

Aplikasi Mudah Alih Kewangan dan Belanjawan Peribadi, “CashSave”

Personal Finance and Budgeting Mobile Application, “CashSave”

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Abstract: Kajian terbaru mendapati terdapat peningkatan minat dalam kewangan peribadi dan belanjawan akibat langsung daripada wabak coronavirus. Oleh itu, projek ini bertujuan untuk menyediakan platform untuk membantu dalam perjalanan pengurusan kewangan mereka dengan membangunkan aplikasi mudah alih yang mudah digunakan dengan antara muka pengguna yang intuitif untuk meningkatkan minat dan tabiat mereka dalam belanjawan. Sistem pengesyor yang dicadangkan menyediakan nasihat dan pengesyoran yang sesuai bersama dengan visualisasi yang jelas tentang perbelanjaan keseluruhan dengan cara yang mudah diurus oleh pengguna. Sistem yang dicadangkan dibina menggunakan metodologi prototaip dengan pelaksanaan JavaScript, HTML, CSS dan Pengesahan Firebase. Dengan aplikasi yang dicadangkan ini, ia boleh mewujudkan satu inisiatif untuk pelajar dan orang dewasa lain untuk memulakan perjalanan belanjawan mereka serta membimbing kertas lain mengenai pembangunan aplikasi mudah alih dalam bidang kewangan peribadi dan belanjawan.

Katakunci: Kewangan, Belanjawan, Aplikasi Mudah Alih, Perbelanjaan, Penjejakan Perbelanjaan, Pengurusan Kewangan, Sistem Pengesyor, Transaksi

Abstract: *Recent studies discovered that there is an increase of interest in personal finance and budgeting as a direct result of the coronavirus pandemic. Therefore, this project aims to provide a platform to aid in their financial management journey by developing an easy-to-use mobile application with an intuitive user interface to bolster their interest and habit in budgeting. The proposed recommender system provides suitable advice and recommendations along with clear visualization of the overall expenditure in the way that are easily manageable by the users. The proposed system is built using prototyping methodology with the implementation of JavaScript, HTML, CSS, and Firebase Authentication. With this proposed application, it can*

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create an initiative for students and other adults to start their budgeting journey as well as guiding other papers regarding development of mobile application in the field of personal finance and budgeting.

Keywords: *Finance, Budgeting, Mobile Application, Spending, Expense Tracking, Financial Management, Recommender System, Transactions*

1. Introduction

Budgeting is the process of managing one's revenue and expenses over a specified period of time. The method of arranging one's personal daily expenses and transactions is crucial to maintain a healthy financial habits. Younglings especially millennials and Gen Z are starting to leave school and become a responsible adult. Unfortunately, most school or universities does not include personal finance as a course to educate students about the importance of daily budgeting. The lack of basic financial education leaves many society fresh-comers clueless in managing their money, including credit applying procedure and how to properly manage debt [1].

The current budgeting process involving manual records of personal expenses is inefficient to keep track of every financial output and input in the current days. Nowadays people do not carry around a small notebook just to take note of the details of every transaction in their daily life. In addition, with the amount of works and studies done throughout the day, it is difficult for them to recall the exact amount of each and every expense made. This has led to decrease of interest in financial tracking in which makes budgeting later on more troublesome.

In order to encourage young adults to develop the habit of keeping track of their daily transactions, an easy-to-use expense tracking mobile application is constructed to help ease the process of recording every transaction. The process of recording income and expenses is made entertaining and effortless with the aid of the mobile application where can be accomplish on any modern smartphones which is an essential item for modern human. The proposed mobile application allows the users to record and update their revenue stream with an easy-to-use expense tracking user interface to visualize their financial statement over a defined time period.

With this proposed application, it can create an initiative for students like me and other adults to start their budgeting journey. As quoted from a former journalist from OutlookIndia: "Without a budget, it is difficult to create such a surplus and stick to it. Living beyond one's means can lead to financial disaster" [2].

2. Literature Review

2.1 Concept of Creating a Personal Finance and Budgeting Application

The current budget recording method involved was done manually in a traditional way. The old methods of record daily transactions by using a pen and paper can be seen used by some peoples especially at the old age. The tradition may adhere to their offspring as children tend to intimidate their elders' action. Therefore, the concept of tracking personal finance using software or any other digital devices may sound strange to some of the generations.

The most common way of tracking transactions using the traditional method involves pen and papers. This way of tracking personal expenses on a daily basis may bring inconveniences as there will be extra items to be carried with them everywhere they go. Thus, the items used to record their expenses does takes up spaces in the pockets or any hand carries storage, making budget tracking a hustle. This may discourage the habit of recording every transaction consistently as it may cause involuntary reflexes to reject the action to achieve financial discipline.

The other way to track personal expenses is by using an old-school spreadsheet. Spreadsheet allows user to categories each expense based on its respectable area in a tabulated manner. Recording expenses in spreadsheet does come with some benefits. For examples: custom-designed spreadsheet may encourage the discipline for user to actively manage their personal finances, provide user with more control over the general layout and content for the spreadsheet, and most importantly the sheer amount of community support on the "personal budget worksheet" template to help beginner in their finance management journey.

