is to develop a platform that can be simple and easy to use and comprehend and integrate e-commerce with learning features. The platform will engage the users not only to purchase fruit but also learn more about the money through a combination of purchasing fruit with gaming financial literacy courses. The platform will maintain the interest of its users due to the system of real-time feedback and educational incentives. This will result in increased user retention and happiness. The possibility to trace the progress both in purchasing and learning will make the process more exciting and motivating.

Online shopping and financial literacy in Bangladesh

Among the objectives of the Bongo-fruits initiative is to ensure that e-commerce grows in Bangladesh. A mix of virtual trading and instructional modules will make people learn and start using digital financial tools. The financial literacy will increase significantly since the platform will be used by more individuals, particularly those who are residing in regions of the nation that do not receive sufficient assistance. This would assist in making more individuals access the financial services so that they have the means to make improved investing decisions.

Empower the local companies

The outcomes of the project would have a tremendous impact in the business of suppliers. The platform will also assist suppliers to operate their businesses in a more effective manner by providing them with a complete package of business management tools, including order processing, sales analytics and inventory tracking. They will also be in a position to develop their businesses in a better way in the event they have access to a greater number of consumers. Gamification of the platform can also motivate merchants to improve their products and services which will be beneficial to the entire ecosystem.

Growth and new technology

The technology infrastructure will also be established in the project which can expand with the number of users, quantity of products offered and features to be introduced. It is easy to manage millions of users on the platform since the backend is deployed on cloud computing providers such as AWS or Google Cloud. By relying on modern tools such as Flutter, Firebase, and Node.js, the platform will be current with the latest in e-commerce and in educational technology. Market positioning and business sustainability. The idea

will allow the Bongo-fruits to shine in the Bangladeshi market providing them with a business and educational platform. This distinction can empower the platform to occupy a large portion of the market in the growing sectors in e-commerce and financial literacy. The platform will also be capable of remaining in business as there are numerous methods through which it could earn income including selling goods, payment of instructional tools, and payment of vendors.

Social Impact and Community Development

Bango-fruits project would aid in socially developing Bangladesh at a greater magnitude by showing the people how to better manage their funds and persuade them to be responsible consumers. The educational component will help fill the knowledge gaps in people regarding personal finance, thus enabling them to be educated on budgeting, investing, and the reasons of saving. This may subsequently translate to economic benefits of people and community in the long run.

Information to guide you to make smarter decisions

The other important outcome of the project is that it has accumulated data-driven knowledge regarding the behavior of users, the kind of purchases that they make and their performance in learning. This information can be used to give consumers personalized recommendations, enhance its products, and tailor educational content on the platform. In addition, the same insights might be beneficial to businesses, banks, and government officials wishing to learn more about how the Bangladeshi people shop online and manage their finances.

1.6 Organization of the Report

This report is presented in a reasoned, chapter by chapter format to give you an entire view of the Bongo-fruits project, how it came to be and what it may hold in the future. The chapters discuss a specific aspect of the project and that is clear and easy to follow by the reader.

Chapter 1: Introduction

The chapter provides the background of the project and rationale as to why the Bongo-fruits platform was developed. It contains the problem statement, objectives, extent, methodology and the estimated outcomes of the project. The chapter provides the background that you will require to value the role and significance of the project to the

world of Bangladeshi e-commerce and financial education.

Chapter 2: Literature Review

E-commerce, gamification, and financial literacy are the areas of focus of this chapter that reviews the available literature and existing platforms. It identifies market gaps and indicates the direction technology trends and best practices have had in the design and development of the Bongo-fruits platform.

Part 3: Analysis and Design of Systems

The detailed description of this section of the research includes the system requirements and user roles as well as the architectural design. It discusses the three-tier and modular structure, design of the database and the layouts of the interfaces. The chapter discusses the gamification elements, the virtual trading sections, and the way to ensure that all the elements work in unison.

Chapter 4: concluding it all

This chapter discusses the way the platform was actually created. It provides a clue on the types of technologies being employed, such as Flutter, Firebase, Node.js and cloud hosting solutions. The chapter discusses the topic of the backend and frontend development, API integration, testing, and deployment and how the system was transformed into a solution.

Chapter 5: Testing and Validation

This chapter discusses the various testing of the platform to ensure that it was reliable, and functional and user-friendly. The unit testing, integration testing, performance testing, and beta testing are described and the manner in which input is utilized is used to enhance the system is also described.

Chapter 6: Results and Discussion

In this chapter, the author examines the outcome of the project. It involves an evaluation of the level of engagement of the users, vendor performance of their job and the level of impact on the education. Possible issues, limitations, and how things may be improved in the future are also discussed in the chapter.

Chapter 7: Conclusion

The final chapter recaps the most valuable findings and achievements of the project. It demonstrates the role the platform plays in enhancing e-commerce and financial literacy in Bangladesh and suggests what should be done to expand it to be larger, more comprehensive, and more research-friendly in the future.

Chapter 2

Background

This chapter describes the Bongo-fruits project, including an overview of e-commerce and digital financial literacy in Bangladesh, existing solutions and the technological and methodological framework of the project. It addresses user requirements, market issues, Agile Development, Flutter based front end, Firebase Firestore and gamified educational modules.

2.1 Introduction

Digital technology has become so fast that it has transformed the way people everywhere in the world acquire goods, services, and information. Such transformation is most evident in the e-commerce sector in Bangladesh where electronic platforms that enable customers and traders to interact more easily are becoming more prevalent among the old markets. This growth has occurred, however, there is still a very wide gap in accessibility, financial knowledge and use of new tools that can assist the users and businesses do better. Many of local economy consists of small fruit sellers, and it is likely that they will not be able to keep the tracking of their sales, inventory and market tendencies. It becomes more difficult to them become grown and remain financially stable. To correct these issues, the Bongo-fruits project designed in the form of a digital ecosystem was created that not only connects people to local fruit vendors but also includes the means to assist people to learn about money. The system aims to educate individuals in budgeting, investing, and virtual trading and simplifies the daily transactions of the people by integrating the functions of e-commerce and gamified learning settings. This two-pronged strategy ensures that the platform encourages participation in the economy as well as skill building, as such, will assist the users to gain economic independence in the long-term. Modern technology frameworks such as cloud-based infrastructure, Flutter-based mobile app development, and powerful backend services with either Node.js or Python are also employed in the project to ensure that it can grow, is reliable, and can process data in real time. Due to its implementation of an agile development approach, the platform may rapidly adapt to the user feedback and market adjustments. This is a changing digital world and this approach ensures it is always handy and effective.

2.2 Literature Review

The literature review will give a description of the studies, works and frameworks which are significant in developing digital platforms that integrate e-commerce and financial education, particularly in Bangladesh. This section examines what already exists, identifies gaps in the existing market, and situates the Bongo-fruits project within the context of emerging technological and social-economic transformations which are currently taking place in Bangladesh. Chowdhury and Uddin [1] emphasize that, despite the fact that digital transformation could lead to more efficient and accessible markets, several significant issues should be addressed including the limited infrastructure, how to make users embrace new technologies, and adherence to rules. Alamgir and Akter [6] take a closer view on the factors that influence decision of customers to use e-commerce. They conclude that it is important to have trust, usability, and perceived value. By giving people easy access to financial tools and information, Hossain and Rahman [5] demonstrate that mobile financial services may assist people in feeling more included, particularly those who lack adequate access to them. Rahman and Huda [7] discuss the idea of how digital education can assist individuals to learn more about money. They emphasize that interactive and gamified approaches can make the users more engaged and assist them to retain what they study. Technological structures and tools are also given a lot of attention in the literature. Flutter has gained a lot of awareness as a cross-platform application development system that can allow developers to develop apps fast and deliver the same user experience across all platforms [11], [12]. Firebase products such as Realtime Database and Authentication provide mobile apps with scalable backend services to securely and safely store and retrieve data in real time [2], [3]. The cloud infrastructure such as AWS and Google cloud ensures that the system can scale to the growing demands of the users and will always be accessible [9]. There has been a research on the application of gamification in financial education to enhance the learning and motivation. Gupta and Arora [4] demonstrate that the use of gamified modules such as virtual trading and rewarding systems can make financial literacy apps much more engaging and help people to retain what they have learned. Rahman and Hasan [8] explain that, when e-commerce and educational capabilities are placed on the same platform, one can experience synergistic effects that motivates user interaction with one another and enhance their competencies. The ease of use and the accessibility is also worth considering. The W3C has guidelines on web accessibility

[10] that provide a standard to ensure that the digital platforms can be used by a wide user group including people with disabilities. According to the World Bank [9], it is very crucial to ensure that no one is left behind in the digital world in order to achieve equitable economic development. It demands technological solutions, which should bridge the gaps between various social and economic classes. Bangladesh is yet to have an in-depth knowledge of the overlap of e-commerce, mobile financial services and digital education. A majority of the past studies have focused on either commerce or education individually, but few platforms have integrated both to support the convenience of making transactions and educating individuals on the subject of money. Based on such ideas, Bongo-fruits project provides a holistic platform that bridges the accessibility and user involvement and financial education gaps particularly among small-scale vendors and ordinary consumers. In Table 2.1 shows the summary of literature review of existing work.

Table 2.1: Summary of Literature Reviewed.

Reference	Focus Area	Key Findings	Relevance to Bongo-fruits
M. Cowdhury & M. Uddin, 202. [1]	Digital transformation & e-commerce	Digital platforms enhance market efficiency but face adoption challenges	Highlights the need for a user-centric, accessible platform
Google, 2023[2]	Firebase Realtime Database	Provides secure, real-time data storage and retrieval	Core backend infrastructure for Bongo-fruits.
Google, 2023[3]	Firebase Authentication	Enables user login and authentication management	Supports secure user onboarding and access

A. Gupta & A. Arora, 2021[4]	Gamification in financial literacy	Gamified approaches improve engagement and learning outcomes	Guides design of educational modules on Bongo-fruits
M. S. Hossain & M. Rahman, 2021[5]	Mobile financial services	Enhances financial inclusion and access to financial tools	Informs integration of financial literacy features
S. Md. Alamgir & S. Akter, 2020[6]	E-commerce adoption	Customer trust and perceived value affect adoption	Helps design user-friendly interfaces and UX strategy
M. Rahman & M. Huda, 2022[7]	Digital education in developing countries	Interactive learning increases knowledge retention	Justifies gamification and learning modules
M. M. Rahman & M. Hasan, 2019[9]	E-commerce potential in Bangladesh	Combined commerce and Education increases user engagement	Supports holistic design approach

The World Bank, 2023[10]	Digital inclusion	Technology bridges socio-economic gaps	Guides equitable access and scalability
W3C, 2023[11]	Web accessibility	Ensures inclusivity for diverse users	Informs accessibility compliance in UI design
Google, 2023[12]	Flutter documentation	Enables cross-platform app development	Core technology for Android app development

2.2.1 Similar Applications

Several digital platforms enabling a combination of e-commerce and financial education or gamified learning have been developed in Bangladesh and elsewhere. Bongo-fruits project has seen a lot in these platforms. Such applications demonstrate various means of engaging and involving users, leveraging technology, and developing systems. They demonstrate effective approaches and constraints which allowed us to make our choices in relation to how to do things.

