# Finflow – Track your Finances

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***Abstract* – Finflow, a JavaFX graphical user interface (GUI) application, facilitates efficient tracking of users' incoming and outgoing transactions through its straightforward and lightweight design. It includes user registration and login features to ensure a secure and tailored experience. The system's core functionalities include the addition and automatic categorization of both incomes and expenses. Finflow utilizes a Model-View-Controller (MVC) pattern a clear separation between data, user interface, and business logic. The Model component manages data storage and manipulation, while the View ensures a responsive interface. The Controller handles user interactions, serving as the go-between the Model and View, managing user input, and orchestrating data flow. A significant advantage of Finflow is its automatic categorization of income and expense, reducing the need for manual categorization. Leveraging Java's object-oriented principles, the project employs inheritance and encapsulation to establish a flexible and adaptable system capable of accommodating future enhancements. A significant feature of Finflow includes the visually informative pie chart. The pie chart dynamically illustrates the user's financial situation by visually distinguishing between incomes and expenses, enhancing visual appeal and providing users with a swift understanding of their financial breakdown. Moreover, the educational resource module in Finflow endeavors to empower users by presenting current and relevant content, enabling them to strategize and enhance their financial planning skills.**

***Keywords* – *JavaFX, GUI Application, Finflow, Transactions, Model-View-Controller (MVC), Data Access Object (DAO), Object-oriented principles, Automatic categorization, Pie Chart***

## I. Problem Description

In today's fast-paced world, managing finances effectively is crucial for individuals juggling through multiple and diverse expenses. However, the complexity of modern finances and cumbersome manual record-keeping often lead to challenges in tracking and organizing financial activities, leading to anxiety, excessive spending, and missed opportunities for savings and investments. Acknowledging the importance of financial awareness and the challenges associated with income and expense tracking, we propose the development of an innovative solution for the Income and Expense Tracker System named *Finflow* which is a user-friendly JavaFX GUI app designed to streamline income and expense tracking effortlessly.

The scope of the project encompasses the creation of a JavaFX GUI app utilizing modern technologies such as JavaFX and Java. This application adheres to the Model-View-Controller (MVC) framework, ensuring a structured and maintainable codebase. Key features of Finflow include user registration and login functionalities for a secure and personalized experience, automated income and expense tracking to minimize manual data entry, expense categorization into predefined categories like food, clothes, education, and personal expenses, budget setting and monitoring capabilities to foster financial discipline, dynamic visualization tools such as pie charts for visual representation of financial data and educational resources designed to assist users in understanding the concepts of financial literacy and the significance of tracking income and expenses.

The purpose of Finflow is to empower individuals with a comprehensive tool for managing their finances effectively. By offering a user-friendly interface, automated tracking features, and dynamic visualization tools, Finflow aims to offer a comprehensive solution to enhance financial awareness, facilitate budgeting, simplify expense tracking, and promote financial security.

Ultimately, Finflow seeks to address the challenges of modern financial management by leveraging technology and automation to empower users to take control of their finances and achieve greater financial stability and success.

## II. Analysis (Related Work)

Financial tracking is a critical practice that holds immense value for both individuals and businesses alike. It serves as a foundational element in understanding one's financial standing, facilitating informed decision-making, and strategic planning. A comprehensive investigation conducted by the Harvard Business Review underscores the significance of regular financial monitoring, revealing that businesses committed to this practice have higher probabilities of thriving and expanding compared to those neglecting it.

Through an extensive analysis of various companies over time, the study found that financial tracking enables organizations to identify emerging trends, allocate resources judiciously, and adapt swiftly to dynamic market conditions. Moreover, businesses that prioritize financial tracking demonstrate a superior capacity to anticipate and mitigate financial risks, leading to enhanced profitability and long-term viability.

The recent data from The New York Fed's quarterly Household Debt and Credit Survey paints a concerning picture of consumer debt in the United States. As of the fourth quarter of 2023, total consumer debt has soared to $17.503 trillion, with the average debt per U.S. adult standing at $58,604. Alarmingly, approximately 77% of American households carry some form of debt burden.

