FINANCIAL MANAGEMENT AND BUDGET MONITORING APPLICATIONS

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Abstract

Finance Helper is a mobile application designed to address the financial challenges faced by young adults, particularly students and early-career professionals, by tackling the lack of real-time budgeting tools that often lead to overspending and financial stress. The app enables users to set savings goals, track daily expenses, receive real-time budget notifications, and generate monthly spending summaries through an incremental development model that integrates predictive algorithms and AI for personalized financial insights. Built using modern programming tools like Java/Kotlin and mobile development frameworks, its key features—expense categorization, real-time alerts, and visual spending summaries—aim to enhance financial awareness and discipline. Results demonstrate improved user adherence to savings goals, reduced impulsive spending, and greater financial literacy. By offering a tailored solution that bridges gaps in existing financial tools, this study contributes to financial technology innovation, promoting financial independence and well-being among young adults while advocating for responsible money management practices. The app's accessibility and actionable insights reduce financial stress, underscoring its potential to foster long-term financial resilience.

1.0 INTRODUCTION

Augmented Reality (AR) is defined as a technology that combines the virtual world with real world in real time to create a view directly from the real world. This technology has long been used for entertainment purposes and to help convey information to the surrounding Font size: 12 community, such as in education and training.AR technology has often collaborated with the world of education and training since 1990. Today's AR technology provides a great experience, delivering clear visuals to users (Johnson, 2010). Furthermore, a study by Elmqaddem (2019) confirms that the use of AR will grow rapidly due to the competition between AR platforms from Google and Apple. This will indirectly change 21st-century learning techniques in line

with software and hardware technology advances. According to Avila (2021), research on augmented reality applications is increasing in primary and higher education. Studies have also shown an increasing application of AR in medical education, especially for simulating and enhancing the imaging of complex medical procedures.

There are professionals in schools and institutions who are implementing the use of AR during the learning process in the classroom, especially in compulsory subjects such as Mathematics, Biology, Chemistry and Physics. The application of 3D models in AR technology allows users to manipulate objects, which helps students through the learning process by allowing them to explore 3D objects themselves in a virtual world in a real-world environment. Based on research conducted by Guntur (2020), learning using AR can increase student motivation and drive and impact students' cognitive and affective aspects of learning because the AR environment displays spatial relationships that cannot be obtained from textbooks or any printed sources. Analysis of AR technology's use to develop interactive learning materials encourages the structuring of interfaces with computer systems in educational research (Osadchyi, 2021). Roopa (2021) argues that today's generation of children often gain understanding of something by listening, touching and observing. AR technology that incorporates augmented reality animation content into classroom teaching has the potential to interest and inspire students. Combining AR technology and gamification will improve the teaching and learning process.

Gamification is a mechanism that is no stranger to being used in professional fields such as business marketing, education and the like, where the mechanism involves two-way interaction to create changes in the individual himself. Gamification is defined as applying game design elements into a non-game context that encourages user behaviour and increases individual involvement to create individual motivation and interaction through design elements (Deterding, 2011). Manzano-León (2021) argues that learning using a gamification approach improves student engagement, motivation and academic achievement. Points, medals, rankings and game levels are necessary gamification features in an educational game. According to him, the more gamification features in a game, the higher the motivation and effectiveness of a game for students.

According to Avila (2021), gamification is often found in articles, books and conference presentations. This finding shows the growing interest among researchers in using gamification to create fun AR learning experiences. In addition, in the context of eLearning, Saleem (2021) argues that eLearning integrated in gamification is a new form of learning structured to provide a practical mode to students. eLearning content should promote full-time education to improve

the curriculum. This is because using game technology in education increases student motivation because it helps to enhance active learning (Rozhenko et al, 2021).

The Human Heart Anatomy Augmented Reality Mobile Application development aims to focus on mobile learning used by matriculation students who take Biology subjects in line with the syllabus at the Matriculation level. The scope of this application is for matriculation students as an additional platform to further increase their understanding of the topic of the transport system (Transport System), which contains subtopics such as heart structure, heartbeat (beat onset and factors), cardiac cycle and electrocardiogram (EKG) function in the human heart. According to Buijtendijk (2020), the field of medicine has taken great strides in research and understanding of the cardiac transport system over the past two decades.Therefore, this application was developed as additional support for students to increase their understanding of the topics covered through augmented reality and gamification mechanisms by providing a structured and simple mobile learning application.

2.0 LITERATURE REVIEW

Finance Helper: A Financial Management App for Young Adults

Finance Helper is a mobile application designed specifically to support young adults—particularly students and early-career professionals—in developing effective financial management habits. Many in this demographic experience a recurring pattern of overspending at the beginning of the month, followed by financial stress and scarcity toward the end. This app seeks to counter that pattern by offering a set of intuitive, easy-to-use features including daily expense tracking, monthly savings goals, and real-time budget alerts. The objective is to empower users to gain control over their finances, build healthy money habits, and make smarter financial decisions.

Unlike traditional budgeting tools that focus only on recording past transactions, Finance Helper takes a proactive approach. The application uses intelligent forecasting algorithms to predict potential overspending, enabling users to make adjustments in advance. Spending classification algorithms further allow users to differentiate between essential and non-essential expenditures, helping prioritize savings and encourage long-term financial discipline. Personalized feedback and intuitive visuals make the app both informative and easy to navigate.

Finance Helper integrates artificial intelligence and predictive analytics to tailor the budgeting experience to individual users. By learning from user behavior, the app provides customized

financial tips, automatically adjusts budgets, and sends timely alerts. Features such as receipt image recognition streamline expense logging by allowing users to scan receipts and automatically categorize their purchases. This automation saves time and enhances user engagement, making budgeting less tedious and more impactful.

Research on personal finance tools has shown that many applications either overwhelm users with complex features or fail to support real-time decision-making. Studies have revealed that static, survey-based methods used in many financial tools do not capture the dynamic nature of daily financial activity. Finance Helper addresses this limitation by offering real-time budget adjustment and predictive financial insights, making it more responsive and personalized compared to traditional apps like Mint and YNAB.

In summary, Finance Helper is more than just a financial tracking tool—it is a smart, user-friendly assistant that actively helps young people take charge of their money. By combining intelligent features with a clean interface, the app reduces financial stress and fosters better financial habits. Its development represents an important step in creating accessible, technology-driven solutions for personal finance, specifically tailored to the needs of the next generation.

3.0 METHODOLOGY

Finance Helper is an innovative mobile application designed to enhance financial awareness and support young adults in developing sustainable financial habits. The app addresses the financial challenges of students and young professionals by integrating seamlessly into their daily lives through real-time notifications, predictive budgeting, and categorized expense tracking. Finance Helper helps users better manage their finances, making it easier to set savings goals, track expenses, and receive timely budget notifications. Its goal is to guide users toward long-term financial security through personalized and proactive support.

To meet the specific financial management needs of young adults, Finance Helper provides a variety of features that aim to improve financial behavior. These include expense categorization, savings goal monitoring, real-time budget notifications, and monthly spending summaries. Through these tools, users are empowered to gain control over their daily finances, prevent unnecessary overspending, and work toward their short-term and long-term financial goals with greater confidence and awareness.

One of the core functionalities is the classification of expenses. Users can easily record their daily spending by categories such as dining, shopping, transportation, and stationery. This

classification helps both the users and the system to understand where the money is going. By knowing what the user is spending on, the app's AI can better analyze spending patterns and offer relevant suggestions (Wang & Chen, 2023). This makes the budgeting experience more accurate and personalized.

Another important feature is the ability to set and monitor savings goals. Users can define a specific savings target for each month and track their progress throughout the budgeting cycle. Visual progress bars and reminders keep users motivated, supporting them in sticking to their financial plans and gradually building financial discipline (Huang & Zhou, 2022).