It all may sounds good for the spreadsheet budget tracking method, but the main concern realized with the method is the lack of willpower to open the spreadsheet software to update the financial spreadsheet frequently. This method lacks the attractive factor to draw the eyes of the majority to take interest in personal finance management. Moreover, it is quite common to notice the error produced when updating the spreadsheet with the exact details of every transaction. This incident happens frequently as users may forgot the details of each and every transaction that occur during the day. Unfortunately, despite having thousands of beautifully designed "personal budget worksheet" templates may not solve the issue mentioned as it lacks the accessibility of a modern smartphone. Thus, the concept of a personal finance and budget tracking system is proposed with the accessibility of the application of modern mobile development framework. The proposed system is created with convenient and ease-of-mind as the main focus to encourage the habit of personal finance discipline among the public.

2.2 Knowledge-Based Recommender System

An effective budgeting approach involve complex decision-making by one individual, which often times is quite difficult for common people who lacks the certain knowledge and experience doing so. This is where recommender systems come into place to assist the users to deal with the vast array of choice when deciding various option of spending throughout their day. Knowledge-based recommender systems are chosen as the suggested approach for the system. In knowledge-based recommender systems, recommendations are based on existing knowledge or rules about user needs and item functions [3]. Knowledge-based recommender systems gain advantages over other models in terms of its data selection and security as it provides recommendations based on user's previous record and is thus user independent. Knowledge in the knowledge base is referenced when the system encounters a new recommendation problem [4]. The most commonly used technique in knowledge-based recommender system is case-based reasoning, in which uses previous cases to solve the current occurring problems [5]. Case-based reasoning contains a set of cases, and each case holds knowledge about a problem or situation, together with its corresponding solution or action [6].

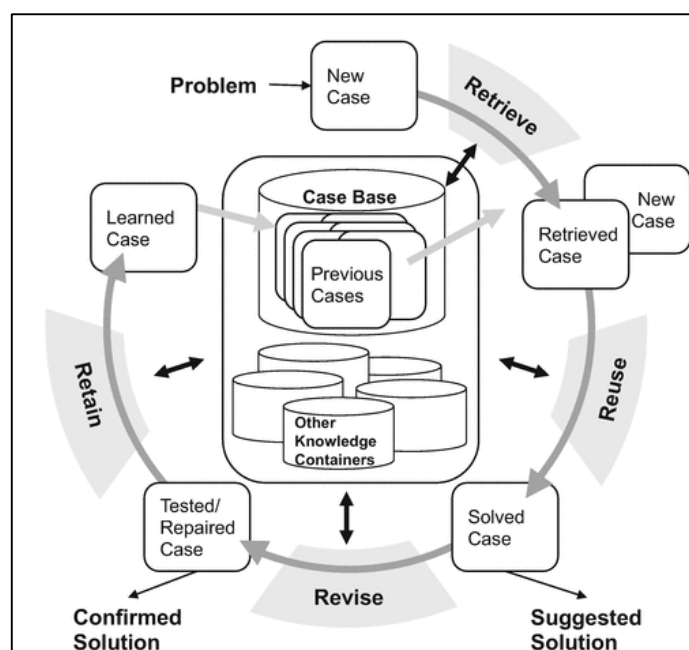


Figure 1: Flow Chart of Case-Based Reasoning

One of the knowledge areas used for the system is the “50/30/20 Budgeting Plan” proposed by a former credit writer at NerdWallet. She suggested the allocation plan of splitting the expected income after tax to roughly 50% of our income on necessities, 30% on wanted goods, and at least 20% on savings and debt repayment [7]. Thus, a big pool of financial advices and quotes from several credited financial advisor was suggested by the proposed system to help users get more knowledgeable insights on how to manage their money effectively.

2.3 Improved Features of “CashSave” Application

The first thing any users draw attention to is the name of the application. Thus, this project had proposed a simple and easy-to-understand name for this mobile application: “CashSave”. As the name suggested, the main purpose of this system is to help user in their budget saving journey. The proposed system includes several improved features which differs it from the other expense tracking method as stated in Section 2.1.

Firstly, in order to solve the issue of frequent data updating error caused by human factor as mentioned earlier, the system was designed with the ability to quickly update transaction using the intuitive graphical user interface. By encouraging the consistent update of their financial portfolio, users could identify any potential errors on their billing statements or other expenses. Users will also be reminded constantly to prevent them from feeling hopeless behind on their budget tracking duties.

Moreover, the system provides graphical representation of their weekly and monthly financial record in an easily manageable layout to keep them updated on their budgeting goal. The system also acts as their personal budgeting guidance coach by providing the users with financial insights on the way to manage their expenses intelligently with the aid of the integrated recommender system within the system. The proposed recommender system is able to predict and analyze users’ interest in spending by taking advantages from several sources of information [8]. The system put its main focus on the study on the field of finance that may be beneficial for businesses. The recommendations are solely dependent on users’ preference on budget constraint thus producing a more personalized recommendation outcome [9].

2.4 Comparison of Existing Related Systems with the Proposed System

This project researched and studied other personal financial budgeting tracking app that are related to the proposed system to propel the process of development. Several applications had been chosen to analyze the features in the existing related system and how they are beneficial in the enhancement for the development of “CashSave” mobile application.

“Mint: Budget planner & tracker”, also short as “Mint” is a free money manager and financial tracker app that is developed by Intuit Inc. Intuit Inc. is financial software business located in Mountain View, California, USA. The company owns different suites of financial tools that is inherited inside “Mint” [10]. Next, “Digit: Save money, pay off debt, invest with ease” is the name of the application as listed in Google Play Store. “Digit” budgeting app aims to help users get results and reach their money goals effortlessly. The app was developed in San Francisco, USA by Hello Digit Inc. that specialize in mobile application development in the area of finance [11]. Meanwhile, “iSaveMoney-Monthly Budget Planner & Daily Expense Tracker” as listed in Google Play Store is an expense tracker app developed by DigitLeaf LLC based in Virginia, USA. The main goal of the “iSaveMoney” mobile app is to assist users in saving money by tracking their expenses [12].