Despite the clear benefits of financial planning, Schwab's 2021 Modern Wealth Survey reveals a stark reality: only 33% of Americans have a written financial plan. Among the majority who have not developed a plan, nearly half cite insufficient funds as a barrier, while others point to the perceived complexity of financial planning or a lack of time.

These findings underscore the urgent need for accessible and user-friendly financial tracking applications. Such tools can empower individuals and businesses to take control of their finances, set achievable goals, and navigate the complexities of financial management effectively. By providing insights into spending habits, identifying areas for saving or investment, and facilitating long-term financial planning, a robust financial tracking application can play a pivotal role in fostering financial stability, resilience, and success.

Moreover, previous works and literature reviews in personal finance management offer valuable insights and diverse approaches to tackling similar challenges. For instance, Shivani Gupta [1] devised a Python Django software application to mitigate the limitations of manual income and expense tracking systems. The primary aim was to streamline processes, minimize manual errors, and enhance efficiency through automation. Users were required to register and obtain a unique ID to maintain individualized records of income and expenses. The system facilitated daily tracking of income and expenses, with graphical representations available at regular intervals, such as weekly or monthly summaries. This comprehensive approach provided users with a holistic view of their financial standing. With its user-friendly interface, extensive reporting features, and robust security measures, the system empowered users to take charge of their finances and pursue their financial goals effectively.

Similarly, Tanvi Parab et al. [2] developed a web application titled "Expense tracker" using MERN (MongoDB, Express, React, and Node) technology. This platform allowed users to efficiently manage their expenses digitally, eliminating the need for traditional paper diaries and manual calculations. It offered various categories for both income and expenses, such as clothing, food, entertainment, investments, rent, salary, and business expenses. Moreover, the application featured a reminder function that alerted users if they exceeded their set expense limits. Additionally, it generated monthly reports based on users' daily input of expenses and income, facilitating record-keeping and financial management.

These examples highlight the innovation and creativity in the field of financial tracking applications, showcasing their potential to address the needs and preferences of users effectively.

## III. System Design

### *System Architecture*

Finflow is built in a Model-View-Controller (MVC) architecture pattern, facilitating modularization, scalability, and maintainability. The architecture consists of the following components:

**Model:** The model component represents the data and business logic of the application. It encapsulates entities such as UserAccount, Transaction, and DAO (Data Access Object) classes responsible for interacting with the database.

**View:** The view component encompasses the user interface elements of the application. It includes JavaFX FXML files defining the layout, styling, and visual components presented to users, such as the home page, transaction history, educational resources, and profile settings.

**Controller:** The controller component acts as an intermediary between the model and view, facilitating communication and interaction. It comprises JavaFX controller classes that handle user inputs, process requests, invoke business logic methods from the model, and update the view accordingly.

**Database:** The database serves as the persistent storage layer for the application, storing user profiles, transaction records, educational content, and other relevant data. It interacts with the model component through DAO classes to perform CRUD (Create, Read, Update, Delete) operations.

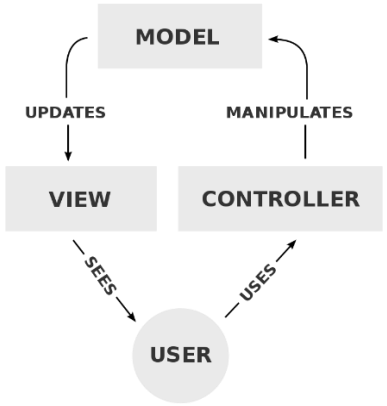



Figure 1. System Architecture Diagram

### *UI design ( draft design)*

**User Login:** Users can log in to the Finflow application using their username and password. Upon successful authentication, they gain access to their personalized dashboard, where they can view their financial overview, transaction history, and other features.

**User Sign Up:** New users can create an account by providing their username, email address, and password. After completing the sign-up process, they can log in to the application and start managing their finances.