To help users stay on track, Finance Helper also includes real-time notifications. When a user is approaching or has exceeded a predefined budget limit, the app sends alerts to inform them promptly. This timely feedback prevents users from overspending and encourages better control of their financial actions in the moment, not just in hindsight (Garcia & Martinez, 2020).

At the end of each month, the app generates a detailed monthly summary in the form of charts, graphs, and categorized data. This report gives users an intuitive overview of their spending behavior, making it easier to identify habits and trends. Armed with this insight, users can make smarter financial decisions in the future and optimize their budgeting strategies for the following months.

From a system design perspective, Finance Helper combines robust functional and non-functional requirements to ensure performance and scalability. Core features include user registration and authentication, secure data logging for expenses, real-time savings tracking, and dynamic notification systems. On the backend, the app is built using Android Studio and integrates with Firebase for real-time data synchronization and authentication. It is deployed via AWS cloud infrastructure to ensure scalability, stability, and high availability. This system architecture allows for a seamless cross-platform experience, strong data security, and responsive interactions, meeting the expectations of modern mobile users.

3.1 Hardware and Software Requirements

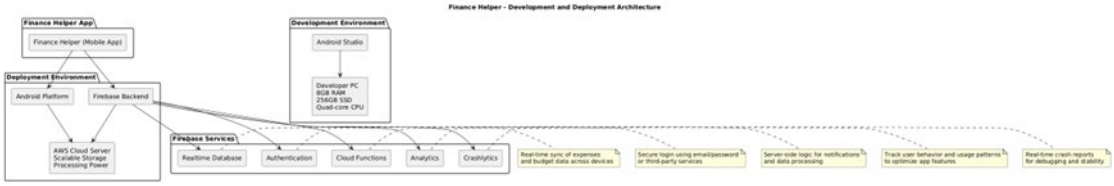

Figure 3.1 Hardware and Software Requirements