All application mentioned above comes with various features but most of them share similarity in terms of helping users in their expense tracking and other financial tools. When it comes to the basic task of a budgeting app, all of the app listed does it well with a twist in how they implemented the features. Additionally, some of the apps provide extra functionality to further assist users in their financial journey with AI assisted recommender system in which can be found in “Mint” and “Digit” Budgeting app. The downside of the feature is it’s locked behind a pay wall which limits the accessibility for most users, especially young adults and students who just started their financial journey. Although those app is not perfect at any means, the advantages of each of the budgeting and expense tracker app can be analyzed and investigated for research purposes. The table below shows the features each app possessed in comparison with each other as well as the proposed “CashSave” budgeting app.

Table 1: Comparison of Budgeting Applications

Features/ App	“Mint”	“Digit”	“iSaveMoney”	“CashSave”
Log in & Registration	√	√	√	√
UI navigation	√	√	√	√
Transaction tracking	√	√	√	√
Add/ remove expense category	√	√	√	√
Account balance tracking	√	√	√	X
Monthly expense monitoring	√	√	√	√
Budget plan customization	√	√	√	√

Table 2: Comparison of Budgeting Applications (Cont.)

Notifications	√	√	√	X
Data visualization (charts)	√	√	√	√
Recommender system (saving insights)	√	√	√	√
Robo-advisor (investment insights)	X	√	X	X
In-app purchases	√	√	√	X

3. Methodology

This chapter explains the use of prototype models in this project and the activities that had been carried out in each phase.

3.1 Prototype Model

System Development Life Cycle (SDLC) provides the foundation for processes used to develop an information system. Methodology is a formalized approach to implementing the SDLC where it is a list of steps and deliverables. There are many different systems development methodologies like waterfall development, iterative development, system prototyping, throwaway prototyping, spiral, agile so on and so forth and they vary in terms of the progression that is followed through the phases of the SDLC. A system development methodology refers to the framework that is used to structure, plan, and control the process of developing an information system and each methodology with its own recognized strengths and weaknesses. Each of the available methodologies is best suited to specific kinds of projects based on various technical, organizational, project and team considerations. Therefore, we need to consider some important methodology selection criteria like clarification of user requirements, familiarity with technology and application, system complexity, system reliability, and project duration range.

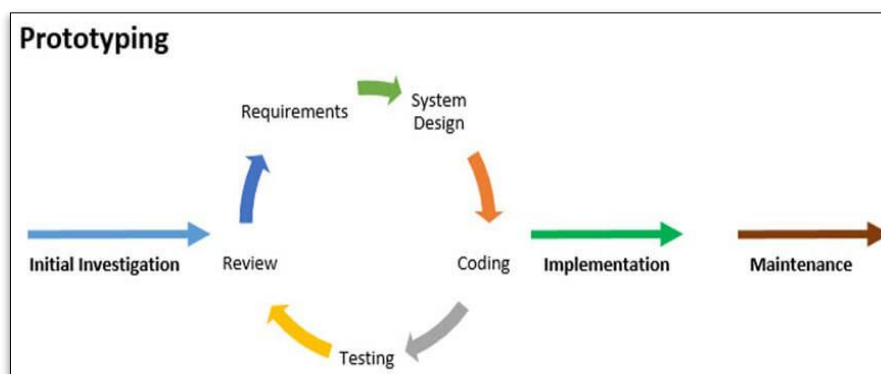


Figure 2: Flowchart of Prototyping Model

The Software Process Model adopted in the project is a prototyping model [13]. Prototyping is a software development method where after each iteration the prototype is presented to the customer for evaluation. Customers will test and evaluate the prototype and determine whether the prototype is developed according to their requirement or need to do some modification. The modification of the prototype will depend on the feedback given by the tester or customer [14]. After modification, the

prototype will be evaluated again by the customer or tester to get feedback and do improvement again. The process will repeat again and again until the prototype is completely fulfilling the requirement of the customer. Then, the prototype will start to be developed and sent to the customer.

3.2 Initial Investigation Phase

The team must propose a project, specify its timetable, activities, and projected conclusion during the initial inquiry phase. It will eventually result in a set of blueprints that will guide the team through the project phases. Producing a project proposal, as well as setting up a Gantt chart and identifying the problem statement, are sub tasks for this phase. Microsoft Word, Microsoft Excel, and Lucid Chart were utilized.

3.3 Requirement Phase

This phase will examine the requirements in detail in order to define what the system should perform. The sub tasks include describing the system's requirements in depth and designing the system's Use Case and Class diagram.

3.4 System Design Phase

This phase will create a short and simple design of the intended system, providing the user a rough concept of how it will look. The sub-activities include creating the prototype system's interface and determining the prototype system's feature requirements.

3.5 Coding Phase

The prototype will be developed in this phase based on the information acquired during the requirement analysis and system design phases. The sub activity entails creating a prototype system based on the preceding phases.

3.6 Testing Phase

The developed prototype will be evaluated throughout this phase. This aids in determining the system's strengths and weaknesses. Making a note of the material so that it can be revisited later. Customers will be able to test the prototype system as part of this sub activity.