1. Bikroy.com is a famous online Bangladesh-based market place, which allows individuals to sell and purchase items in a large variety of categories, including fruits and groceries. It is very good at transaction and inventory management but it does not contain any educational or financial literacy elements. Bongo-fruits seeks to fill the deficit of educational and financial literacy factors in the online marketplaces such as Bikroy.com.

2. Pathao and Shohoz are mobile platforms that provide service solutions and both have robust application-based interfaces, real-time order tracking, and user verification systems. These resources demonstrate how mobile apps should be designed, enhanced, and secure payments should be implemented. These methods were used, as well as Flutter and Firebase Authentication, to create the Bongo-fruits mobile app.

3. Bongobazar is a localized e-commerce, targeted at small businesses. It demonstrates the necessity to have convenient vendor dashboards and real-time inventory. However, it lacks any gamification or user-educational modules. That is why Bongo Fruits have included virtual trading and rewards systems.

4. Two such gamified learning platforms are Khan Academy and Duolingo, which are in use across the globe. Although they were not e-commerce apps, their efforts over designing interactive modules, tracking progress, and learning by incentives assisted Bongo-fruits in devising their strategy of gamification and in particular in structuring financial education modules and virtual trading sims.

5. The mobile financial services in Bangladesh are Nagad and bKash that enable individuals to pay, access their account and access financial services. Their decisions to integrate cloud-based systems to secure transactions, convenient mobile interface, and working with a database motivated the Bongo-fruits design, including Firebase Firestore

to store and access secure and scalable data on the backend.

These similar apps are examined in the Bongo-fruits project to determine what has been successful in the available platforms in terms of having user interactions, apps workability, and secure transactions. It also considers what is not effective such as incorporating financial literacy, including games, and vendor-customer-admin dashboards that display all information. These concepts assisted us in making methodological as well as technical decisions in the process of preparing Bongo-fruits.

2.3 Gap Analysis

The section discusses the gaps and issues that were identified in the current literature and related applications on the fields of e-commerce and financial literacy platforms in Bangladesh. Several platforms exist where people can trade fruit and learn about money online, yet, most of them do not integrate the two into one system, so users have to change systems to do both. Moreover, many of the existing solutions only consider the vendor or the customer perspective. They do not consider the needs of administrators, sellers and consumers simultaneously. One more gap that has been identified is the absence of gamification to enhance the user engagement and financial literacy. The majority of applications currently available just provide fixed content or general tutorials. They lack interactive capabilities such as virtual trading, reward systems or learning simulations. This implies that users do not hang around and the user does not really understand the functions of money in practice. There are also issues of accessibility, scalability and performance with current platforms. Not all individuals apply cloud-based, real-time database databases such as Firebase Firestore. These solutions simplify the act of syncing data, scaling up and down and to manage data in various roles and devices. Platforms dealing with sensitive user and transaction information are still faced with security and reliability challenges. The Bongo-fruits project would like to address these gaps by developing a single platform to integrate e-commerce and financial education along with role-based dashboards, game-based learning and powerful cloud-based backend with Firebase Firestore. The project provides a new and practical solution to the Bangladeshi market by addressing both the issue of the functional problems and the user experience. It is more relatable, easier to utilize and more financially literate to all involved. The Table 2.2 shows feature Comparison Between Existing Systems and the Proposed System

Table 2.2: Feature Comparison Between Existing Systems and the Proposed System

Features	Existing Systems	Proposed System
Integrated E-Commerce & Financial Education	No integration between e-commerce and financial literacy; separate platforms.	Combines both e-commerce and financial education in one platform.
Gamified Financial Education	No gamified learning; traditional tutorials or static content.	Provides gamified learning modules for financial literacy.
Real-Time Data Synchronization	Limited real-time data sync; not scalable for multiple roles.	Real-time data synchronization across customer, vendor, and admin.
Scalability	Limited scalability; struggles with large user bases and data.	Designed for scalability; cloud infrastructure to support growth.
Vendor-Customer-Admin Role-Based Dashboards	No comprehensive role-based dashboards; separate platforms for each.	Role-based dashboards for customers, vendors, and admins.
Security & Data Privacy	Basic security; vulnerable to breaches and unauthorized access.	Strong security protocols; real-time encryption and secure data handling.

2.4 Summary

The literature reviewed and existing programs gave a profound insight into the current research in the areas of e-commerce and financial literacy. Although the two regions have expanded substantially over the last few years, our comparison of the two domains indicates that they have a number of significant gaps that curtail their synergy. Most interestingly, there is no integration between e-commerce solutions and financial education programs. Online marketplaces are easily accessible to users

who lack the proper guidance on how to spend and keep their money well efficiently as they engage in online trading. Equally, there are financial literacy programs, which, however, do not often interrelate to real-life and practical e-commerce. The other problem is that gamification is hardly used in financial education. Studies indicate that learning methods that are gamified enhance better user engagement, retention, and motivation. Nonetheless, only a handful of sites in Bangladesh, or elsewhere in the world, have managed to introduce an interactive, game-based component to financial literacy resources. Moreover, several of the systems that are there are not user friendly or do not have an easy scaling ability. This complicates the ability of the same to access a large number of users, both individual customers as well as small scale vendors who would be in the best position of benefiting. The Bongo-fruits project aims at overcoming these problems by developing a multi-purpose platform that combines e-commerce and interactive financial literacy learning. Using the abilities of gamified learning, the platform will make financial education more entertaining and useful to ordinary users. The tools will also help the vendors and administrators make financial decisions, expand the business and also scale their systems. The project is planned using contemporary applications like Firebase Firestore and Flutter, which will be efficient, reliable, and accessible. Finally, Bongo-fruits plans to enhance user experience, empower financial literacy, and increase financial inclusion all over Bangladesh by employing a novel, technology-based strategy.

Chapter 3

Research Methodology

The chapter provides a description of the method of making the Bongo-fruits platform and describes the research methods. It is detailed about the methods, tools and techniques involved in planning, constructing and testing of the system including how to select development frameworks, technologies and testing approaches.

3.1 Requirement Analysis & Design Specification

3.1.1 Overview

This part goes into great detail about the Bongo-fruits platform's system requirements and the designing specifications. It contains a list of functional and non-functional requirements, user needs and business goals used to design and develop the system. The section also talks about the architecture and design choices, i.e. the technologies, system components and integration strategies used. The goal is to make sure that the platform not only meets user needs and technical standards, but solves some of the biggest problems in e-commerce and financial education.

3.1.2 System Design

Business Process Modeling

The Bongo-fruit business process model is one method of listing the interaction of the user parts and system elements in a simplified digital ecosystem. The model focuses on 5 interrelated processes: Identity and access management, shopping and payment, vendor fulfilment delivery and customer engagement with financial literacy features. Identity and access management provides secure signing up with the help of the Firebase authentication for the Customers, Sellers and Admin role. Shopping and payment: Use of mobile financial services like bKash, Nagad for e-Commerce growth towards financial inclusion in Bangladesh. Vendor fulfilment and delivery processes are optimised through order notifications, stock verification and logistics handovers - in keeping with the best practices for e-Commerce adoption. Customer engagement is a combination of gamified financial literacy programs and trading simulations in order to enhance digital education and financial awareness. In Figure 3.1 using BPMN to define responsibilities, decision

points and exception management, Bongo-fruit shows how digital transformation, fintech and education can seamlessly be embedded in the wider socio-economic development agenda of Bangladesh.

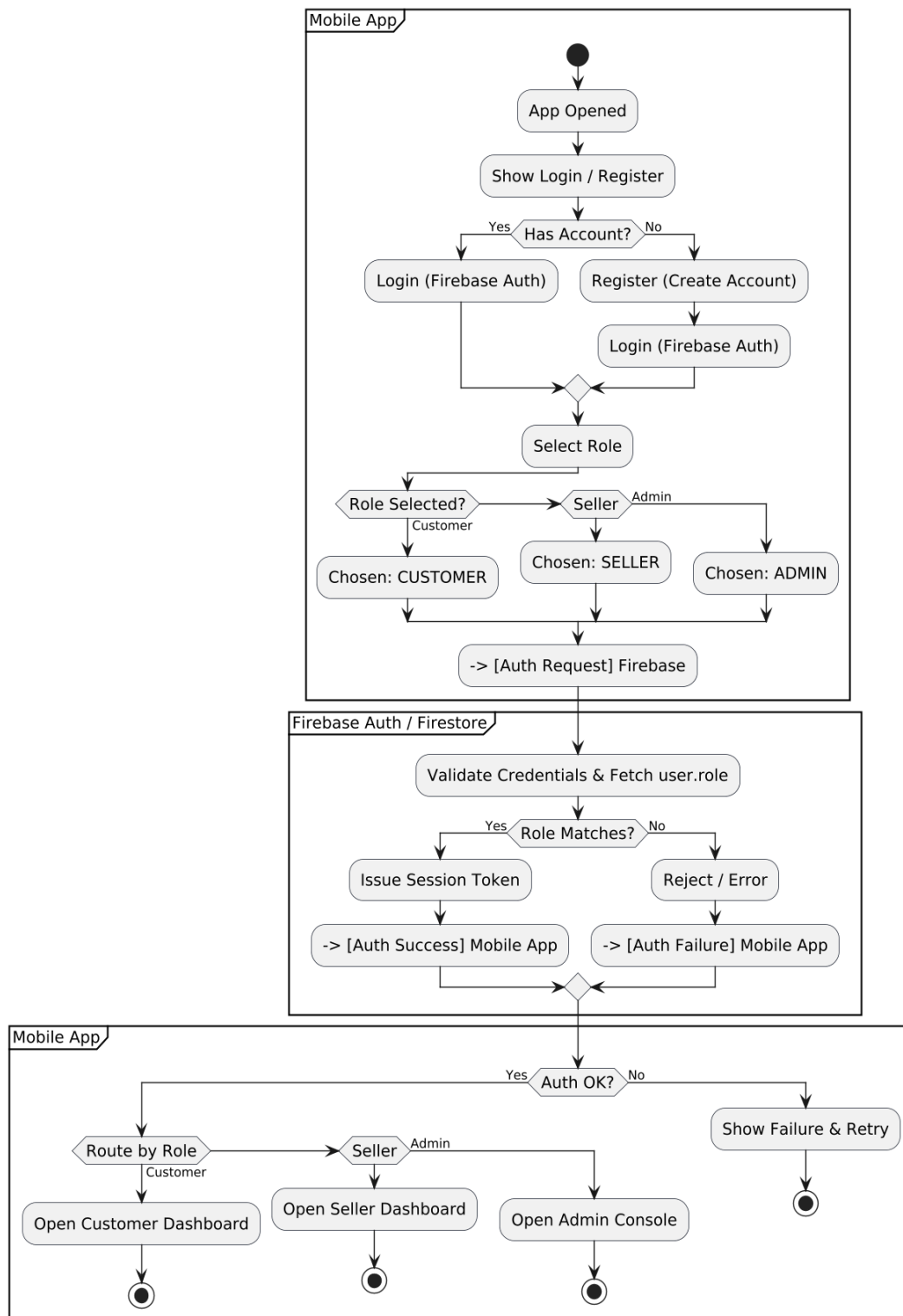


Figure 3.1: Business Process Modelling

Use Case Modeling

Figure 3.2 demonstrates how the actors are related to the system functionality that dictates the cascading of compatibility between the business and the technical processes with the help of a use case diagram.