3.2 Finance Helper Use Case

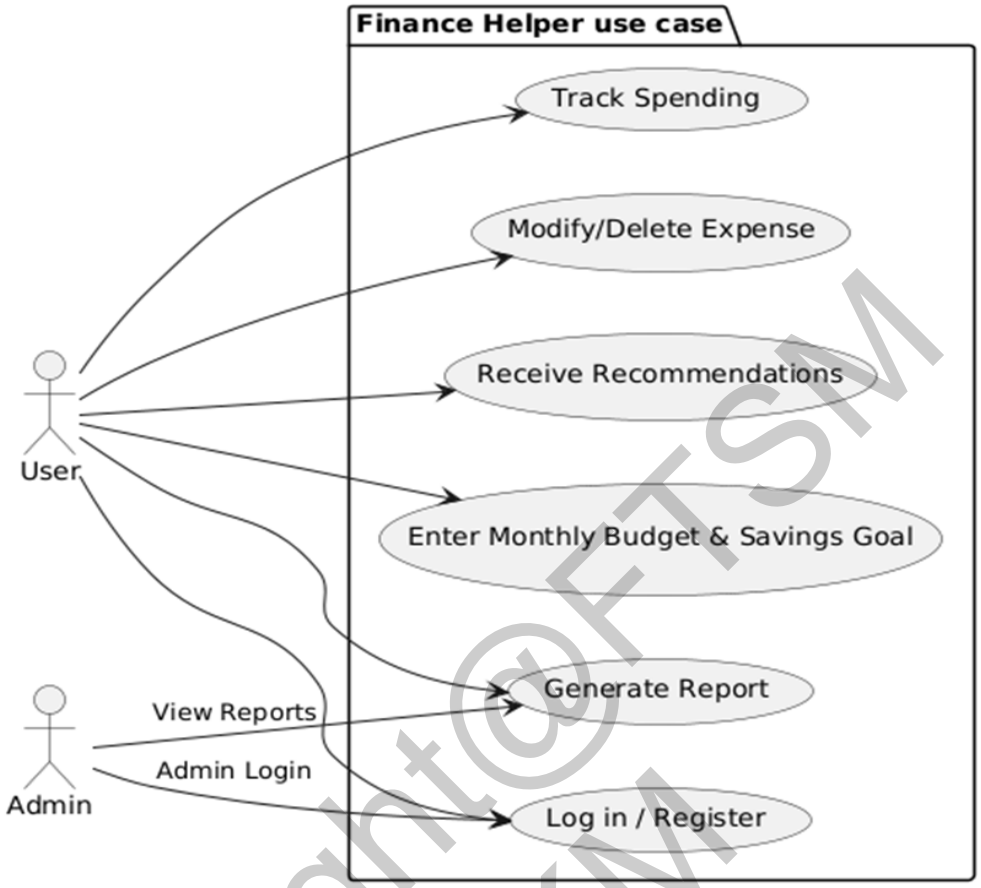

Figure 3.2 Finance Helper Use Case

3.3 Finance Helper Sequence Diagram

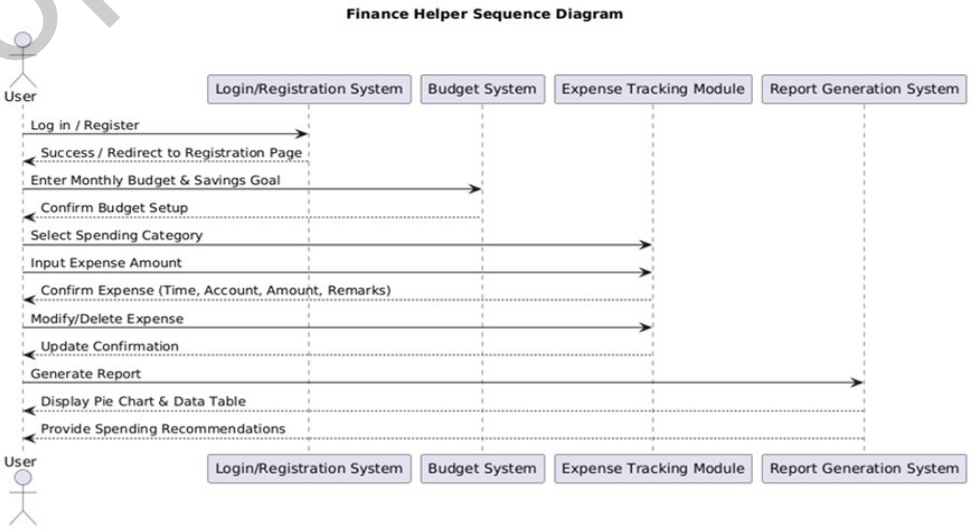

Figure 3.3 Finance Helper Sequence Diagram

3.4 Finance Helper Activity diagram

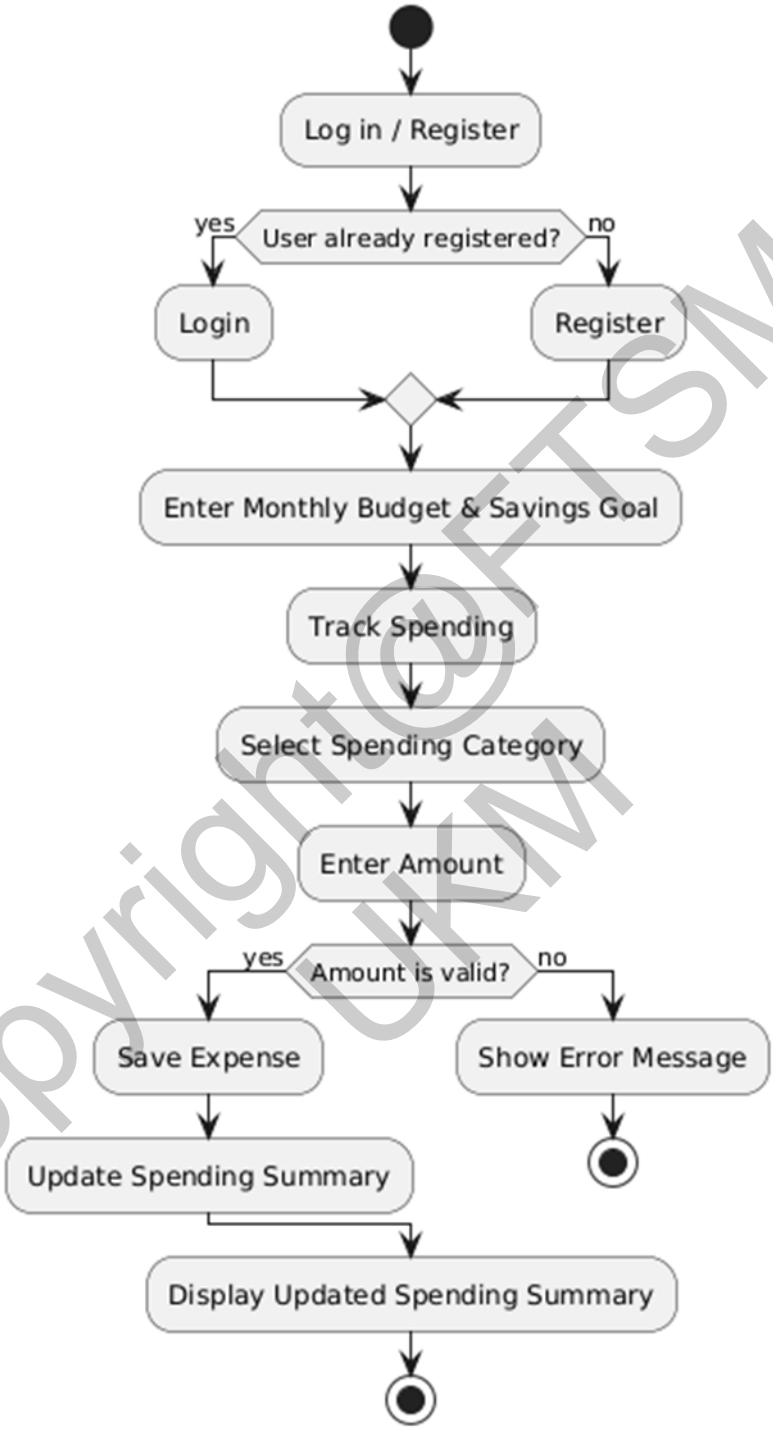

Figure 3.4 Finance Helper Activity diagram

3.5 Entity Relationship Diagram

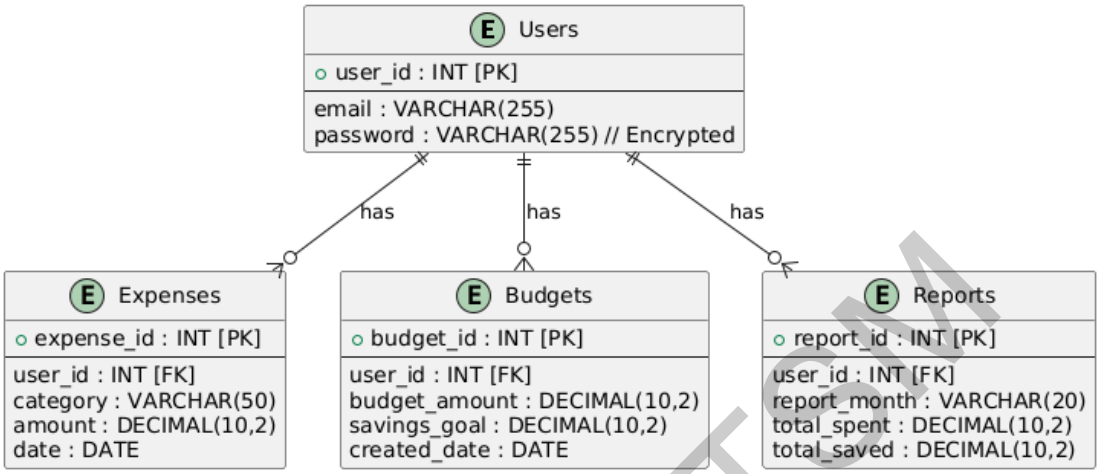

Figure 3.5 Entity Relationship Diagram

3.6 Budget Notification Algorithm Flowchart

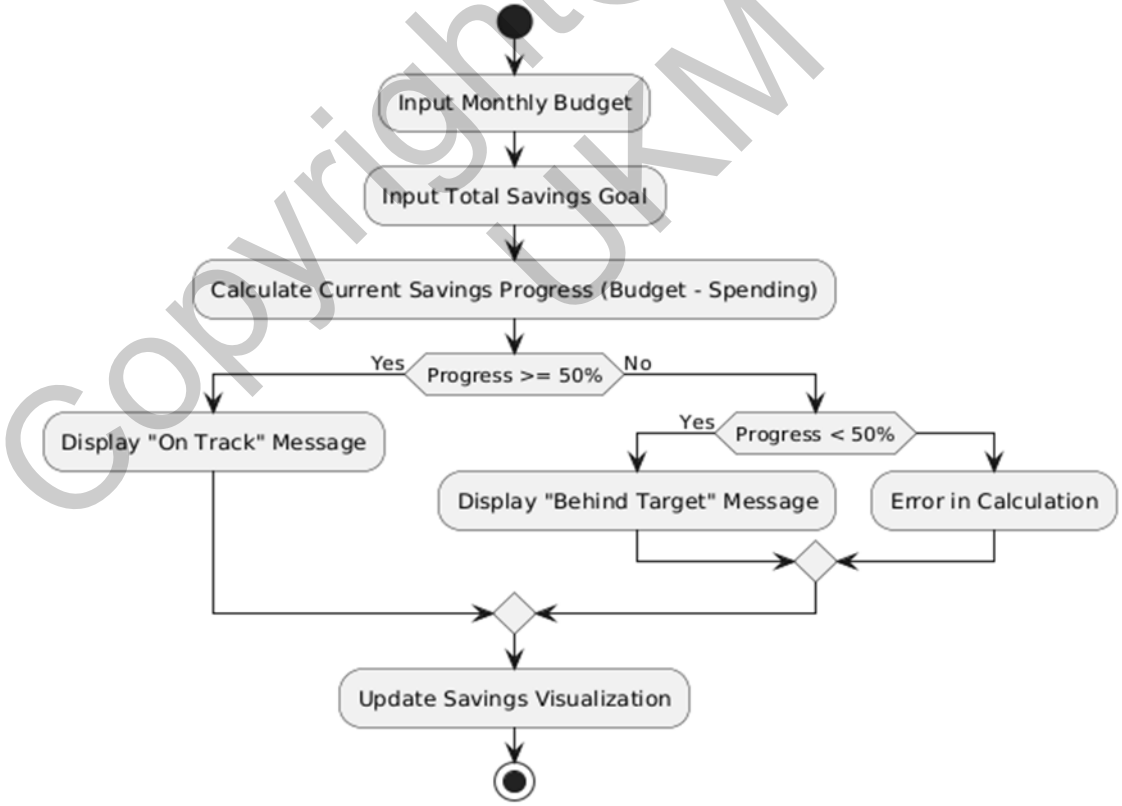

Figure 3.6 Budget Notification Algorithm Flowchart

4.0 RESULTS

4.1 Application Development

The development of Finance Helper is carried out on the Android platform using Java programming language. To ensure modularity and maintainability, the system is built following the Model-View-Controller (MVC) architecture, effectively separating the interface logic from core business operations. Various development tools and libraries are utilized to enhance system performance and user experience. OkGo is adopted as the network request framework to interact with the backend via RESTful APIs for uploading and downloading user data. For profile picture handling, Glide and PictureSelector are integrated to support image selection, uploading, and rendering. The user interface is implemented using Fragment combined with ViewPager, enabling smooth switching between multiple modules on the main interface. Runtime permission handling is added to support Android 6.0 and above, ensuring proper access to storage and camera features.