3.7 Review Phase

Based on the data gathered during the testing phase, this step will evaluate the prototype. Users will provide feedback and suggestions for parts that need to be changed or adjusted the next time the system is improved. Customers are asked to provide feedback on what the system needs and how it feels in the sub activities. This will aid in the prototype system's future development.

3.8 Implementation Phase

The final system is developed based on the final prototype, tested as a whole, and then turned into a product in this phase. Implementing the final version of the system, allowing consumers to test it, and granting the system a final judgement are the sub activities. It will be released into an application and utilized in real life once it passes all of the requirements.

3.9 Project Planning (Gantt Chart)

The development of the project is prepared extensively to accommodate each phase of the project. The project is estimated to be completed in around 260 days. The stage has been classified as planning, analysis, Prototype I, Prototype II, Prototype III, design, and final phase. In order to illustrate the state of the project, a Gantt Chart is proposed during the initial phases to plan out the work to be

done accordingly during the given time period to complete the task. The Gantt Chart proposed is as shown below:

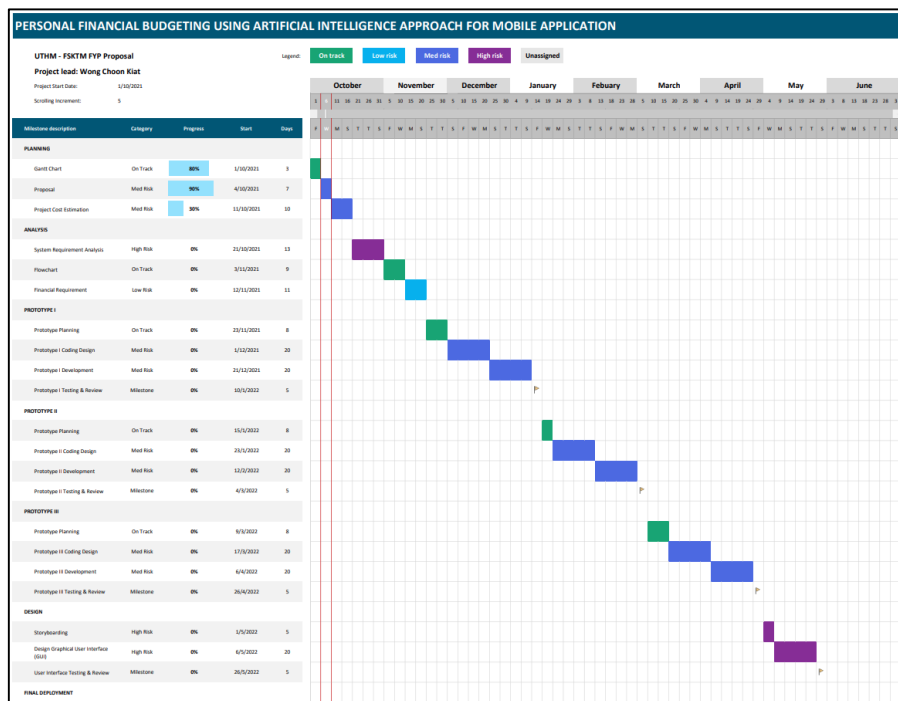


Figure 3: Gantt Chart of Project

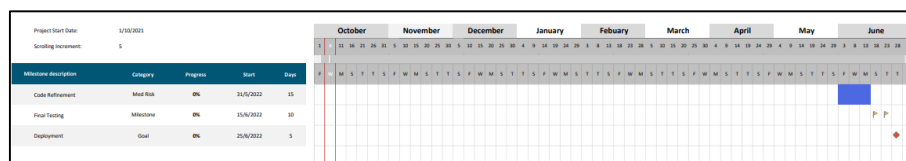


Figure 4: Gantt Chart of Project (cont.)

4. System Analysis, Design and Results

By analyzing the systems generated, system requirement analysis plays a role. The purpose of the system requirement analysis is to determine the general meaning and core idea of the system environment. The process of system requirement analysis is categorized into three, namely, use case diagram, class diagram, sequence diagrams, and activity diagrams.

4.1 Use Case Diagram

Figure 5 shows the use case diagram of the personal finance and budgeting mobile application. The use case diagram shows an overview of the whole process and data flow for those regarded as the most developed. In this scheme, the entities involved are user and admin.