**Forgot Password:** If users forget their password, they can request a password reset by providing their email address. The

system sends a password reset link to the user's email, allowing them to create a new password and regain access to their account. This feature ensures users can securely recover their account access in case of forgotten passwords.

**Home:** On successful login, the user is directed to Home. It provides an overview of total income, balance, and expenses. It displays the most recent transaction and includes functionality to add income and expense transactions with automatic categorization

**Transaction History:** Lists all transactions with options to edit and delete.

**Reports:** Displays a pie chart visual representation of transactions. This provides users with a comprehensive and actionable overview of their financial situation. It enables users to better understand their spending habits, track progress towards goals, manage budgets effectively, and plan for the future with confidence

**Profile:** Lists profile details and allows for editing of profile fields.

**Educational Resources:** Finflow attempts to promote financial literacy by providing each to understand up-to-date content to help users better understand and plan their finances.

**Logout:** Logs the user out of the application.

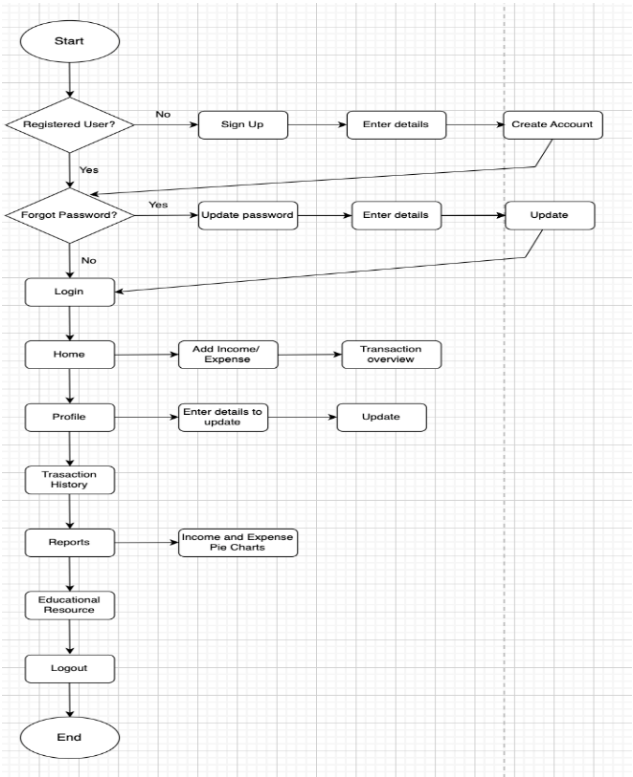



Figure 2. Original UI design

Finflow aims to provide users with a clear and intuitive interface for effectively managing their finances, accessing educational resources, and updating their profile details seamlessly.

## IV. IMPLEMENTATION

### *A. Class Definition*

Finflow includes key entities such as **User**, **Transaction**, **TransactionType**, and **TransactionDetails**. These classes encapsulate relevant attributes and behaviors, promoting code reusability and maintainability.

### *B. Generics/ Collection/ Iterators*

Finflow leverages the power of Java generics, collections, and iterators in various aspects of our application. For instance, iterators were employed when populating transactions, while collections were utilized to manage transaction types dynamically, facilitating efficient data manipulation and retrieval.

### *C. Abstract Classes/ Interfaces*

Finflow architecture adheres to best practices by defining interface classes like **UserDAO** and **TransactionDAO**, which are then implemented by concrete classes such as **UserDAOImpl** and **TransactionDAOImpl.** This approach helps in achieving modularity, extensibility, and code clarity.

### *D. Inheritance*

By employing inheritance, Finflow establishes a hierarchical relationship between classes, exemplified by the superclass **Config**, which serves as a foundational entity extended by the **DatabaseConnection** class. This inheritance hierarchy promotes code reusability and maintains a structured and organized codebase.

### *E. Lists*

Finflow effectively utilizes lists to manage and manipulate data structures such as transactions and categories throughout the application. Lists offer flexibility, allowing us to perform operations such as adding, removing, and iterating over elements efficiently.