In Case 1, Customer Logging in and Role Selection, the actors here are Customer, Vendor, Admin and Firebase Backend. The condition is that the user has to install the application. The trigger can be set to take place upon the user clicking the login button. The workflow is that once the end user logs in with the system with his/her credentials, he/she chooses a role and Firebase authenticates the credentials and role and redirects the user to the respective dashboard. The postcondition is that the authentication of the user is verified and the interface is redirected. The errors that can take place are role mismatch and unauthorized access errors. Place Fruit order in Case 2 is the name of the case, and the actors here are the Customer, Vendor, Payment Gateway, and Firebase Backend. The precondition is that the customer should be registered and items placed in the cart. The description will entail the customer clicking on the checkout option. The system entails generating an order in Firestore, payment being requested by the gateway and notification being notified to the vendor in the event of a failure. The postcondition is that the order is accepted, and the vendor starts the process of fulfillment. There are exceptions such as non-payment or stock-out. The Vendor and Firebase Backend are used in Case 3, "Vendor Managed Inventory. The condition is that the management should be provided with the record of the suppliers. The event that happens is when the vendor makes updates on the dashboard. The procedure involves the revision of price and stock details in Firestore, and the updated system would show updated prices and stock. The postcondition is that the replenishment of stock is ready and accessible to the clients. Some of the possible exceptions are canceled orders, out of date products, redirection, resource unavailability, authentication and network/quota problems. In Case 4, Learning Module, Backend and Customer (through Firebase) are the actors. This module requires an active account with the customer. The condition is the access of the learning module by the customer. The customer goes through the module and the backend rewards and offers a trading simulation on the screen. The aftercondition is that the customer gets redeeming points. The exceptions can be module errors or wrong calculations. Case 5, Registration of Permission and Vendor, has the following actors: Vendor, Administrator, and Firebase Backend. The condition is that the seller should possess KYC documents. Status entails the search of application by the admin. This process continues or rejects depending on verification done by the Firestore by the admin. The postcondition is that

the vendor obtains or loses access to the vendor dashboard. Exclusions are incomplete documentation or fraudulent applications.

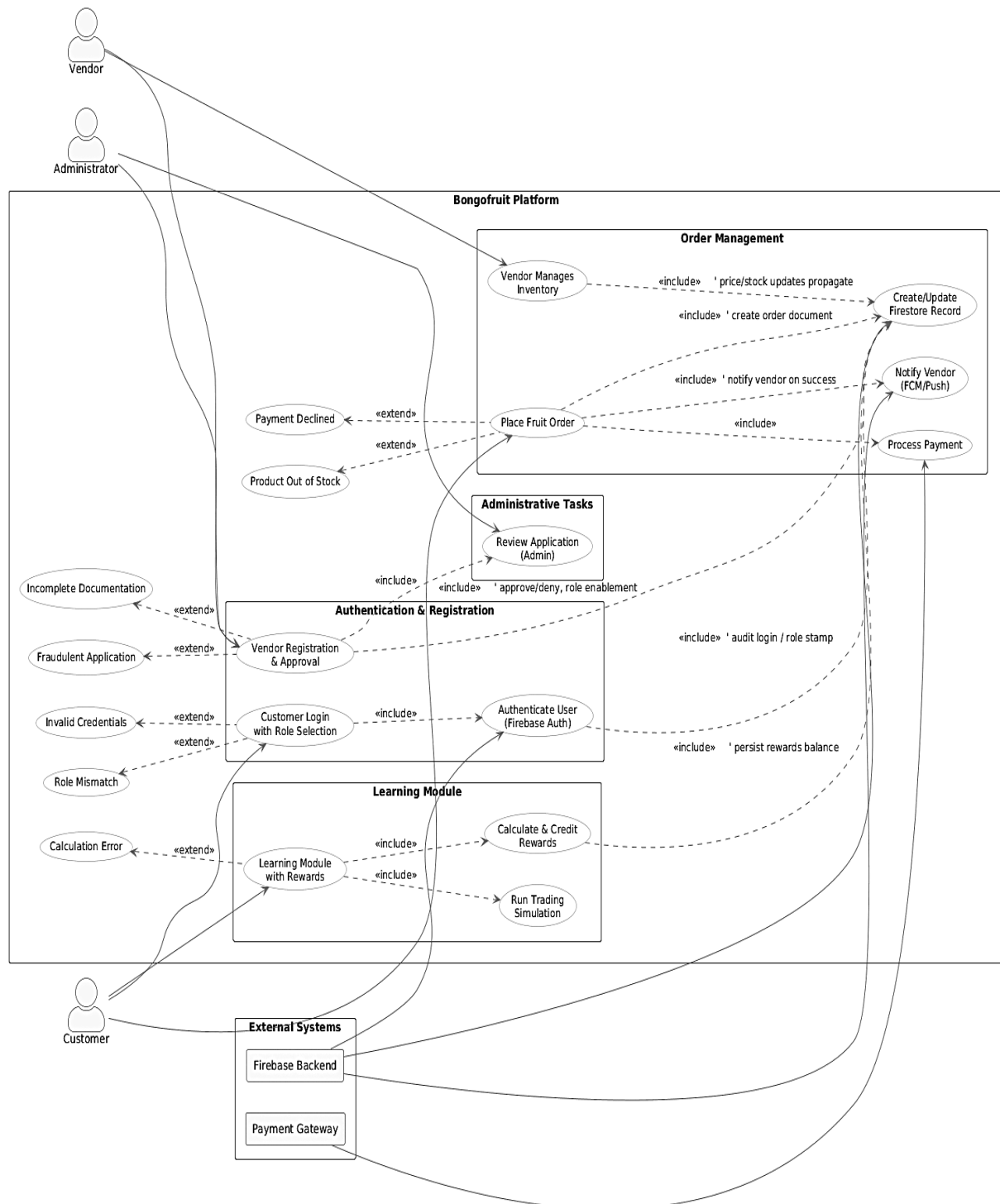


Figure 3.2: Use Case Diagram

3.1.3 Functional and Nonfunctional Requirements

1. Functional Requirements

User Registration and Authentication: Users, vendors and administrators need to register, log-in and authenticate their identity using Firebase Authentication. Product Management: Vendors need to know how to add, change and remove items from their inventory. Order Processing and Management: Customers and vendors should be able to place orders and manage orders. Payment Integration: The system should be able to integrate with payment systems such as credit and debit cards, and mobile money. Gamified Educational Modules The platform should have Financial literacy modules re-modeled into games. Dashboards based on Roles The system should have separate dashboards for the customers, vendors and administrators. Product Search Customers should be able to search product based on product types, price and availability. Real-time Analytics, The system should provide the vendors and the administrators with the real-time reports about sales, user activities and the financial information to the users.

2. Nonfunctional Requirements

It should have a fast and scalable system and have the capacity to handle thousands of users without being sluggish. It must follow best security practices whereby, strong encryption and authentication are used to secure sensitive information. The site must be intuitive, user friendly, dependable with a minimum amount of downtime with good failover features. What is important is constant accessibility that allows user confidence and interaction. It should be available on a variety of devices, such as Android tablets and smartphones, which would make the platform accessible to a great number of users. It is necessary to have maintainability so that it can be easily updated, troubleshooted and scaled. The long-term success of the platform will be ensured by a maintainable codebase, which will enable quicker implementation and resolution of the problems. The privacy of data also matters and the platform has to abide by the data protection rules and laws, and handle user data in a responsible manner.

3.1.4 Data Flow Diagram

A Data Flow Diagram (DFD) is a way of depicting how data flows through a system, as well as how the data interacts with things outside of the system. The DFD provides a clear understanding of how the system receives, processes, stores and transmits information. This helps to understand the functional demands of the Bongo-fruits platform, as well as

its design. We can take the data flow of the Bongo-fruits system and break it down into a couple of main parts. Each part depicts the major processes, data stores, and the data flow between these parts. The Figure 3.3 DFD has different levels and each level will give you a more in-depth look at the system. Below is a list of the most important parts of the system's DFD-

1. External Entities:

- I. **Customer:** Uses the platform to look at products, place orders, pay for them, and keep track of their learning progress.
- II. **Vendor:** takes care of products, processes orders, and gets paid for transactions that are finished.
- III. **Administrator:** In charge of the whole system, keeping an eye on vendor activities, making sure the platform is safe, and making sure users follow the rules.

2. Processes: Bongo-fruits system processes data such as product details, orders, payments, learning materials etc.

3. Data Storage:

- I. **Product Data Store:** This is where you store the information about the products that vendors sell.
- II. **Order Data Store:** Maintains information on customer's order, status and the transactions involved.
- III. **User Data Store:** This is where user information is stored, including user profiles and progress in financial literacy.

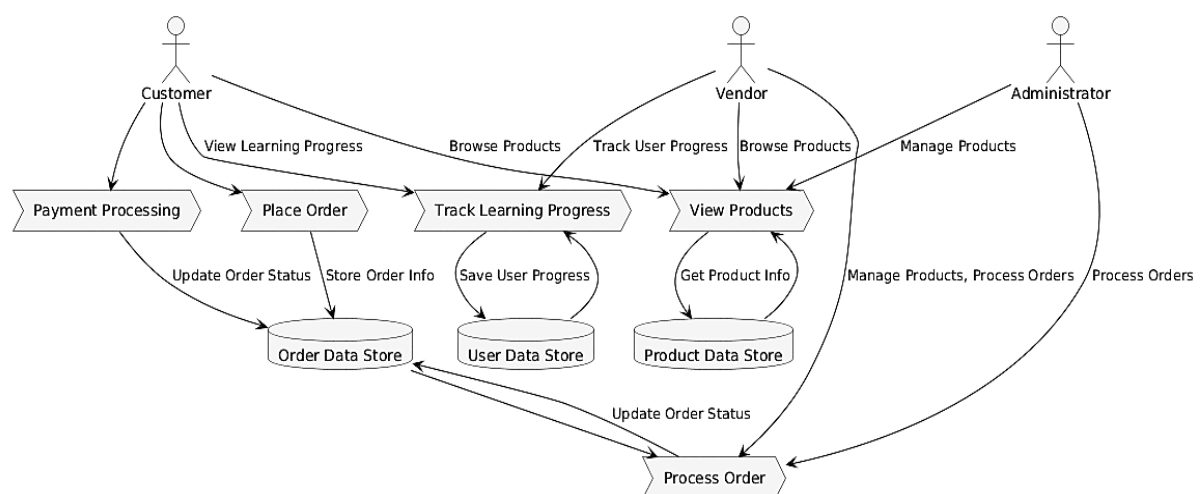


Figure 3.3: Data flow

3.1.5 UI Design

Bongo-fruits Front-end Development.