Key code modules include network request and data parsing logic, achieved through OkGo and FastJSON. When users retrieve their financial data, such as their bill history, functions like mgetAll() handle asynchronous data requests and responses. Profile picture uploads are performed by selecting local images via PictureSelector, then uploading them using OkGo, with the returned image URL used to update the user's avatar. Dynamic UI updates are triggered by SmartRefreshLayout listeners, allowing real-time data synchronization with user operations. Tab-based navigation is achieved by coupling Fragment, ViewPager, and TabLayout, while custom adapters manage the switching logic. The password management interface performs verification of old and new passwords before submitting update requests. For account registration, the system checks mobile number length and password format (combining letters and numbers within 6–12 characters). User avatars are displayed in a circular style for aesthetic purposes, and clicking on notices navigates to a detail page via serialized Intents. The main interface consists of four modules: home, charts, bills, and personal center. Additionally, the app embeds AI-enabled web content through a WebView component that supports JavaScript and local caching. A generic CommonAdapter<T> class is widely used to improve data list rendering efficiency, supporting features like pull-down refresh and pull-up load to maintain real-time data consistency.

In the development process, various challenges were addressed. Android permission issues were solved through proper runtime handling. Performance on low-end devices was optimized to reduce UI lag, and image compression was implemented to support large uploads without crashing. To ensure reliability, the system underwent extensive testing based on a structured

plan. Both functional and non-functional aspects were evaluated through white-box and black-box testing techniques. Functional tests focused on modules such as login, registration, bill tracking, chart visualization, profile updates, password changes, and announcement display. The testing process referred to related documents including the project proposal, user interface design, source code, and user manual.

Testing covered core requirements such as user authentication, financial record management, chart analytics, profile editing, and secure avatar uploads. Non-functional requirements emphasized performance, security, and device compatibility. For instance, all interactions were expected to complete within three seconds, the app needed to support Android 8.0 and above, and all inputs were sanitized to prevent injection attacks. Black-box testing validated UI behavior without knowledge of internal code, using manual input simulation on real devices and emulators. Activities like LoginActivity and RegistActivity were tested for correct input validation and response handling. Non-functional testing included usability testing across various screen sizes, load testing with 50+ concurrent entries, and security testing against SQL and script injection attempts.

System testing confirmed that the app could be smoothly navigated from login through all main features. UAT (User Acceptance Testing) was conducted with real users performing tasks such as registration and bill logging without guidance. The app performed well under different network and usage conditions. Each core test case passed successfully. For instance, valid and invalid logins triggered the correct redirection or warning messages; improper password formats were caught and rejected; bills were saved and reloaded across sessions; and large datasets did not compromise chart rendering speed. Security validations blocked SQL injection, and passwords were handled securely without logging in plaintext.

The testing environment included Xiaomi and Samsung devices, alongside emulators. Logcat and Postman were used for debugging and API verification. Final test outcomes confirmed that Finance Helper meets all its functional goals and maintains a consistent user experience. All major modules performed within expected parameters, validating the effectiveness of the design, development, and implementation strategies.

4.2 USER INTERFACE

The user login interface allows for both login and registration. User registration page: Users can select their profile picture from the album or take a new one. They then need to fill in their username, password, phone number, nickname and email address.

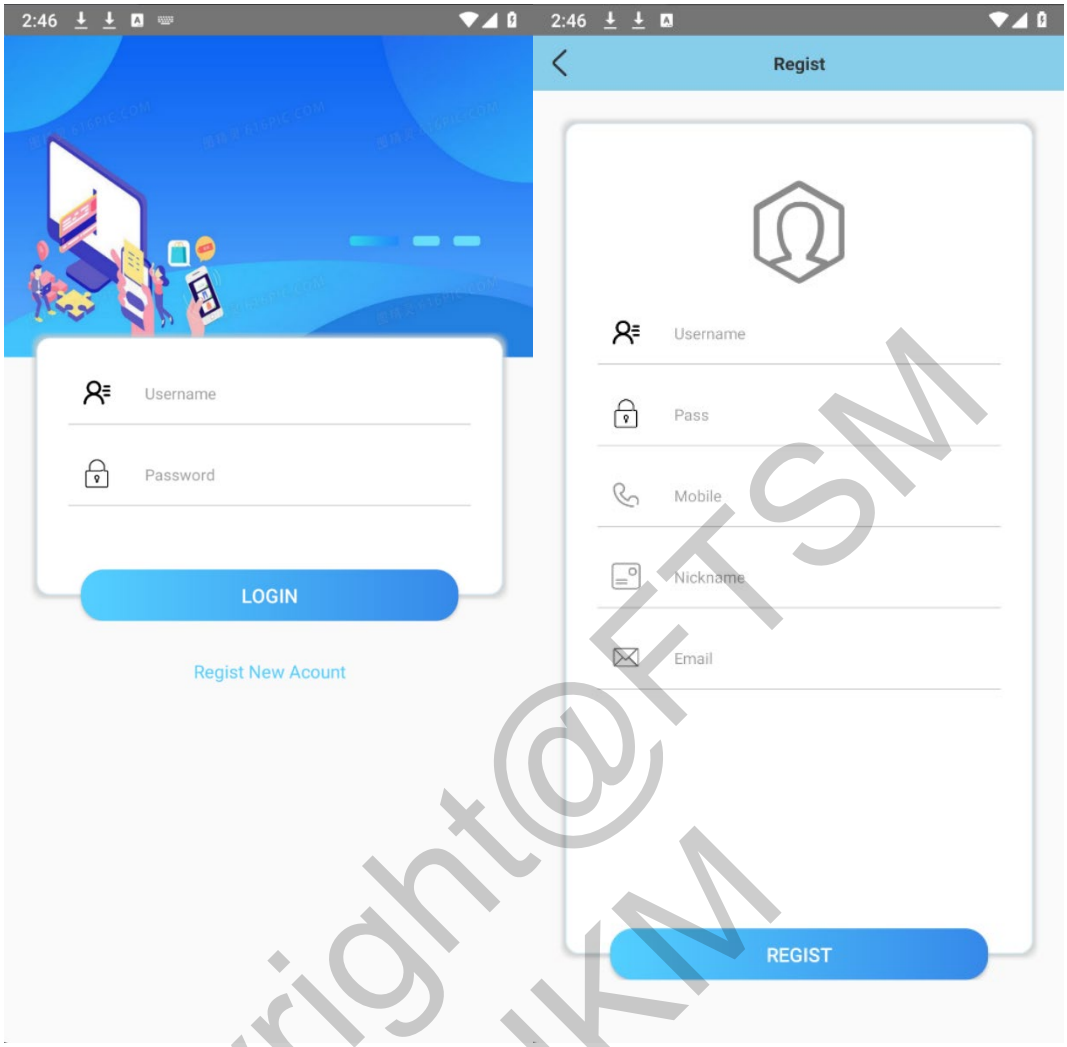

Figure 1 User login and registration pages

User homepage displays all bill information including income, expenditure, time and notes. You can search for specific bills using the first letter. It shows the specific expenditures and proportions for this month. Notifications will inform you if you have overspent this month. Click the plus sign at the top right corner to add a bill.