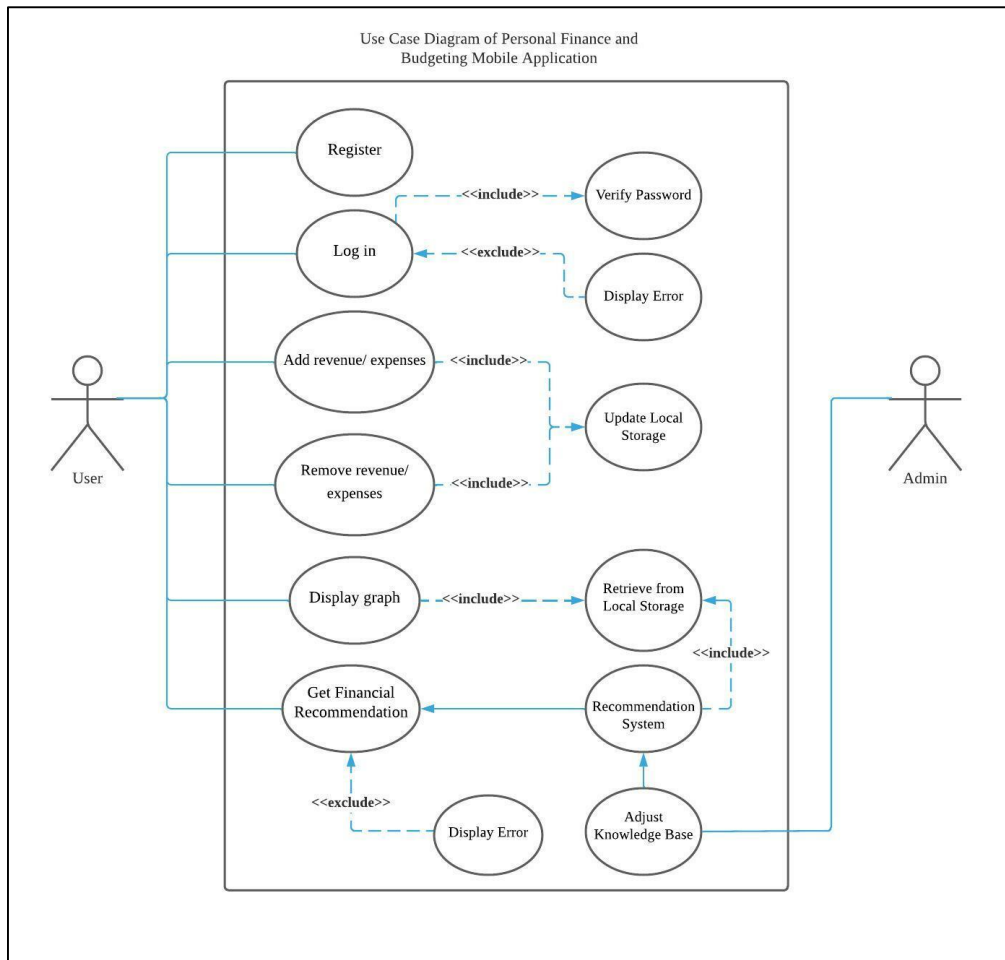


Figure 5 : Use Case Diagram of Personal Finance and Budgeting Mobile Application

4.2 Class Diagram

Class diagrams describe the static structure that is involved in personal finance and budgeting mobile application. This diagram identifies the system more clearly. It is the most widely used diagram in modelling object-oriented systems. It shows a set of classes, interfaces, associations, and generalizations. Figure 6 shows the class diagram for the personal finance and budgeting mobile application.

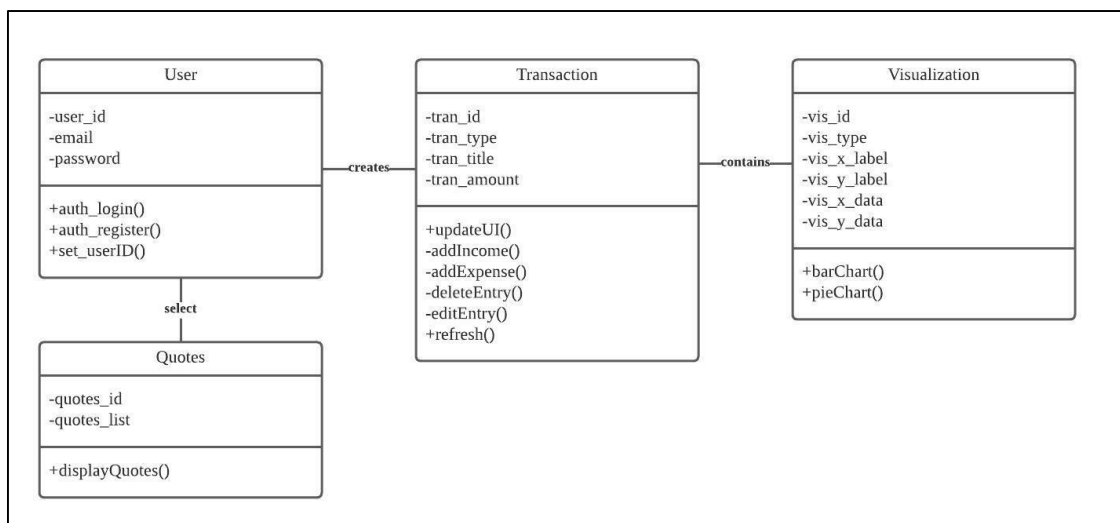


Figure 6 : Class Diagram of Personal Finance and Budgeting Mobile Application

4.3 Flowchart

A flowchart depicts the individual steps of a process in a logical order. It is a generic tool that may be used for a wide range of purposes and can be used to describe a number of processes, including manufacturing, administrative and service processes, and project plans. One of the seven core quality tools, it's a frequent process analysis tool. The flowchart below depicts the overall process of the personal finance and budgeting mobile application.