- i. Authentication Interface: Neat login interface: role drop down and demo credentials access.
- ii. Customer Dashboard: In-built commerce-education center which consists of fruit shopping areas, virtual portfolio education courses, investment learning courses and internet shopping cart.
- iii. Seller Dashboard: The user-friendly interface of business with the key performance measures, the end-to-end order management solution, inventory management, and the simple process of adding products.
- iv. Admin Dashboard: System wide administration including platform statistics, real-time activity feed, user management applications, and business analytics visualization features.
- v. Product Management Screens: interface, including product cards, category browsing, shopping cart and wishlist.
- vi. Order Processing Interface: Full color order processing system with color coded status display.
- vii. Investment Education Hub Virtual investing simulation, portfolio tracking, education progress indicators and rewards system all through gamification.

3.2 Detailed Methodology and Design

Bango-fruits site has been developed through well-considered methodology along with system design that will assist in the issues of e-commerce and financial awareness in Bangladesh. A variety of alternatives on the architecture, technologies, and features of the system were considered in the process of design and development. We considered each of the options by how simple it was to integrate, how compatible it was, how scalable, and user friendliness. This section describes the approach which was adopted, the alternatives that were considered and why the one adopted was selected.

1. Choosing a Methodology

The Agile Development method was chosen for Bongo-fruits because it is flexible, works in cycles, and lets users give feedback at any point in the development process. The Agile method is great for a project that combines e-commerce and educational modules because it lets you quickly make prototypes, test them often,

and keep making them better.

2. Alternatives that were thought about

Waterfall Methodology: This obsolete, step-wise development method was investigated but not implemented due to its being too inflexible. Agile method was more suitable since it had to be changed frequently and would react fast to user feedback. V-Model emphasized a great deal on the checking and validating of each stage. But, it was not the most appropriate option in a project whose needs keep on changing, and where improvements and changes are always welcome. Agile was better suited to Bongo-fruits as it was adaptable enough to adjust to changes as development was taking place.

3. Choosing a Design System Architecture

The Bongo-fruits platform's architecture is based on a modular, three-tier system. This design divides the system into three parts: the presentation layer (frontend), the business logic layer (backend), and the data layer (database). The system was made to be safe, easy to maintain, and able to grow.

4. Flutter for Frontend Development

Flutter has been chosen based on its ability to create quality mobile applications that can be used on most of the platforms. It speeds up the process of development and makes the UI and UX look the same on the devices.

i. Options looked at

React Native was another good alternative to create cross-platform apps. Nevertheless, it was discovered that Flutter was more practical and offered a better stable experience, especially when an application needed high-performance, like Bongo-fruits. Native Android (Java/Kotlin): Native Android development would have been the most ideal and would have involved distinct Android and iOS apps, which would have made development considerably more expensive and time-consuming.

ii. Other options looked at

Python (Django/Flask): Python framework is regarded as easy to handle and many users. However, the decision was to go with Node.js because it had the ability to service a large number of connections at once with little lag, which is important to real-time applications like Bongo-fruits. Firebase Firestore is the database: Firebase Firestore was chosen as the database because it can sync data in real time, grow with the app, and work well with Flutter. It also offers a safe, cloud-based solution that automatically scales,

which is perfect for the platform's growing needs.

5. Others that were considered

They were old relational databases since they were stable and they could process complex queries. They would have had to do more in real-time data syncing and scaling, however, it will not be an issue to Firebase Firestore. MongoDB will allow you to organize the data in any manner you feel like and Firestore already has an existing data synchronization system which works in real time and it makes more sense overall based on the technology stack as a whole. The reason behind the choice of stripe is that it was reported the safest and fastest method of handling payment in any form of payment. It may serve the platform quite well as it had high API and was simple to deploy. The local payment gateway adopted in the region is bKash and Nagad because these are more people-oriented. Stripe has been however selected due to high international rates of service delivery and good security which will steer the platform to grow outside Bangladesh. The implementation of bongo-fruits was associated with the implementation of modules on financial literacy based on the use of gamification. Such modules will empower the users to get to know of money related issues as they trades and get returns. Some of the possibilities that occurred to the mind. In the former case the articles/videos not changed were deemed as educational content. However gamification also was found to have a relative effect of increasing engagement and retention thus making it a more viable tool to users in learning. External LMS were also considered. It would have made integration difficult, and would have made customization of the learning experience a challenge. The educational modules would be easy to add to the platform in a personalized way.

3.3 Project Plan

The Project Plan will specify the tasks, resources, milestones and activities that will enable the successful development and initiation of the Bongo-fruits platform. The plan is systematic in order to ensure that the project proceeds in the right direction and achieves its objectives in time. A detailed Gantt chart, indicating the timeframe and deadlines of each activity and the key project steps is presented in this section. The Bongo-fruits project consists of various stages, each one has certain objectives and activities:

- i. Gathering and Analysis of Requirements.

In this process, the project team interviews the stakeholders (customers, vendors, and administrators) to determine what they require. Interviewing people, viewing competitor platforms, and documentation of functional requirements and non-functional requirements are some of the most essential activities. The deliverable of this phase is the Requirements Document that contained the user stories, use cases and system

ii. System Design and construction.

The process involves everything to do with the system architecture, database schema and user interfaces. The group will complete the modular 3 tier architecture of the platform, select the appropriate technologies and prototype the front and back-end components. All of this can be delivered in the form of the Design Specification Document, System Architecture Diagrams and UI/UX Wireframes.

iii. Developing and Implementing.

This is whereby a system is constructed based on the selected technologies. The initial stages of development are to set up the back-end database (Firebase Firestore) and include the APIs and the main functions. Secondly, Flutter is taken to do the front-end development to ensure that the platform is functional on every device. Two significant items that should be done are the Alpha Release of the platform with core features and a Testing Plan.

iv. Testing and Ensuring that all works.

This stage involves a lot of experimentation to ensure that the platform is functional, is safe, and user-friendly. This involves security testing, performance testing, integration testing and unit testing. The Test Reports and the Beta Release of the platform are the deliverables.

v. Launch and Deployment

When the system has passed the testing phase, the platform will be deployed on a cloud-based infrastructure (AWS or Google Cloud). In this period, the platform will be tested by a small number of users in the beta mode and will receive feedback. The final Launch Plan would be prepared and the platform will be opened to all. Two of the things that should be done are the Production Release and Post-Launch Monitoring.

vi. After the launch and upkeep

Once launched, the platform will be monitored 24/7 and any changes that are necessary will be informed by the users. During this stage, maintenance will be frequently done, and bugs will be resolved, and new features will be implemented. One of the things that have to be completed during this phase is the Maintenance and Updates Plan.

3.4 Task Allocation

Table 3.1 offers the overview of the major activities performed during the project and ranging between week 1 and week 33.

Table 3.1: Task Allocation Timeline

Tasks	Weeks																
	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33
Project Planing and scoping.																	
Field Survey																	
UI/UX Design																	
Environment Setup(Flutter ,Firebase etc)																	
Project implementation																	
Testing and Bug finding																	
Fix the error and test again																	
Final Product and Report Writing																	

3.5 Summary

This part described the methodology and design requirements of the Bongo-fruits platform, including how the development strategies were selected, the architectural structure of the system, and the explanations of the main technological decisions. As to be discussed, the functional and non-functional requirements were also addressed along with the design considerations that guided the selection of the three-tier architecture, Firebase Firestore as the database system, and Flutter as the frontend development. Further, project plan and task allocation of the next phases were elaborated with clear milestones and schedules. Risk management strategies were also addressed in the section so that the project remains on track. The implementation phase will follow the next stage; in which, the core functionalities will be created and tested.

Chapter 4

Implementation and Results

The chapter provides a summary of the process of bringing together the Bongo-fruits platform, how the design specifications were transformed to a working system. It also displays the output of the development including the key features, the functionality of the system, and the response of the system to people who have tried it.

4.1 Environment Setup

Implementation of Database

The Firebase Realtime Database is taking the form of a backend in the case of Bongofruit. This database will be designed to support multi-role process (Customer, Seller, Admin), and to support e-commerce processes and financial literacy as depicted in Figure 4.1 and 4.2. They store their parent references users, learning modules, orders and products among others and they are easily accessed and updated as well as filtered across the platform.

The data model has the following fields:

- i. Personal data (name, e-mail, phone, position, verified).
- ii. Name of vendor (shop name, business license, KYC documents, plan type)
- iii. List of the products (name, category, unit, price, and stock number, photos).
- iv. Name of product, quantity, unit price, amount (shopping cart items).
- v. Records of orders(customer reference, vendor reference, order status, amount, delivery details)
- vi. Payment data (payment method, transaction number, value of payment and payment status)
- vii. The learning modules (module ID, name, type, level of difficulty, reward points)
- viii. Progress of learners (user reference, module reference, status, score, completion Timestamp)
- ix. Reward points (redeeming points, reward history, reward source)
- x. Notifications (type, title, body read / unread status)
- xi. Board information (orders a day, gross merchandise value, money returned, number of people registered).

The architecture provides good throughput read/write in that similar data is stored at a single point and also to allow real time synchronization of the customer/vendor/administration dash boards. To provide an example, when an order is placed by a customer, the customer and vendor dashboard is automatically updated without having to refresh the whole dataset. The progress and rewards balance is also kept in real-time and integrated into a mix of a shopping and learning experience.

Collection	Document ID	Fields
users	6eQC0AiZWgN76oc8QjOVT8PxAo32	- address: "Dhanmondi, Dhaka" - createdAt: September 2, 2025 at 11:14:14AM UTC+6 - email: "customer@bongofruit.com" - isActive: true - lastLoginAt: September 11, 2025 at 2:30:35PM UTC+6 - name: "Happy Customer" - phone: "01733333333" - userType: "UserType.Customer"

Figure 4.1: Database Architecture

Collection	Document ID	Fields
fruits	0qMptajHJCZLvUBQmv1	- category: "Tropical" - description: "Juicy pineapple with a tangy-sweet flavor" - imageUrl: "https://drive.google.com/file/d/1a5_2UFKXi8hwBQN4nRHt9x8hcqwp0M0/view?usp=sharing" - isAvailable: true - isInSeason: true - isOrganic: true - name: "Pineapple" - price: "120" - rating: 4.8 - reviewCount: 24 - unit: "piece"

Figure 4.2: Database Architecture

4.2 Testing and Evaluation

To measure the reliability of the multi-role platform features and the hybrid of e-commerce in education functions in different applications, bongofruit testing was carried out. The methods of testing that were involved are:

- i. Unit Testing - The fundamental structures of the product such as user authentication, selection of product listing and the determination of rewards points were checked.
- ii. Integration Testing - Assured the flow among the dashboards (Customer, Seller, Admin) and ensured that it is straightforward to synchronize the information with Firebase Realtime Database.
- iii. E-commerce WT- Modified customer cart-checkout orders, such as cart payment gateway notifications and inventory updates.
- iv. Gamification & Learning Module Test, & Check-out Rewards - Check-in, verified, and simulated progress, and redemption.
- v. Privacy & Access Control Test - See to it that the role-based restrictions (Customer, Seller, Admin) were applied and that unauthorized access was not granted.
- vi. Device Compatibility Test- Evaluated the functionality of the app in the diverse Android devices with diverse screen resolution and hardware capabilities.
- vii. Error Handling Test- The test cases involve payment failure, out of stock goods, wrong login credentials, and network issues to make it gracefully recovered.