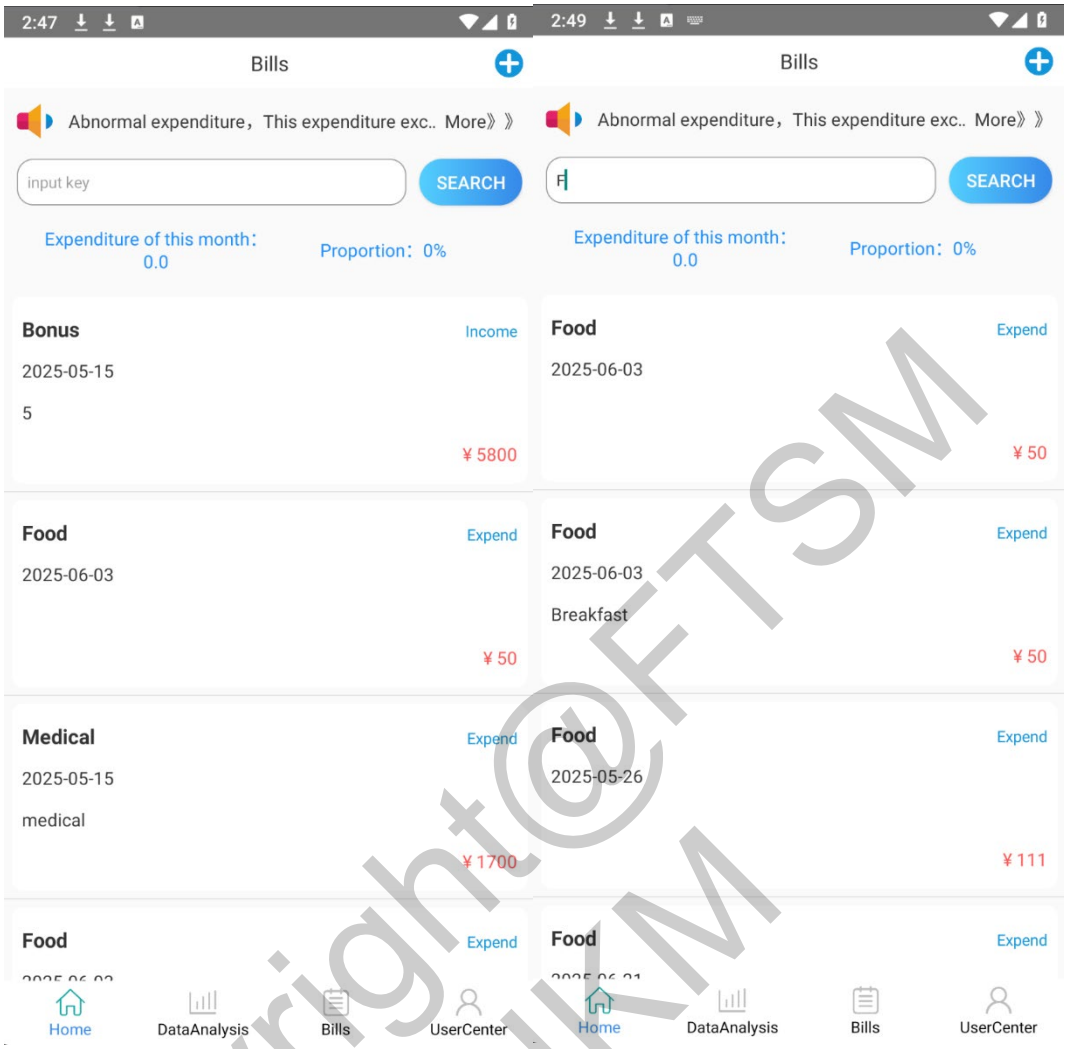

Figure 2 User bill homepage and search page Notification Page

The notification interface allows you to check if you have exceeded your budget for this month. If you have exceeded it, it will alert you. If not, it will display the percentage.

Figure 3 Notification Page

Click the plus sign to select the type of expense bill, enter the amount, add a note for the bill details, and also choose the date.

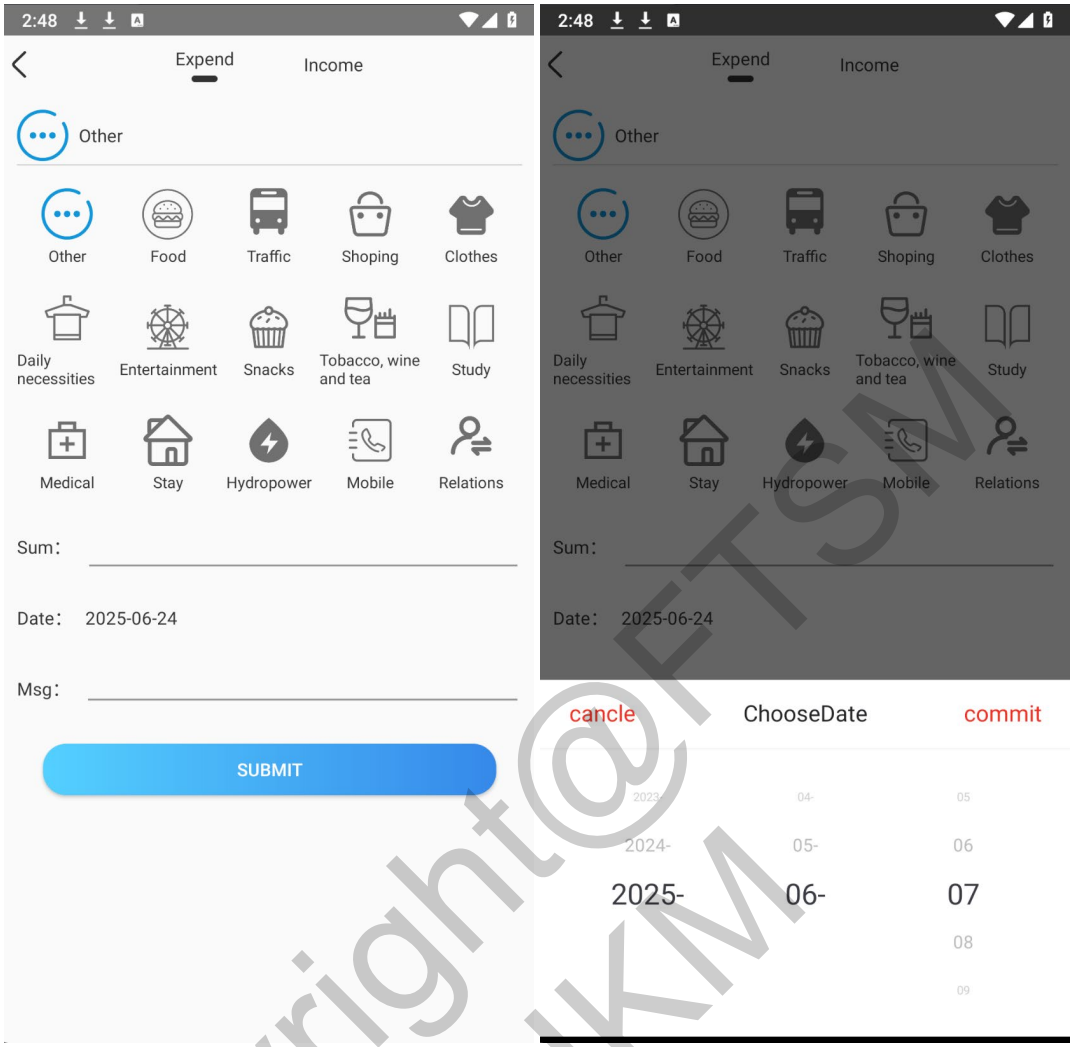

Figure 4 Add consumption page

Click the plus sign to select the type of income bill, input the amount, add a note for the bill details, and also choose the date.

Figure 5 Add Income Page

The user interface of the chart can display the monthly expenditure chart and the monthly income chart. Then, corresponding consumption and expenditure suggestions will be provided below. Users can also click the AI button on the upper right corner to jump to the AI interface, where they can ask all questions related to their income and expenditure.