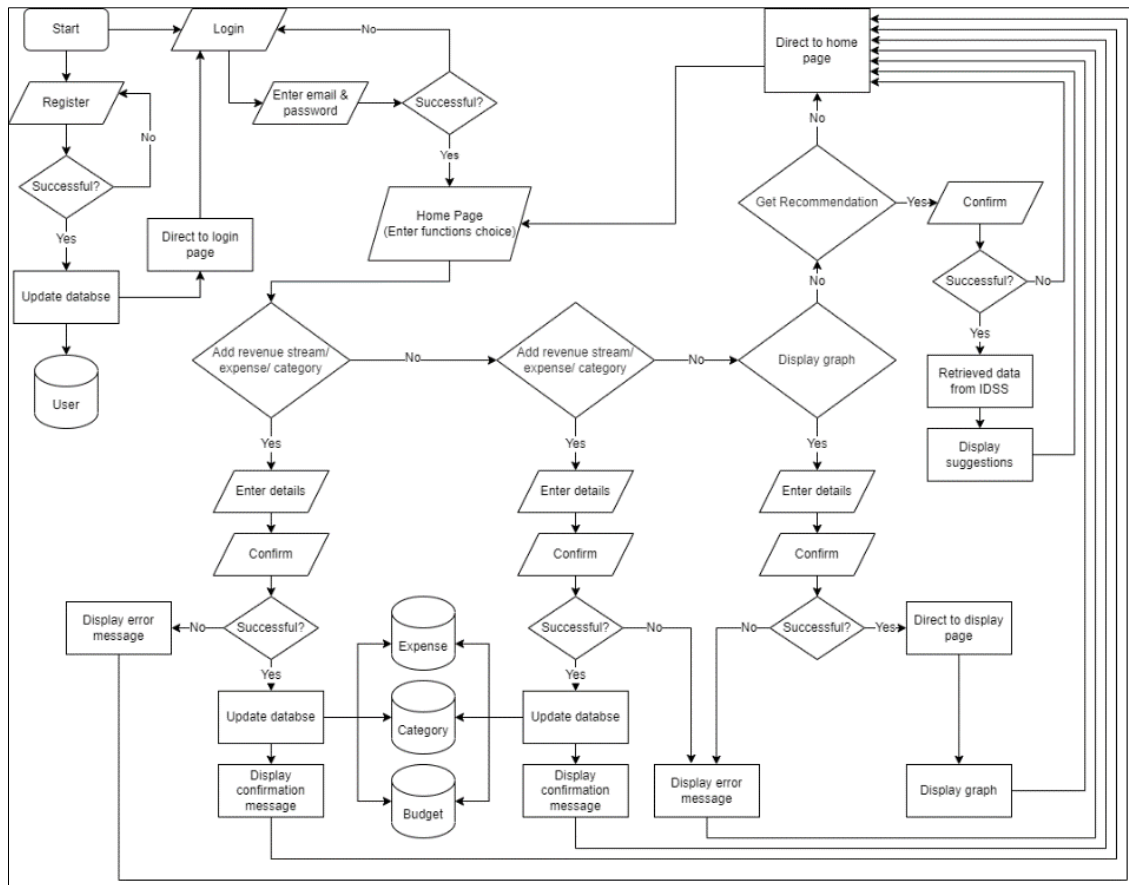


Figure 6: Flowchart of Personal Finance and Budgeting Mobile Application

4.4 System Architecture

The architecture of a mobile app is a collection of structural pieces and their interfaces that make up the system. It contains various approaches that aid in the development of a mobile application. All procedures that function on mobiles are incorporated into the app architecture. This combination of systems aids in the prevention of customer issues. Below illustrate the overall system architecture of the proposed personal finance and budgeting mobile application.

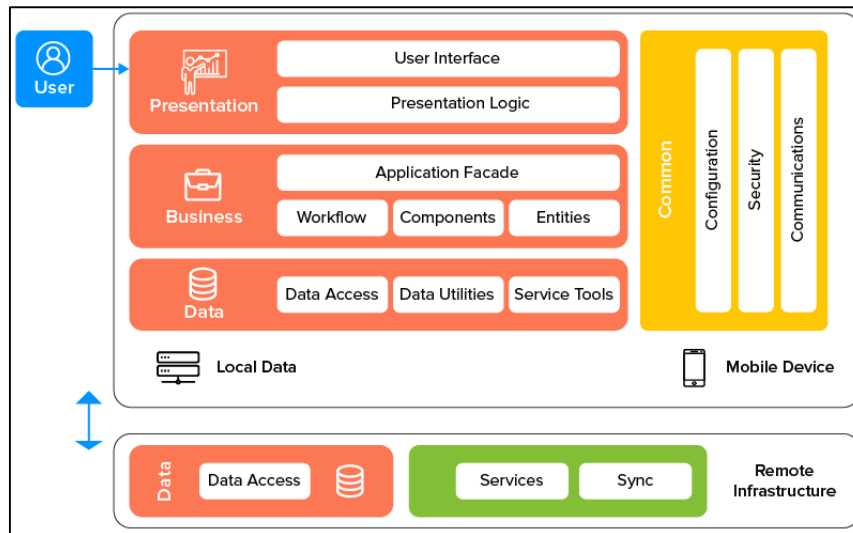


Figure 7: Three-layer Architecture

The chosen architecture for the development for this mobile application is three-layer architecture. This three-layer architecture is crucial when designing or developing a mobile app. It refers to the internal architecture of your component [15]. The following are the three most crucial layers of mobile architecture design: presentation later, business layer, and data access layer.

4.5 Database Scheme

The database scheme is listed as follows:

- i. User (user_id, email, password)
- ii. Transaction (tran_id, tran_type, tran_title, tran_amount)
- iii. Visualization (vis_id, vis_type, vis_x_label, vis_y_label, vis_x_data, vix_y_data)
- iv. Quotes (quotes_id, quotes_list)

4.6 Interface Design

After all the user's requirements were successfully analyzed, the project will proceed in the design phase. In this phase, both interface and database had been designed in order to help visualize the system before proceeding to the actual coding of the system. The system's designed interface is baked on the needs and requirements of the system user that will be practicing this system. Figure 8 shows the interfaces that have been designed based on the system requirement as requested to suit users' need.