4.3 Results and Discussion

The application was tested on multiple Android devices and under different network conditions. Below is a summary of the results from the Figure (4.3 to 4.17).

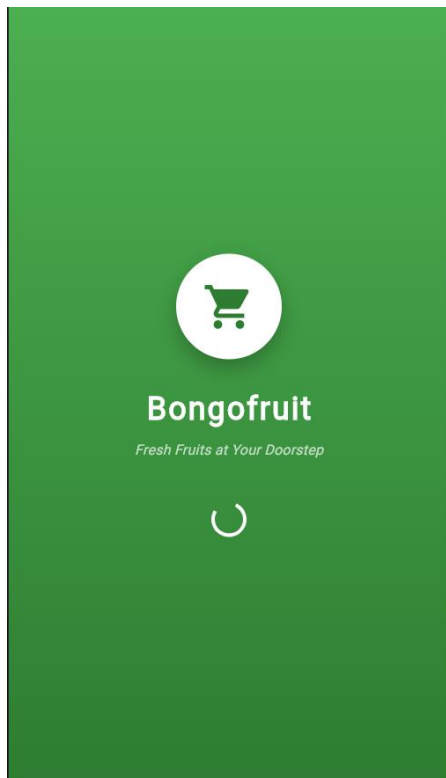


Figure 4.3: Splash Screen

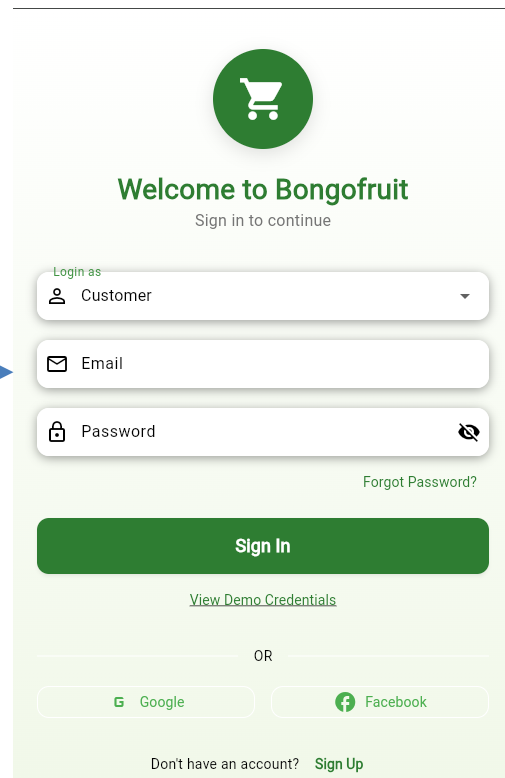


Figure 4.4: Log In/Sign In Screen

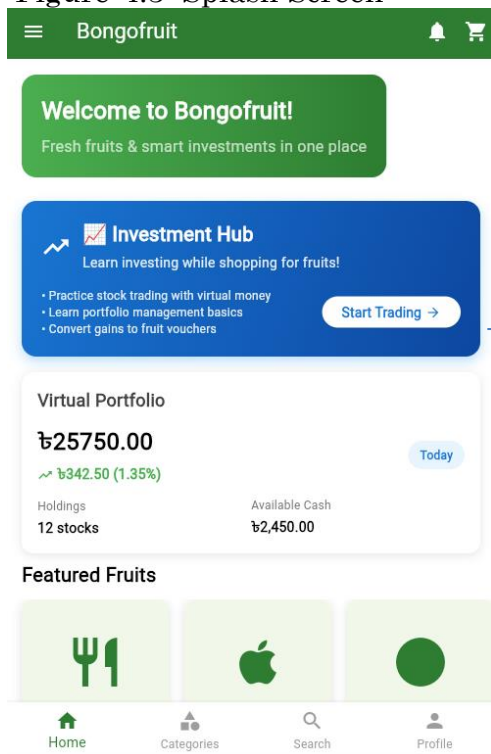


Figure 4.5: Customer Dashboard

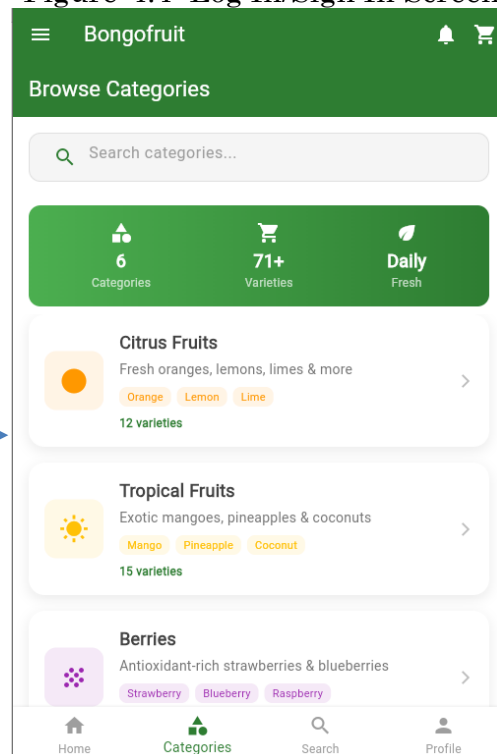


Figure 4.6: Categories Screen

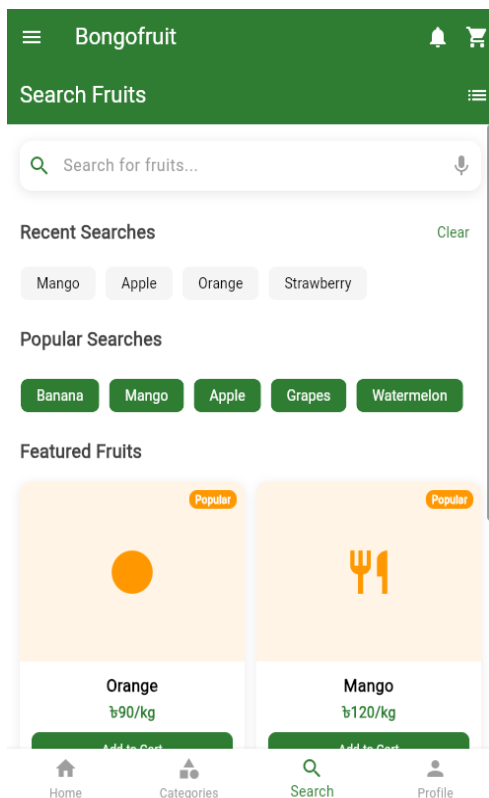


Figure 4.7: Search Screen

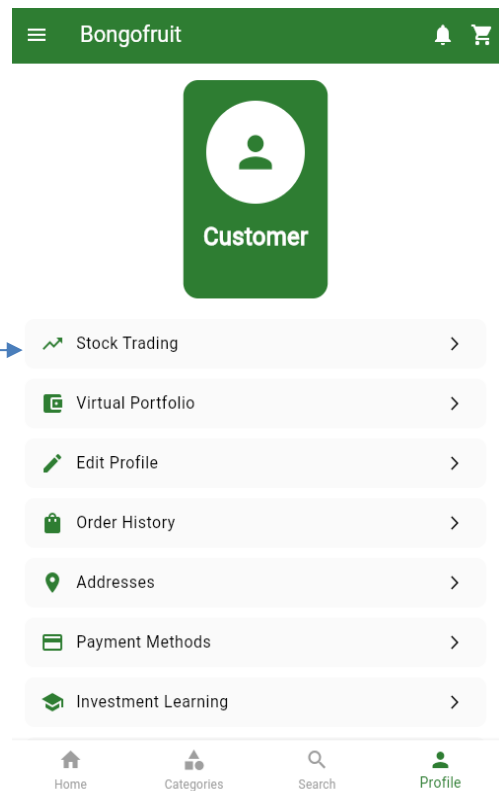


Figure 4.8: Customer Profile

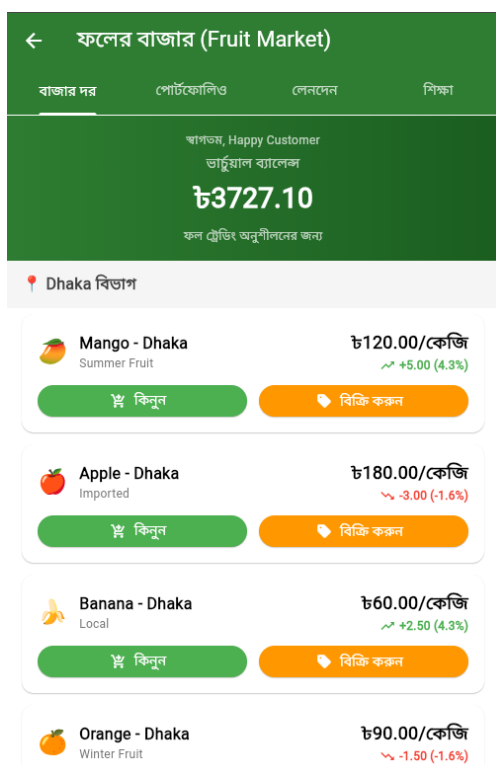


Figure 4.9: Stock Screen

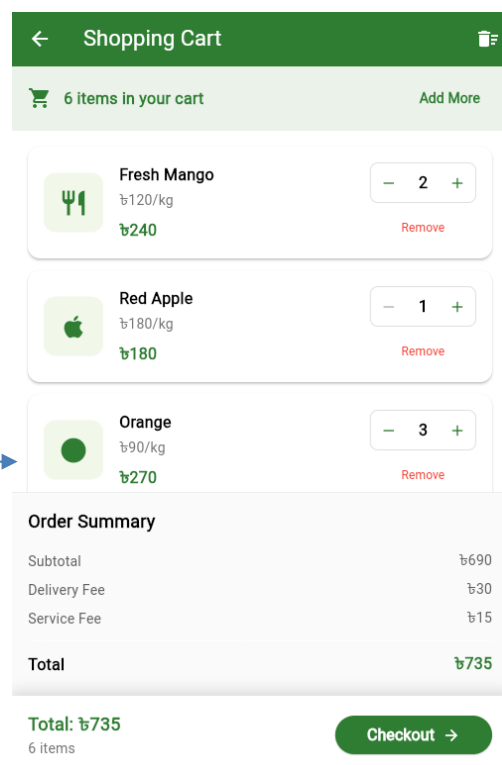


Figure 4.10: Add To Cart

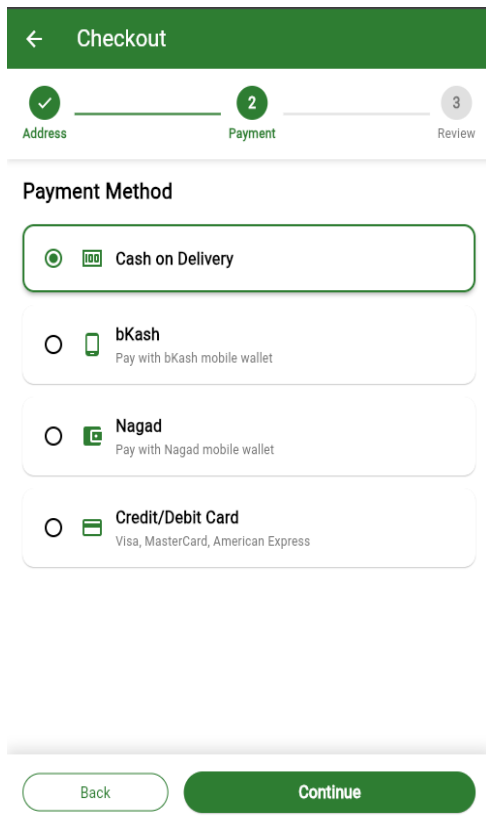


Figure 4.11: CheckOut

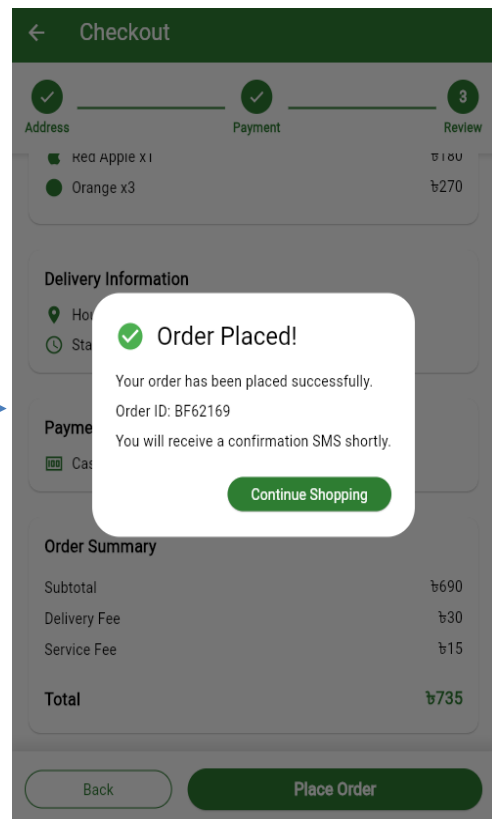


Figure 4.12: Payment

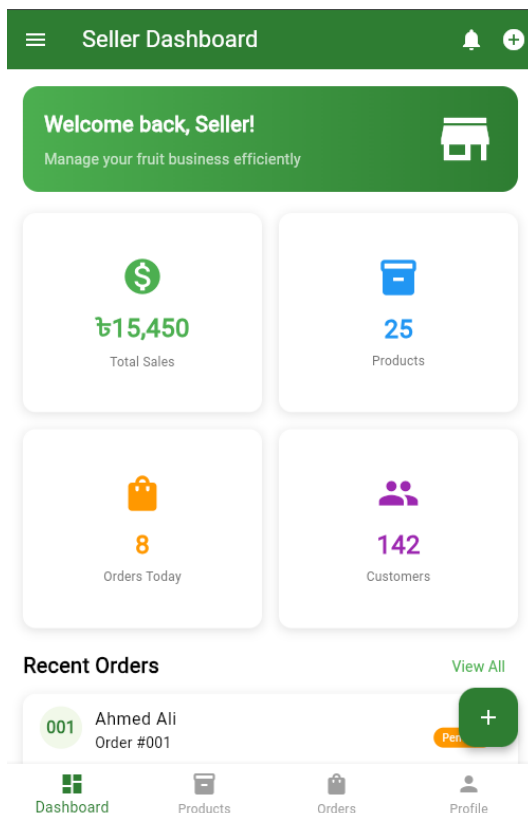


Figure 4.13: Seller Dashboard

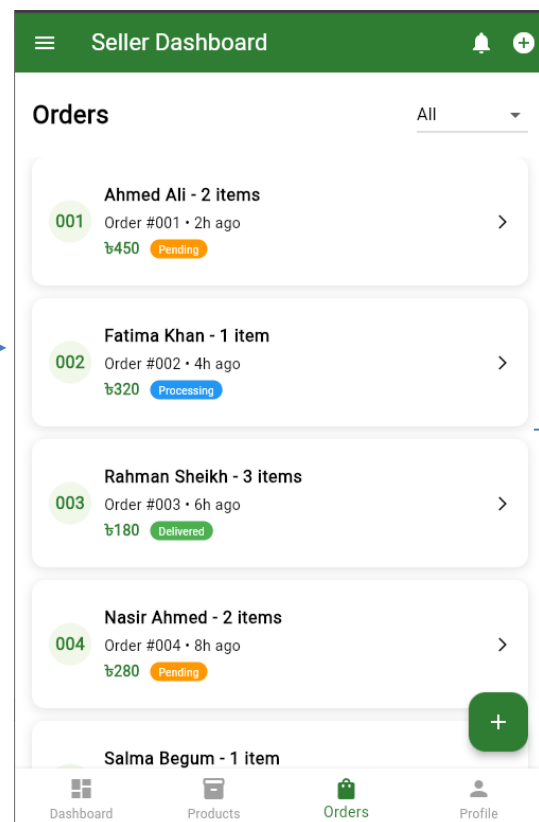


Figure 4.14: Seller Order Screen

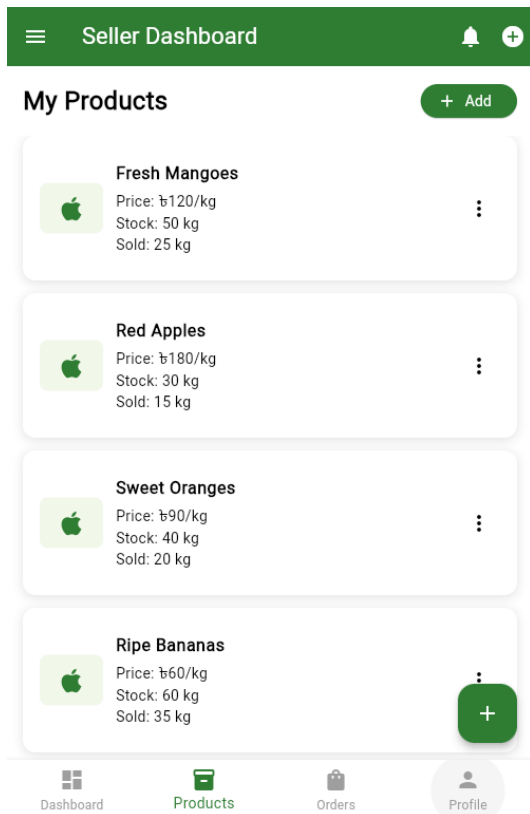


Figure 4.15: My Products

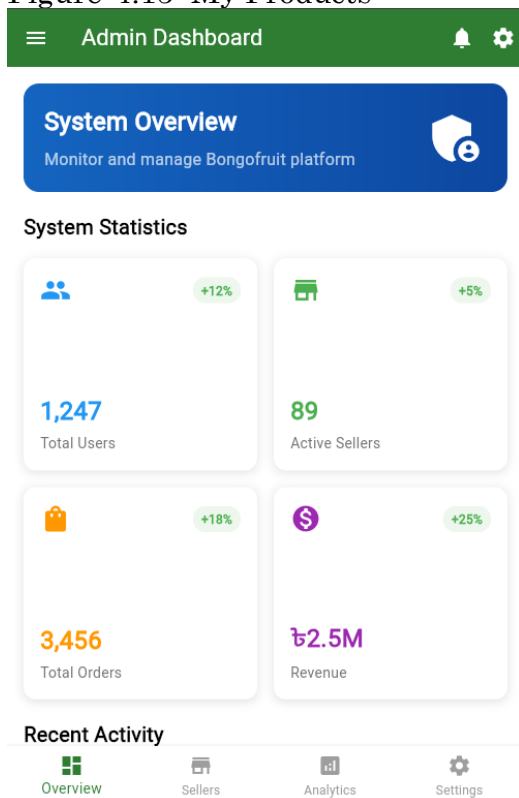


Figure 4.16: Admin Dashboard

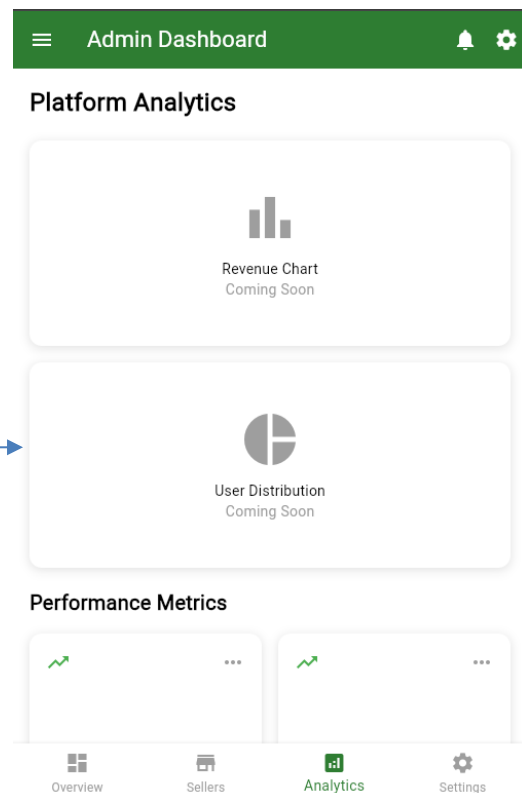


Figure 4.17: Analysis Screen

Test Results and Reports

- i. User Authentication – Role-based login and registration worked correctly → Pass
- ii. Product Listing – Catalog displayed with accurate details → Pass
- iii. Cart & Checkout – Items added and orders created successfully → Pass

4.4 Summary

This section provided a complete overview of the process by which the Bongo-fruits platform was developed and what was learned in the process. It featured the key attributes and functionality of the system including e-commerce, financial literacy modules, and gamified learning features. It also discussed the performance of the platform during testing along with its achievements and areas that it can improve. The testing phase, which was subject to user feedback, contributed to making the platform more appropriate to release it.

Chapter 5

Engineering Standards and Design Challenges

This chapter discusses the standard of engineering that was adhered to in designing the Bongo-fruits platform and the design challenges that arose in the process. It discusses the best practice, industry standards, and technical requirements that informed the development process, the issues that arose in the attempt to make the system work, develop, and become user friendly.

5.1 Compliance with the Standards

In order to ensure that the Bongo-fruits platform is efficient, stable and meets industry requirements, there are several significant engineering rules that it adheres to. The objective of the platform to offer a smooth user experience, ensure the data is safe and ensure that the scalability and performance is at all times influenced the selection of these standards. The principal criteria that will be applied to the project and those alternatives that were considered and why they were chosen will be discussed below.