Figure 6 Chart analysis and AI analysis page

The bill statistics interface allows users to view the bills for today, this week and this month. It will display the total output and total consumption. Users can also select a specific date to view the bill for that particular day.

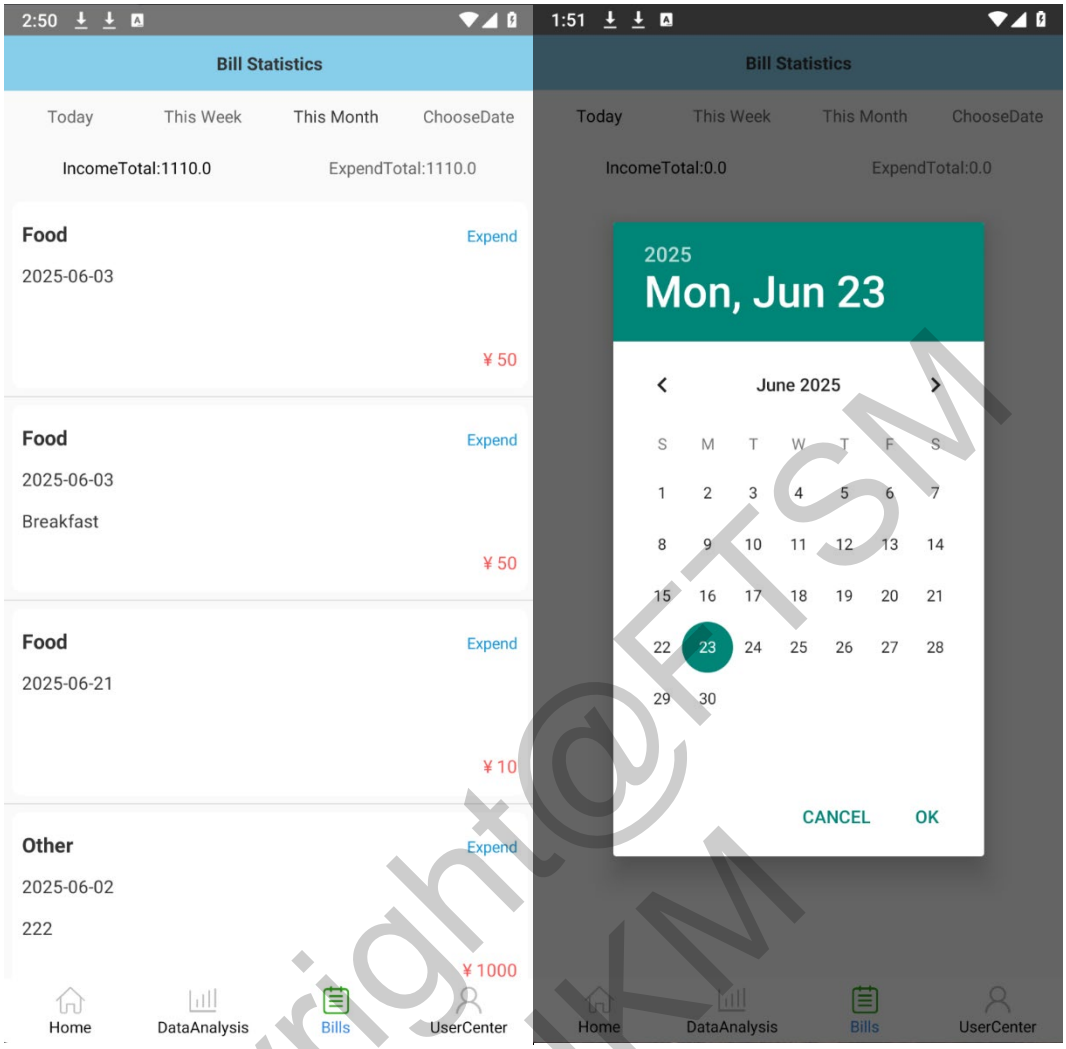

Figure 7 Search for the daily bill page

The user information interface allows users to modify their income targets, savings goals, username, profile picture and information, change their password, and log out of their account.

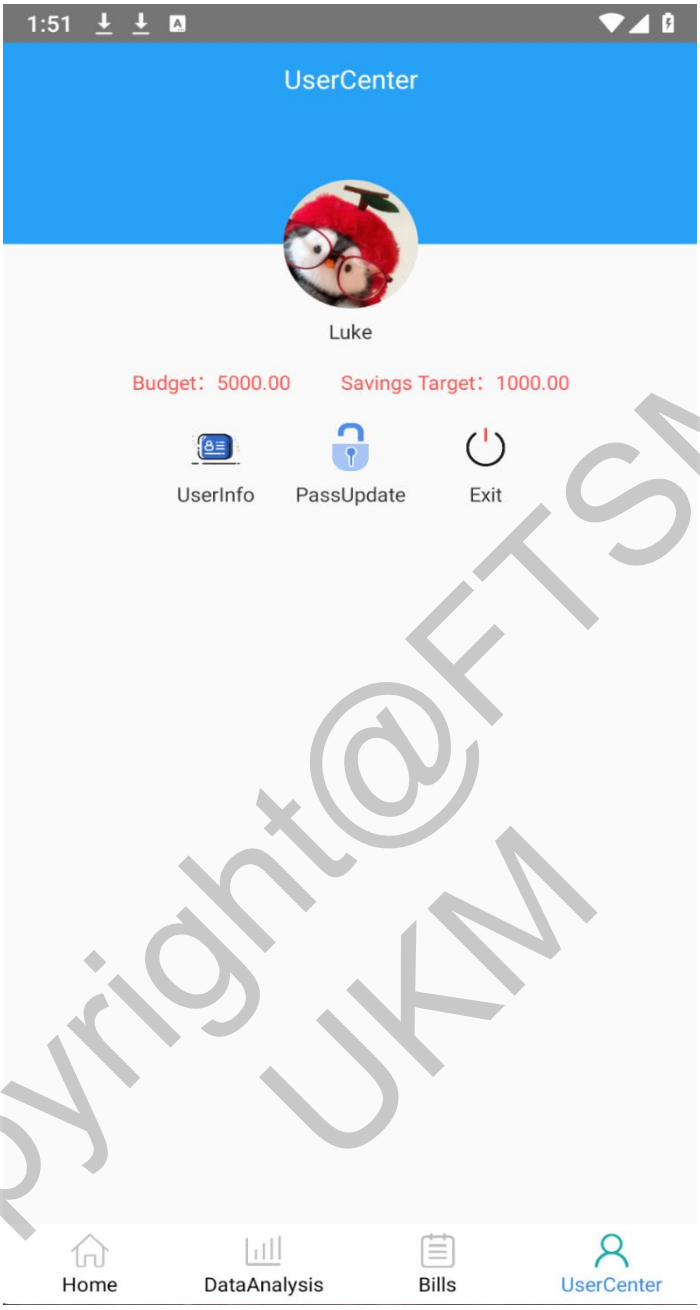

Figure 8 User Information Page

Modify income and savings targets: You can modify the income target and the savings target on this interface.