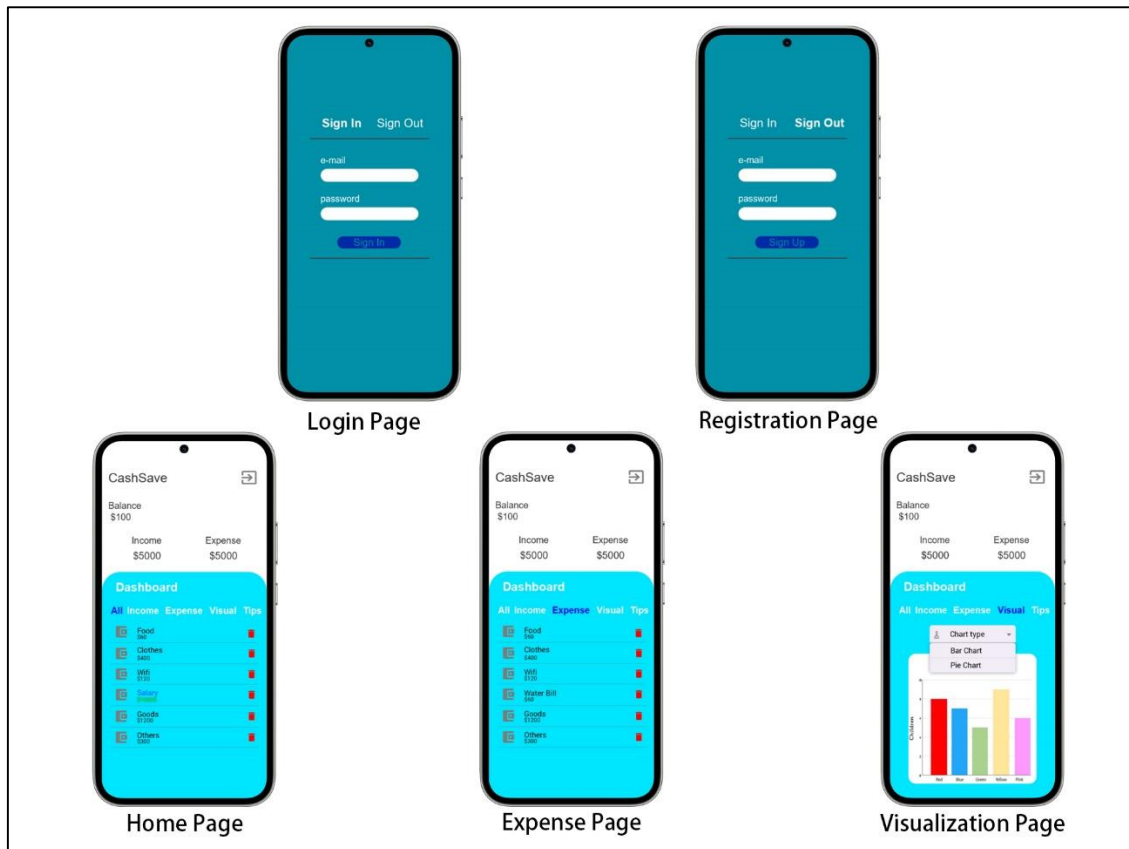


Figure 8: User Interface Design Sketch

4.7 Implementation and Testing

Following the analysis and design phase, the implementation and testing phases were completed. Implementation is the step of a project where the theoretical design is turned into a working system, giving users confidence in the new system's ability to function properly. It entails meticulous planning, research of the current system and its implementation restrictions, creation of change-over procedures, and evaluation of change-over methods. The final and most crucial phase is implementation. Giving users trust in the new system that it will operate effectively is the most important stage in developing a successful new system. In this section, you'll learn about each of the modules and how they're integrated into the system.

4.8 Test Case

Testing phase is critical for ensuring the application or system's functional quality. System testing evaluates whether the programme can be executed effectively and function in accordance with the project's requirements. During the testing phase, some flaws may be discovered, and developers will work to reduce the number of faults in the system. A test case is a set of actions carried out to ensure that a certain feature or operation of your software programme is working properly. A Test Case is a set of test procedures, data, preconditions, and postconditions developed for a specific test scenario to check any requirement. The test case specifies specific variables or conditions that a testing engineer can use to compare expected and actual results in order to determine whether a software product is working as intended.

Table 3: List of Important Test Cases

No.	Test Cases	Description	Outcome
TEST_100 Login & Registration			
1.	TEST_100_001	Verify login when user entered correct email and correct password.	Passed
2.	TEST_100_002	Display error message when user entered correct email and invalid password.	Passed
3.	TEST_100_003	Display error message when user entered invalid email and correct password.	Passed
TEST_200 Adding Revenue/ Expenses			
1.	TEST_200_001	Check if user is able to enter string in the title input field when adding new entry in “Income” tab.	Passed
2.	TEST_200_002	Check if the user is able to enter number in the amount input field when adding new entry in “Income” tab.	Passed
3.	TEST_200_003	Check if the system is able to record date and time when a new entry “Income” tab is registered.	Failed
TEST_300 Removing Revenue/ Expenses			
1.	TEST_300_001	Check if the selected entry is removed after user pressed on delete icon in “All” tab.	Passed
2.	TEST_300_002	Check if the selected entry is removed after user pressed on delete icon in “Income” tab.	Passed
3.	TEST_300_003	Check if the selected entry is removed after user pressed on delete icon in “Expenses” tab.	Passed
TEST_400 Financial Data Visualization			
1.	TEST_400_001	Check if the application will allow users to select chart type.	Passed
2.	TEST_400_002	Check if the selected chart type is displayed correctly under the “Visual” tab.	Passed
3.	TEST_400_003	Check if the chart is able to show correct amount based on income and expense.	Passed

Table 4: List of Important Test Cases (Cont.)