### *F. Maps*

Finflow utilizes HashMap for mapping transaction categories to their corresponding image representations. This mapping mechanism enables seamless retrieval and display of transaction history, enhancing the user experience and visual appeal of the application.

### *G. MySQL DB Connection*

Finflow leverages JDBC (Java Database Connectivity) to establish connections to the MySQL database for data persistence, execute SQL queries, manage transactions, and retrieve data. JDBC provides a standardized interface for interacting with relational databases, ensuring secure storage and retrieval of user, transaction, and transaction-type data. Additionally, JDBC enables robust error handling and recovery

mechanisms, enhancing the reliability and stability of the application.

### *H. External Libraries*

Finflow utilizes external libraries such as JavaFX and Scene builder alongside JDBC to construct its graphical user interface (GUI). Scene Builder offers an extensive range of UI components and functionalities, enabling the creation of interactive and visually appealing interfaces. Leveraging JavaFX enhances the user experience through improved navigation, responsive layouts, and captivating visual elements, ultimately resulting in a more aesthetically pleasing application.

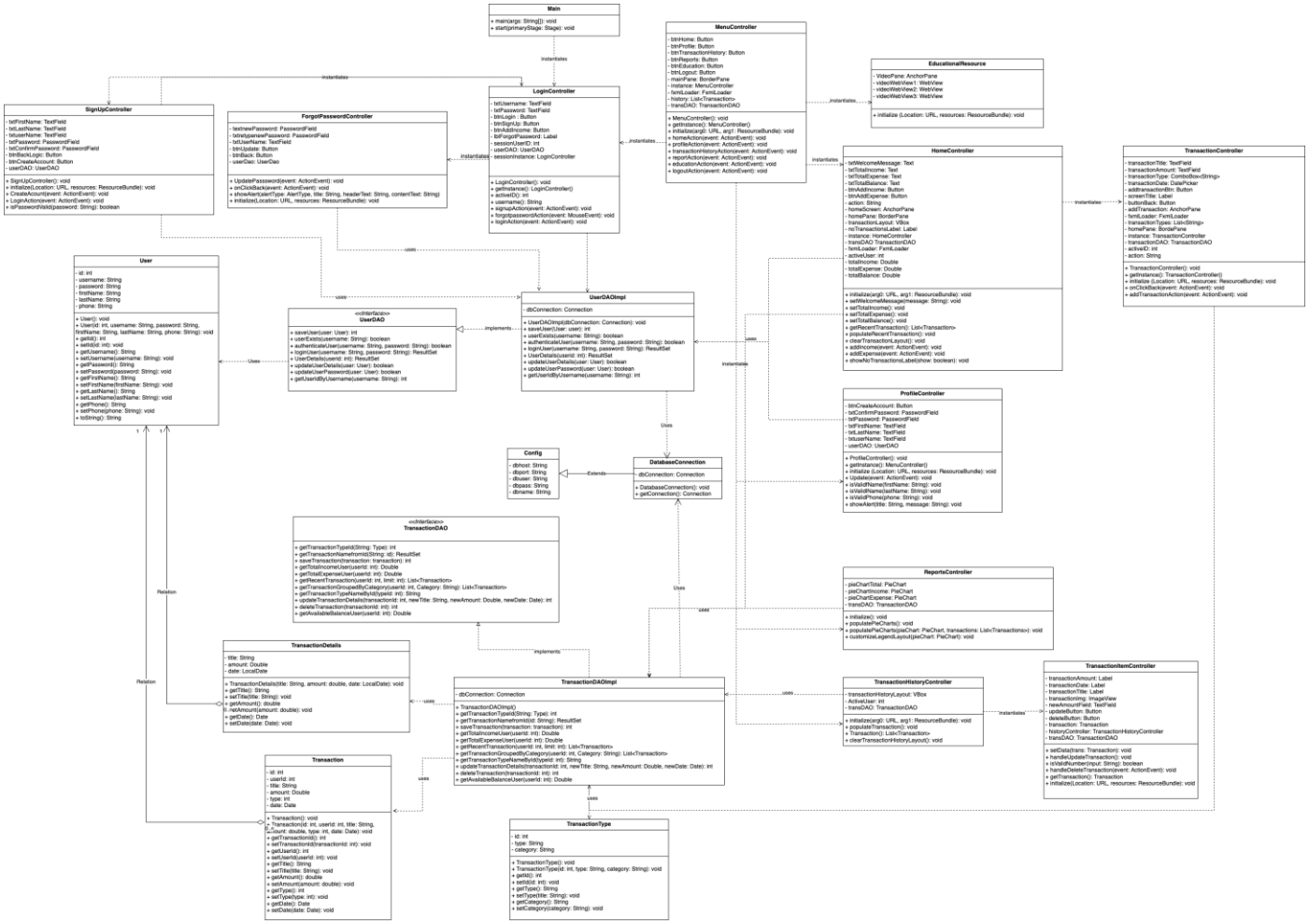
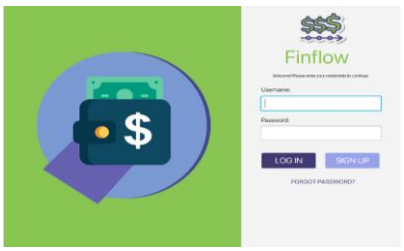