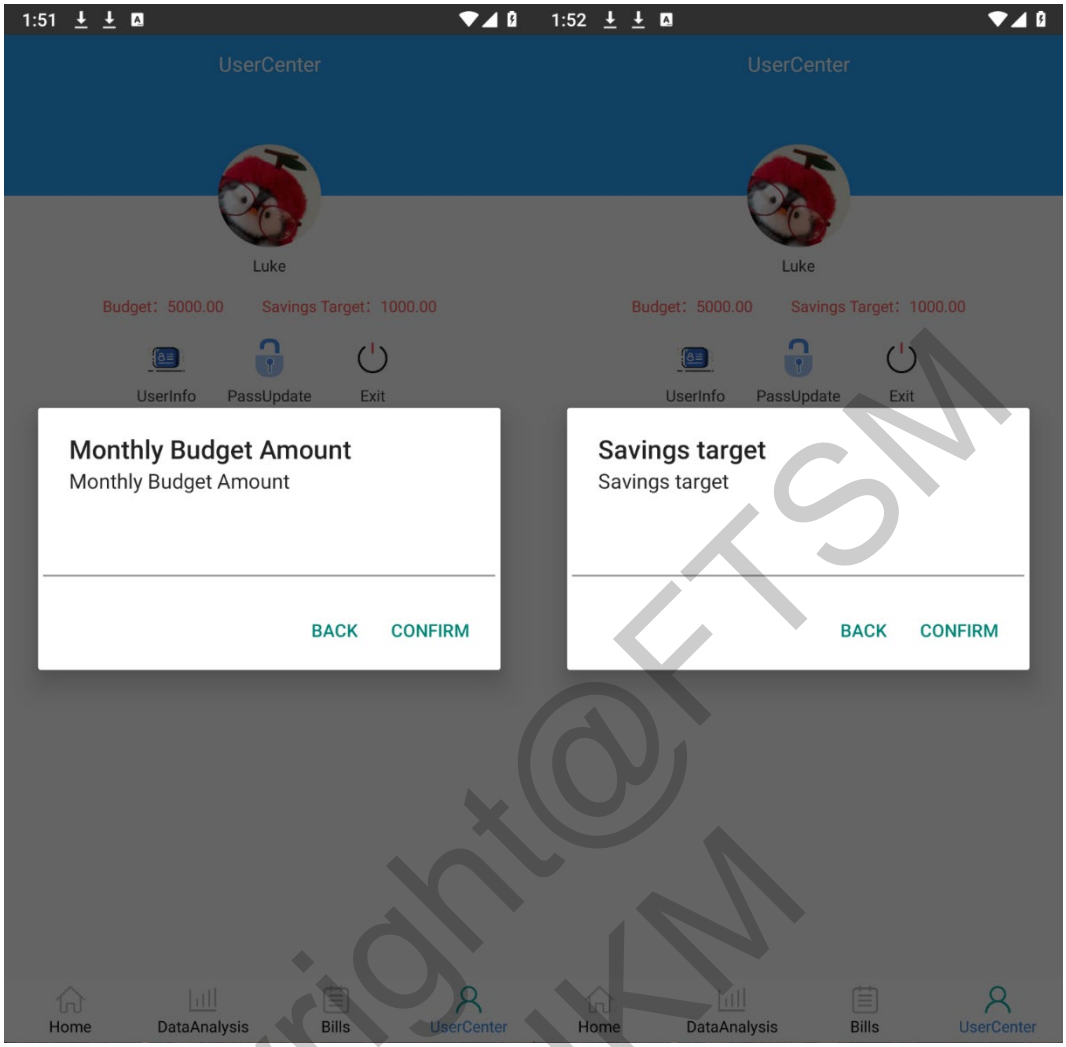

Figure 9 Input storage target and budget page

Modify personal profile picture and nickname, as well as phone number and user password

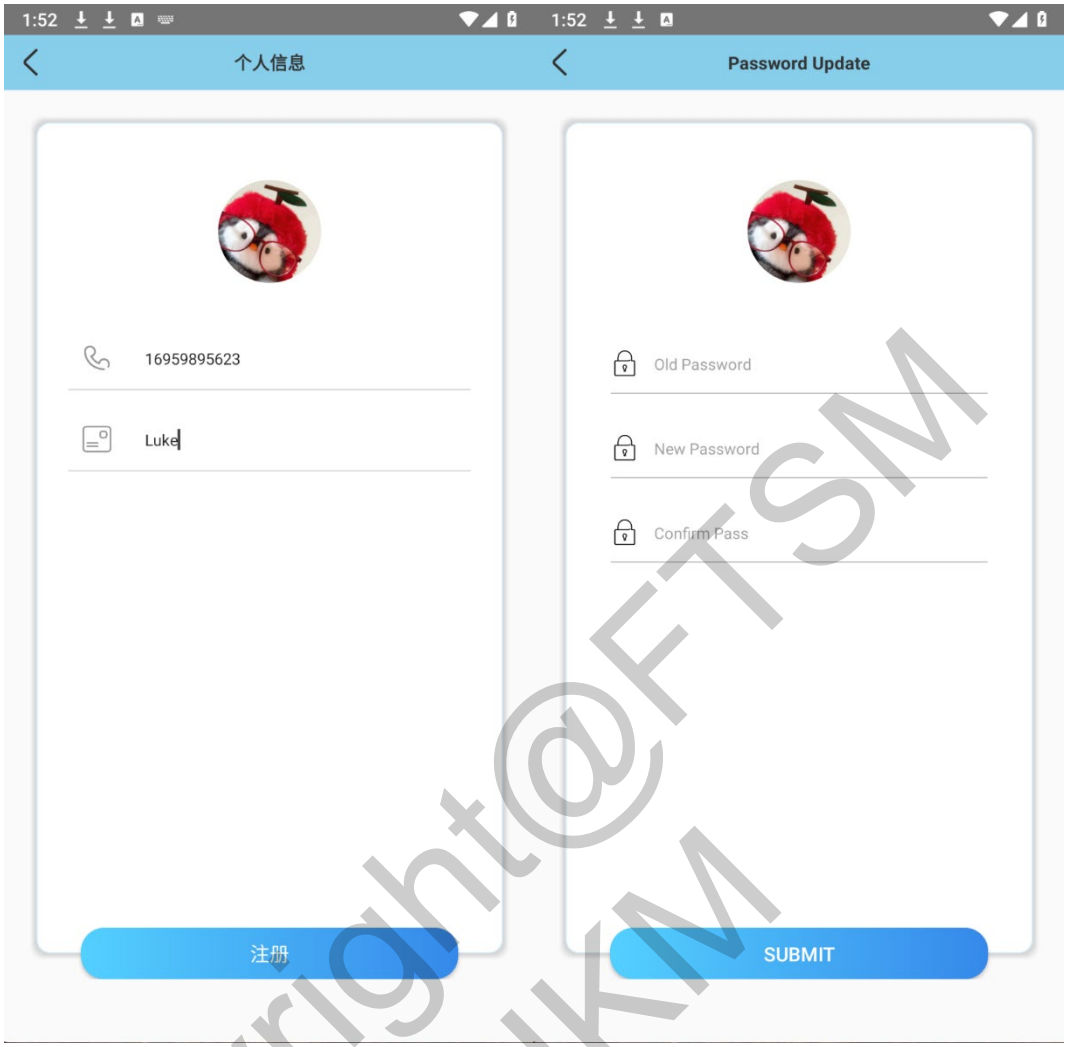

Figure 10 Modify User Information and Password Interface

4.3 Application Evaluation

REQUIREMENTS:

Tests are based on the following core features outlined in the system requirement specification:

User authentication: Login, Registration.

Core functionalities

Bill tracking (LbActivity)

Chart analytics (ChartActivity)

Notice display (NoticeActivity)

Account features:

Profile editing (UserUpdate)

Password management (PassUpdate)

Avatar upload (via PictureSelector and OkGo)

NON-FUNCTIONAL REQUIREMENTS:

Performance: All interactions (e.g., API responses, page loads) must occur within 3 seconds.

Compatibility: Runs on Android 8.0 and above; screen responsive on multiple devices.

Security:

Password must be masked and securely validated.

Inputs are sanitized to avoid injection attacks.

File Handling: Upload of images for profile picture must complete without crashing or freezing.