TEST_500 Financial Recommendation			
1.	TEST_500_001	Check if the application is able to display locally stored quotes randomly on the container.	Passed
2.	TEST_500_002	Check if the application is able to retrieve new quotes from the internet.	Failed

4.9 Overall Result for Test Case

The overall result of test cases is computed to evaluate the performance and efficiency of the application. The failed test cases indicates that the application could be improved and enhanced in the future.

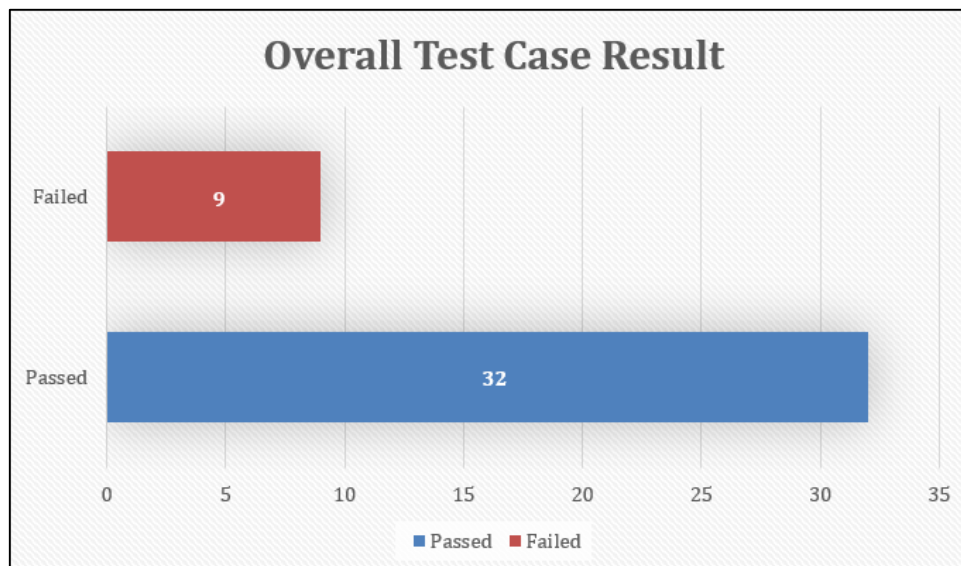


Figure 9 : Overall Test Case Result

Figure 9 shows the overall result of the test case for all of the module included in the system. There was a total of 41 test cases conducted where 32 test cases have been given a positive result of passed. On the other hand, there was 9 test cases out of 41 test cases failed. The total percentage for passed and failed test cases are 78% and 22% respectively. The failed test cases are TEST_100_009, TEST_100_012, TEST_200_003, TEST_200_005, TEST_200_008, TEST_200_010, TEST_400_004, TEST_400_005 and TEST_500_002. All in all, the system has achieved a positive outcome as most of the features consists in the main modules are functional. The system is proven to be reliable and effective in achieving the objectives of the project.

5. Conclusion

CashSave budgeting mobile application is built to allow users to record and update their revenue stream while using an easy-to-use expense tracking user interface to see their financial statement over a set period of time. CashSave provides the functionality of expense tracking on the go to make the process of recording transaction on a daily basis at ease. In comparison with the traditional way of tracking expenses using a notebook or spreadsheet, it is observed that this method of expense tracking is relatively inefficient. As a result, the idea of a personal money and budget tracking system is offered, with the ease of use of a current mobile development framework. The proposed method is designed

with convenience and ease-of-mind in mind to encourage the public to practice personal financial discipline among the public.

Additionally, the application contains a budgeting suggestion and recommendation system to help users plan their budgets and make better financial decisions in the future. User are also provided with the functionality of financial data visualization in the form of charts. The graphical representation of the allocation of their income and expense helps them to better understand and visualize their current spending habits. Users are also prompted with financial suggestion in the form of quotes from credited financial expertise and the handy 50/30/20 budgeting calculator to aid in their financial planning.

The system was developed using Prototyping methodology. Use case diagram, flowchart, and class diagram was designed and constructed during the planning phase of the development of the system. Other than that, functionality case testing was conducted to evaluate the performance of the application in the testing phase.

However, there is no flawless system and improvement needed to be done to the system in the future due to some limitations. Improvement can be made to CashSave mobile application to further enhance on its functionalities and performance. Firstly, the application may improve on its registration process by utilizing Firebase authentication features to verify the authenticity of the email. Next, the system can insert a feature where users are able to enter the application without logging in or registering an account with some limitation implied on storage security. Thirdly, each income and expense entry should include a feature where users are able to select pre-defined or user defined categories. This could aid in users' transactions management where user could easily identify the desired listing based on their preference. Furthermore, each transaction recorded should be identified by current date and time so that users would get informed of the details of each transaction recorded in the system. Lastly, the system could make improvement on its visualization module where the data presented in chart could be categorized and filter based on date and transaction categories with no manual refresh required to fetch latest data from local storage.

In conclusion, Personal Finance and Budgeting Mobile Application, CashSave, meets the objectives and was developed successfully within the given time.

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