- i. Data Security and Privacy Local Data Protection Laws and GDPR. The standard is the General Data Protection Regulation (GDPR). Advantages GDPR ensures that user information is secure and confidential, and this is extremely crucial when private information and financial data are involved. Compliance with GDPR will safeguard you in a court of law, establish trust among users and be embraced by most markets. It is difficult to comply, and you need to continue checking to ensure that all of your data manipulation processes maintain code.
- ii. Alternatives were looked at in the form of local data protection laws in Bangladesh. It is more adaptable than GDPR and more in tune with local requirements, which might assist local businesses to comply with it with ease. It lacks the same global consistency and user trust that GDPR possesses,

thus making it more difficult to make people in other geographic areas adopt it.

- iii. Rationale behind the selection: GDPR was selected since it has a wide perspective on data privacy, which aligns with the ambitions. Google Cloud vs. AWS. The standard used is Google Cloud (Firebase Firestore). Firebase allows you to synchronize your database in real time which is crucial to the Bongo-fruits e-commerce and educational modules. In addition, Firebase is compatible with Flutter as well as Firebase Authentication, which makes it easier to create, test, and expand. It is more expensive than other traditional cloud host services, particularly when the number of users increases.
- iv. One of the options that were considered is Amazon Web Services (AWS). AWS possesses much global infrastructure, features of scalability, and cost management tools. It is easily adapted to your requirements and it integrates with many other applications. It is more time-consuming to install and maintain and requires more specialized skills to install and maintain. Rationale Behind Selection: It was selected primarily due to the fact that Google Cloud can integrate well with Flutter and Firebase, which simplified the process and gave an excellent means of processing real-time information.
- v. WCAG 2.1 for web accessibility, This standard was Web Content Accessibility Guidelines (WCAG) 2.1. Ensures individuals with disabilities can access the platform, which makes it more inclusive overall and compliant with legal and regulatory standards in various locations. Accessibility features may add to the overall development time and may be more complex to develop, particularly when they are custom. One of the options is ADA (Americans with Disabilities Act) standards of web accessibility. It is popular in the US, and it provides clear guidelines on how websites and mobile apps should be made accessible. It is primarily orientated to United States market and that is why it will not be as helpful to users representing other countries. WCAG 2.1 was selected as it contains specifications on how to make websites accessible to all people around the world to ensure that as many people as possible can use the site.
- vi. Safe Payment Processing/ PCI-DSS Compliance. The standard is PCI-DSS

(Payment Card Industry Data Security Standard).Pros: Ensures that credit and debit card data is processed securely, which is crucial to the payment transactions at the platform. Websites that take payments via cards have to comply with PCI-DSS regulations. Certification is extremely rigorous and lack of adherence to the rules may prove to be expensive and costly in terms of legal matters. Integrating with Stripe and PayPal which are both PCI-DSS-compliant payment providers. It is simpler to connect a payment gateway to the existing systems and ensures that you are PCI-DSS compliant without necessarily dealing directly with sensitive data. Reason for Choosing: Stripe has been selected because it is very secure, can scale with your business and is easy to integrate, so you do not have to directly handle sensitive data to be PCI-DSS compliant. Payment processors charge a fee per transaction and thus an increase in costs of running the business.

- vii. Agile and Waterfall Software Development Method. The standard is Agile Development. Agile allows you to build in small increments with feedback loops that are continuous and this is ideal in a project such as Bongo-fruits where user requirements and market conditions can vary as time goes on. It ensures that things can easily and quickly change. All stakeholders should be engaged at all times and in case not under good control; this may result in scope creep. One of the methods considered was Waterfall Methodology. Suited to projects that have strict requirements and deadlines since it gives predictability and organization Not being able to make changes after the project is in development Not being able to be flexible Agile was selected because it is flexible, which is crucial in the Bongo-fruits platform since it is continuously evolving. In order to enhance the e-commerce and financial literacy portions, a lot of iterations and user testing should be done.

5.1.1 Software Standards

The Bongofruit front-end is a Flutter based platform that incorporates e-commerce features with educational investment features. It has a clean login screen with dropdowns of role selection to customers, sellers and admins. The user dashboard is an interactive commerce/education platform, which provides shopping of fruits, virtual portfolio management, educational investment classes, and shopping cart. The seller dashboard offers business savvy interface including performance metrics, order management,

inventory tracking, and lean workflows. The admin dashboard provides system-wide monitoring features, activity monitoring, and business analytics visualization. The product management screens consist of category based browsing interfaces, product detail cards, the shopping cart with the ability to add to wishlist. The order processing interface provides tools of complete lifecycle management of orders and customer communication services. The investment education platform provides a simulated learning experience in the form of virtual trading, portfolio performance, education progress gauges, and integrated rewards.

5.1.2 Hardware Standards

The Bongofruit platform can be used in standard consumer gadgets such as Android phone and tablets. To ensure that Flutter-based front-end and Firebase integration can be effective, the hardware has to have a minimum of 2 GB of RAM, 32 GB of storage and a stable processor. Firestore, which is hosted on the cloud, is used as the backend. It implies that it does not have to depend on local servers and can be easily expanded in size and processing power.

5.1.3 Communication Standards

Any message between the client and the server is done using HTTPS in order to ensure that the information is secure. RESTful APIs are the ones that handle the front-end and the Firebase backend communications. The real-time updates, push notifications, and data synchronization are done using Firebase Cloud messaging (FCM) and WebSocket protocols. They also ensure that communication is quick, dependable, and secure.

5.2 Impact on Society, Environment and Sustainability

5.2.1 Impact on Life

The Bongofruit platform makes a significant difference in the lives of people and families because it enhances their financial literacy and digital skills. Gamified simulations provide the users such as small-scale fruit vendors, students, and regular consumers with an opportunity to learn about investing in a fun manner. Virtual trading and portfolio management modules enhance the abilities of users in decision making, risk assessment and strategic thinking. This is capable of producing an improved economic behavior in the real world. Bongofruit also provides small companies with a structured online market place in which they can easily monitor their stock, orders, and sales performance. This

reduces the physical interaction of the market which is traditional, time and energy saving. The resultant effects are beneficial to consumers; they have easy access to fresh vegetables and fruits, personalized shopping experiences and improved financial awareness. All this combined makes life easier and it assists individuals to be more economically free.

5.2.2 Impact on Society & Environment

Bongofruit is a direct contributor to social, digital inclusion and empowerment. The site links small-scale vendors with a digital ecosystem, which bridges the urban and rural divide as well as the social and economic classes in Bangladesh. This puts the marginalized populations at the disposal of tools and opportunities previously exclusive to the bigger businesses. This inclusion assists in ensuring that the economy is fairer, informal market is less exposed and business grows. It establishes a culture of openness, trust, and accessibility between the buyers and sellers. The platform also makes people work together and learn with one another. Educational programs helping to educate people about money make people be more conscious of saving, investing, and managing a business in an environmentally-friendly manner. Bongofruit promotes the culture of lifelong learning and responsible economic practice by promoting the use of these educational tools as fun and rewarding. This has long term positive impacts.

5.2.3 Ethical Aspects

Bongofruit contributes to the environment by living towards digitization and intelligent utilization of resources. The time spent in the physical markets is reduced resulting in less pollution due to transportation. Online management of orders and stock also reduced food waste since it ensured that there is always an equal balance between supply and demand. Vendors are able to make more accurate predictions regarding the quantity that they will sell and not have to lose too much stock, which is more eco-friendly as it will imply fewer unsold perishable products. The data is stored in a scalable and energy-efficient manner on the platform using Firebase Firestore, which is cloud-based. This implies that there is no requirement of local servers and hardware changes. Modular design and microservices enable Bongofruit to reduce the unnecessary computing, which is more environmentally friendly.

5.2.4 Sustainability Plan

The design of Bongofruit has much to do with ethics. The platform secures personal user

data through maintaining the privacy of data, ensuring the safety of authentication, and transparency of transactions. Bongofruit also safeguards both personal and financial data against being abused by applying role-based access control, encrypted storage, and secure API protocols. Besides, the system is constructed on a foundation of fairness and openness. The platform is socially accountable and minimizes the digital divide through the implementation of transparent reward systems in gamified learning, equitable pricing procedures, and accessible user interfaces to users with varying degrees of technical skills. Ethical design also involves considering user feedback, which promotes participative nature towards platform development.

5.3 Project Management and Financial Analysis

Bongofruit project will be developed and deployed in a phased system based on the Agile approach in order to provide the adaptability, iterative development, and constant feedback on the progress of the project. The scope of the project is the development of a Flutter-based Android application that will consist of a fruit e-commerce system with vendor management tools, customer education modules in the form of gamified finances. The site will also include three level dashboards of customers, vendors and administrators, multi-role authentication, and role-based access security, basic analytics of user engagement and sales. The cross-border transactions, iOS implementation and advanced AI-driven features are out of scope at the moment. The project shall be planned within 6-8 months, which will be divided into four-phase plans. Phase 1 (Months 1-2) will involve the analysis of requirements, UI/UX, and database schema. Phase 2 (Months 3-4) will be focused on the implementation of core modules, which will include the shopping cart, the vendor tools, and the monitoring features of the administration. Phase 3 (Months 5-6) will entail the combination of gamified financial literacy, the payment gateway, and reward systems. The fourth phase (Months 7-8) will be devoted to unit, integration, and user acceptance testing (UAT), bug fixing, a pilot launch, and evaluation. To ensure quality control, stability testing will be conducted in each sprint, and usability and trust as well as validation will be checked during UAT with real vendors and customers. The performance standards of the platform are established to be 5 seconds or less transaction time and 99 percent server availability. Technical risks like delays in payment gateway will be addressed by establishing early partnership with local financial partners such as bKash and Nagad in risk management. The operational risks associated with the unwillingness of the vendor to collaborate with digital tools will be mitigated through

training, onboarding incentives, and trust-building mechanisms. Low early adoption is a financial risk that will be addressed with the help of a freemium business model and a gradual marketing plan. The project human resource management involves the project owner, a final-year student, a development team of 2-3 Flutter, backend, and database developers, and an UI/UX designer who will make sure that the usability and accessibility are checked. There will be academic and technical guidance by the supervisor/advisor. The project is an academic project, but a realistic financial analysis is provided to show that it is a viable project in long term.

1. Estimated Development Costs:

To Develop the application Table 5.1 shows the cost in the project.

Table 5.1: Financial Analysis table.

SN	Item or Component's	Cost in BDT
01	Tools & Equipment AMD Ryzen 5 5600 (6-core), 16 GB DDR5 RAM, NVIDIA RTX 3050 6 GB, and Others	95,300
02	Power consumption for GPU computing	10,000
03	Field Survey	11,500
04	App Publishing, Domain, Fees	26,600
05	Testing	10,000
06	Miscellaneous	35,000
Total Cost		188,400 BTD

5.4 Complex Engineering Problem

The issues discussed in this chapter are the hard engineering problems that arose in the process of developing the Bongofruit platform. The combination of a large number of technical, functional, social, and operational factors may complicate engineering problems. These are issues that require multi-dimensional problem-solving approaches in order to resolve. This section relates the engineering issues of Bongofruit to familiar problem solving types and states the reason behind each mapping.