BLACK BOX TESTING:

Applied to UI-based activity classes to validate input/output without looking into internal code logic.

Ensures the correct UI behavior for:

LoginActivity – Successful and failed login attempts.

RegistActivity – Field validation and registration process.

NoticeActivity – Correct display of list content from API.

PassUpdate – Password mismatch handling.

Tested via: Manual input simulation.

Expected vs actual output comparison.

Use of emulators and real devices.

NON-FUNCTIONAL TESTING:

Usability Testing:

Verified if users can navigate from login to all major features without guidance.

Checked for readability, icon clarity, and layout consistency.

Load Testing:

Simulated 50 concurrent requests for charts and bills using test scripts (e.g., with OkGo).

Monitored app performance and memory usage.

Security Testing:

Attempted SQL/script injection in form fields.

Validated that passwords are not logged or stored in plaintext.

Checked logout functionality to prevent session persistence.

EXIT CRITERIA:

The testing phase will be considered complete when:

All designed test cases are executed on at least 2 different devices (emulator and physical), 100% of major features (login, bill input, chart generation, user update) pass successfully.

Minor visual/UI bugs are either:

Fixed before release, or Logged and approved by the project supervisor as “acceptable for delivery.”

Optional acceptance criteria:

All network calls return status code 200 with valid data, No force-close or ANR (Application Not Responding) events encountered.

TEST CASE DESIGN:

This section provides the detailed test cases based on the selected test design techniques such as White Box, Black Box, and Non-functional testing. Each test case includes the objective, inputs, steps, expected and actual results, as well as the pass/fail criteria.

TC001 – LoginActivity – User Login Test

Test Type: Black Box (Functionality Test)

Test Objective: Verify that a user can log in with valid credentials.

Input: Username: user01

Password: User1234

Test Steps:

1. Launch app
2. Enter credentials
3. Tap "Login"

Expected Result: Navigate to MainActivity screen

Pass/Fail Criteria: System redirects to home page and session persists

TC002 – RegistActivity – Password Format Check

Test Type: White Box & Black Box

Test Objective: Ensure password format follows rules: 6–12 characters, include letters and numbers

Input: Password: abc123, Confirm: abc123

Test Steps:

1. Open registration
2. Enter invalid/valid passwords
3. Submit

Expected Result: Valid password is accepted, invalid triggers error

Pass/Fail Criteria: Toast shown for invalid format, success redirect otherwise

Related Code: Regex pattern in RegistActivity.java:

Pattern.compile("^(?=.*[0-9])(?=.*[a-zA-Z])(.{6,12})$")

TC003 – NoticeActivity – Network Fetch and Display Test

Test Type: Integration, White Box

Test Objective: Verify that notices are fetched from server and listed

Input: Network available

Test Steps:

1. Navigate to NoticeActivity
2. Trigger auto-refresh

Expected Result: Notice list populates with data from server

Pass/Fail Criteria: No crash, list items shown with title/content

Related Code: mgetAll() in NoticeActivity.java

JSON parsing via FastJSON

TC004 – ChartActivity – Load Chart with Sample Data

Test Type: Black Box + Load Test

Test Objective: Confirm chart renders with real data under multiple entries

Input: Bill data for multiple days

Test Steps:

1. Login
2. Add multiple bills
3. Go to Chart tab

Expected Result: Bar chart loads correctly with bars for income/expense

Pass/Fail Criteria: Chart renders without delay (under 3s), values accurate

Related Code: Manual + Timing via Logcat

TC005 – UserUpdate – Update Profile Picture and Nickname

Test Type: Functional & File Handling Test

Test Objective: Check if user can update profile info and avatar

Input: New nickname: Jiahau

Upload image: /storage/emulated/0/DCIM/pic.jpg

Test Steps:

1. Open User Profile
2. Tap avatar and choose image
3. Edit nickname
4. Save

Expected Result: Profile updated and saved on backend

Pass/Fail Criteria: Success toast shown, image updates on UI

Related Code: UserUpdate.java, PictureSelector + OkGo

TC006 – PassUpdate – Incorrect Old Password Handling

Test Type: Security & Input Validation

Test Objective: Ensure that incorrect old password blocks update

Input: Old: wrongpass

New: User1234

Test Steps:

1. Open Change Password
2. Enter wrong current password
3. Submit

Expected Result: Toast: “Old pass incorrect”

Pass/Fail Criteria: Password is not updated if old password is wrong

Related Code: ConfigApplication.getU().getPass() logic check

TC007 – WebAc – WebView Connectivity Test

Test Type: Compatibility & Connectivity Test

Test Objective: Ensure embedded WebView opens external site (https://chat.deepseek.com)

Input: Open Web Activity

Test Steps:

1. Navigate to WebAc
2. Wait for page to load

Expected Result: Chat.DeepSeek page is displayed

Pass/Fail Criteria: WebView loads content with JavaScript and no SSL errors

Related Code: WebViewClient, WebSettings.setJavaScriptEnabled(true)

TC008 – Security – SQL Injection Input Handling (Manual)

Test Type: Security Test (Input validation)

Test Objective: Check for SQL/script injection vulnerability in input fields

Input: Username: admin'--

Password: abc

Test Steps:

1. Open LoginActivity
2. Enter injection input
3. Try to login

Expected Result: Login fails gracefully

Pass/Fail Criteria: System should not crash or log sensitive errors

Related Code: All fields should sanitize input on backend/API level

Report and discuss the test results

5.0 CONCLUSION

The development and implementation of Finance Helper mark a significant step toward empowering young adults to take control of their personal finances. Designed with user needs at its core, the application effectively addresses common challenges faced by students and early-career individuals, including impulsive spending, lack of budgeting awareness, and insufficient financial tools. By combining categorized expense tracking, goal-oriented savings planning, and AI-driven financial suggestions, Finance Helper enables users to cultivate better money management habits and work toward long-term financial stability.

The application demonstrates several strengths. Its user-centric interface is designed for simplicity, allowing users with little to no prior financial knowledge to navigate and utilize core features with ease. Real-time budget monitoring is one of the key components of the system, providing immediate alerts when users approach or exceed their budget limits. This proactive feedback mechanism helps users stay accountable and adjust spending behavior quickly. On the technical side, integration with Firebase ensures secure, cloud-based data storage and real-time synchronization, while the modular MVC architecture supports flexible development and future scalability.

Despite its strengths, the system also faces certain limitations. At present, the application is only available on Android, limiting its accessibility for iOS users. Additionally, the expense tracking feature depends on users manually entering their spending data, which may lead to gaps in information if users fail to log their expenses consistently. The AI component, while useful, currently relies on predefined logic and lacks deeper learning or predictive personalization that could enhance user experience further.

Looking ahead, several improvements are envisioned for the next iterations of Finance Helper. Cross-platform development is a priority, particularly the creation of an iOS version to broaden its accessibility. To increase intelligence and personalization, the app's AI functionality can be expanded using machine learning models capable of recognizing patterns in individual spending behavior. Gamification elements such as achievement badges, reward points, or daily budgeting challenges may be added to boost user engagement and retention. Lastly, enabling offline functionality would improve usability in low-connectivity environments by allowing local data caching and synchronization upon reconnection.

In conclusion, Finance Helper represents a meaningful contribution to improving financial literacy and promoting responsible money habits among young adults. Its practical design, supported by scalable architecture and a vision for intelligent enhancement, makes it a strong foundation for future development. With continued updates and broader support, the app is well-positioned to evolve into a comprehensive and intelligent financial assistant.

6.0 APPRECIATION

I am deeply grateful to my research supervisor, Associate Professor Ts. Dr. Elankovan A. Sundararajan, for his invaluable guidance, unwavering support, and profound expertise throughout my research journey. His encouragement and constructive feedback have been instrumental in shaping this work.

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