5.4.1 Complex Problem Solving

The issues discussed in this chapter are the hard engineering problems that arose in the

process of developing the Bongofruit platform. The combination of a large number of technical, functional, social, and operational factors may complicate engineering problems. These are issues that require multi-dimensional problem-solving approaches in order to resolve. This section relates the engineering issues of Bongofruit to familiar problem solving types and states the reason behind each mapping.

Table 5.2: Mapping with Complex Engineering Problem.

EP1 Depth of Knowledge	EP2 Range Of Conflicting Requirements	EP3 Depth of Analysis	EP4 Familiarity of Issues	EP5 Extent of Applicable Codes	EP6 Extent Of Stakeholder Involvement	EP7 Interdependence
✓			✓	✓	✓	

Depth of Knowledge (EP1): The technical knowledge needed to solve the problems in this regard cuts across various fields. Such are expert skills in such fields as cloud databases, which guarantee scalable storage systems, gamification techniques to attract users, front-end frameworks to create intuitive interfaces, order management systems to simplify product transactions, and Continuous Integration/Continuous Deployment (CI/CD) pipelines to automate the software delivery process. The areas should always be well versed with the professionals in order to resolve the issues and have the platform be sound and secure and dynamic to the changing needs and maximize the performance and the user experience.

Familiarity of Issues (EP4): The well-knownness of the issues in the field differs greatly. Such problems as gamified financial education, front-end development are not that new and are widely discussed in the tech community. Nonetheless, combining these with e-commerce and live data processing is an even newer challenge. Integrating these various factors necessitates a better look at how they are interdependent with each other and the innovative use of the available technologies to develop a smooth working solution. Although the separate parts might be common, their combination presents exclusive issues that must be addressed with new methods to achieve success.

Extent of Applicable Codes (EP5): This dimension revolves around the set codes, standards and regulations that guide the problem under consideration. Web security concerns, like encryption protocols and secure authentication system are to be addressed with great attention in order to safeguard data of the users and avoid unauthorized access.

The privacy regulations such as the General Data Protection Regulation (GDPR) define how the personal information should be gathered, stored, and used. Also the cloud hosting rules provide certain data storage, scaling and uptime requirements, which have to be followed during the development process to avoid risk of legal violations.

Extent of Stakeholder Involvement (EP6): External stakeholders should be involved in the process of solving the problem. In the example of Bongo-fruits platform, joint action with different parties is the key to success. The customers give us useful feedback about usability and functionality, vendors are able to maintain product availability, and deliver on time, and administrators are allowed to monitor security, performance and user experience on the platform. Close collaboration and feedback systems with these stakeholders are needed to resolve issues, improve the features of the platform and do constant adjustments to keep up with the changing demands. The stakeholder participation will make sure to incorporate every opinion in the decision making process.

Mapping with Knowledge Profile

Table 5.3: Mapping with knowledge Profile.

K1 Natu ral Scien ce	K2 Mathem atics	K3 Engineeri ng Fundame ntals	K4 Special ist Knowle dge	K5 Enginee ring Design	K6 Enginee ring Practice	K7 Comprehe nsion	K8 Resear ch Literat ure
		✓	✓	✓	✓	✓	✓

K3: This refers to the foundational understanding of key concepts in engineering, including system architecture, networking, and database theory. System architecture provides the framework for structuring and organizing various components of a system, ensuring efficient interaction. Networking involves the methods of communication between system components, while database theory covers the principles of data storage, management, and retrieval. These fundamentals are crucial for building systems that are scalable, reliable, and efficient. A strong grasp of these areas enables engineers to design systems that function cohesively, with secure data exchange and optimized performance.

K4: This encompasses a deeper understanding of advanced technologies such as cloud computing, real-time data synchronization, and gamified learning systems. Cloud computing allows for the deployment and scaling of applications across distributed servers, offering flexibility and cost-effectiveness. Real-time data synchronization ensures

that data is updated simultaneously across multiple devices or platforms, enabling seamless user experiences. Gamified learning systems combine gaming elements with educational content, enhancing engagement and motivation. Mastery of these areas is essential for developing innovative, cutting-edge solutions in areas like e-commerce, education, and data management.

K5: This principle focuses on the practical application of design concepts, including system integration, user interface (UI) and user experience (UX) design, and database management. System integration ensures that various components of the system work together harmoniously. UI/UX design emphasizes creating intuitive, user-friendly interfaces that provide a positive experience. Database management involves organizing and structuring data efficiently for easy access and modification. A well-designed system incorporates all these elements, ensuring functionality, usability, and data integrity while delivering a seamless experience for end-users.

K6: This relates to the practical implementation of theoretical design principles into real-world systems. Engineering practice bridges the gap between concept and execution, focusing on how designs are realized and deployed. It involves coding, prototyping, testing, and refining systems based on real-world requirements. Engineers must navigate challenges such as system performance, scalability, and user feedback during the development process. This phase is critical for transforming abstract ideas into functional, reliable products that meet the needs of users and stakeholders while adhering to industry standards and best practices.

K7: Comprehension in engineering involves the ability to understand and apply both theoretical and practical aspects of the field. It requires a solid grasp of fundamental principles, as well as the ability to analyze and solve problems based on that knowledge. Engineers must not only be able to recall concepts but also apply them in various contexts, making informed decisions during design, implementation, and troubleshooting. This ability to integrate theory with practice is essential for creating effective, efficient solutions that solve real-world problems and contribute to technological advancements.

K8: This involves gathering and analyzing insights from academic research, industry reports, and case studies to inform engineering practice. By reviewing the latest literature, engineers stay informed about emerging trends, new technologies, and best practices. Research literature provides a solid foundation for decision-making, offering

evidence-based solutions to complex challenges. It helps engineers understand the broader context of their work, learn from previous successes and failures, and apply proven methods to innovate and improve their systems. Incorporating insights from various sources ensures that engineering solutions are both effective and cutting-edge.

5.4.2 Engineering Activities

Mapping with Complex Engineering Activities

Table 5.3: Mapping with Complex Engineering Activities.

EA1 Range of re- sources	EA2 Level of Interaction	EA3 Innovation	EA4 Consequences for society and environment	EA5 Familiarity
✓		✓	✓	✓

EA1: Range of Resources

The range of resources refers to the amount and variety of resources (e.g., human, technical, financial) required for each engineering activity. For example, Backend Development (Database Design) requires considerable resources such as cloud services (Firebase Firestore), developers proficient in backend technologies (Node.js, Firebase), and system architects

EA3: Innovation

Innovation indicates the level of novelty and new approaches introduced by the engineering activity. The Gamified Financial Education Integration stands out for its innovative use of gamification to enhance user engagement in financial literacy. On the other hand, CI/CD Pipeline & Deployment involves applying existing best practices in new, efficient ways to speed up delivery.

EA4: Consequences for Society and Environment

Each activity has societal and environmental consequences. For example, the Backend Development (Database Design) impacts user data privacy and system security, while Real-time Data Processing (Order Management) reduces logistical inefficiencies and contributes to environmental sustainability by reducing unnecessary transportation for order fulfillment. Gamified Education helps to democratize financial knowledge, impacting economic behavior on a larger scale.

EA5: Familiarity

Familiarity indicates the degree to which the engineering activity is widely practiced or recognized in the industry. CI/CD Pipeline & Deployment is a widely adopted practice in the industry, making it highly familiar. In contrast, Gamified Financial Education Integration introduces less common methods of learning, requiring a unique approach to educational content.

5.5 Summary

This chapter provided an in-depth exploration of the engineering standards, design challenges, and complex engineering problems encountered during the development of the Bongo-fruits platform. It highlighted the key engineering activities involved, such as backend development, frontend design, and gamified financial education integration, mapping them to engineering problem-solving categories and activities. The section also emphasized the importance of adhering to industry standards and best practices to ensure a robust, scalable, and sustainable solution. The mapping of these activities provided insight into the resource requirements, stakeholder involvement, innovation, and societal impact, ensuring that the platform not only meets technical specifications but also serves its users effectively.

Chapter 6

Conclusion

This chapter provides a summary of the Bongo-fruits project, highlighting the key achievements, challenges, and future directions. It emphasizes the impact of the platform on users, the technical decisions made, and the platform's contributions to the local e-commerce and financial literacy ecosystem.

6.1 Summary

This chapter presents a clear description of the Bongo-fruits project, recapping the main findings of this project, and its contributions to e-commerce and financial literacy. The process of development is summarized, beginning with the process of gathering requirements and design all the way to the challenges and the solutions effectively used. The ability to incorporate the e-commerce features into the gamified financial education and develop an integrated platform that complies with the key market gaps is one of the most important project achievements. The chapter highlights the effect of the platform on the individual users, society, and the community in general, especially on how it has enhanced the digital inclusion and economic empowerment in Bangladesh. The platform allows not only online commerce with the help of practical e-commerce tools but also allows users to enhance their financial literacy in an exciting manner in addition to that. The project has conformed to the industry best practice and standards, with scalability, security, and user-centric design. Since the Bongo-fruits platform is still in its developmental stage before it can be fully deployed, the lessons learned and insights obtained through the development process can serve as a guideline on how the project can be improved in the future and why similar digital solutions can be used in the region. The success of the project opens the way to improve the digital infrastructure that may serve other underserved markets, which will also lead to a more comprehensive economic increase.

6.2 Limitation

Although the Bongo-fruits project has achieved its main goals, the goals of the project are limited in a number of aspects, which would warrant improvement aspects. The potential

issue related to scalability can be observed on the method of increasing user base, which demands the further refinement of database and caching approach. There are still usability barriers, especially to users with low internet literacy levels who are more likely to live in rural regions, and this requires higher accessibility measures. The slow adoption of vendors has been caused by a digital divide and needs more training and incentives. Besides, the gamified financial education should be additionally assessed. The dependency of the platform on third-party services and compliance with regulations points to the importance of constant monitoring and adapting to the changing risks.

6.3 Future Work

The future growth of the Bongo-fruits platform is concerned with making the site more scalable, performing and user-friendly. Among the critical areas are optimization of the database structure, caching and load balancing methods, and consideration of the multi-region cloud implementation as part of enhancing performance. The adoption of the vendors and users will also be dealt with by providing incentives, training, and engagement plans such as customized recommendations and gamification. Advanced topics, certification programs, and longitudinal studies will be added to financial education modules to measure the real-world effects. Multilingual and users with disabilities support, will enhance localization and accessibility. It will combine AI and advanced analytics to boost personalised recommendations, predictive sales and financial insights. The adherence to data privacy laws, e.g. GDPR will be prioritized as well as increased security. Finally, the next steps in work will be integrations with payment gateways, third-party educational platforms, and supply chain services to make the ecosystem more comprehensive.

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