Figure 3. UML Diagram

## V. EVALUATION

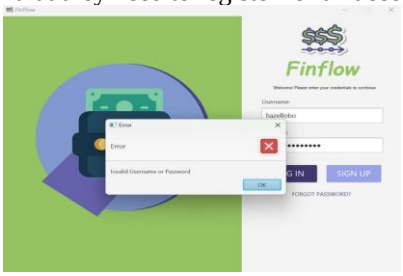
### *User Authentication and Authorization*

The login screen is the initial interface users encounter when opening the Finflow application. Here, users are prompted to enter their login credentials to access their account. Users can input their username and password to log in to their existing Finflow account. The login screen typically includes input fields for username and password, along with a "Login" button to initiate the login process.

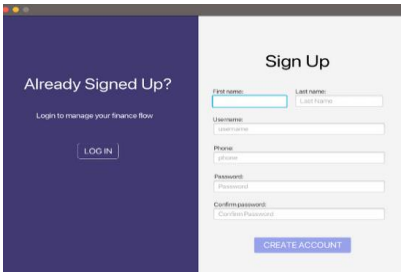



Finflow checks the user's credentials against its database to verify if the user is registered and authorized to access the app. If the user is authorized, they are directed to the Home screen of the application. If not, an error message is

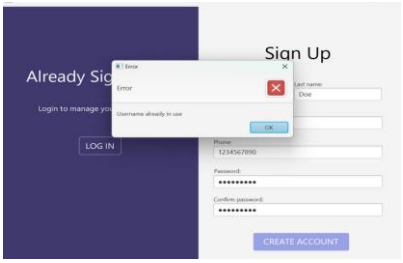
displayed informing the user that their credentials are incorrect or that they need to register for an account.



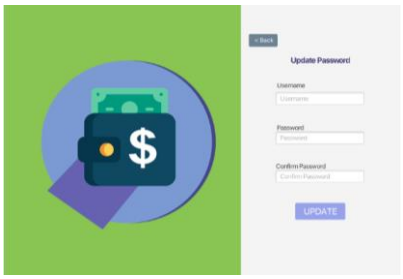

The signup screen allows new users to register for a Finflow account.



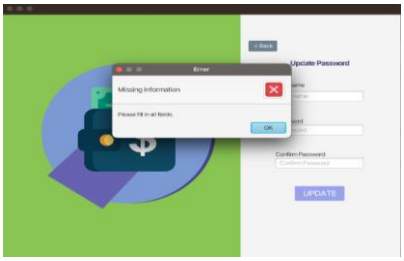

Finflow ensures each input field (e.g., username, password, email) is validated to ensure it meets certain criteria (e.g., minimum length, correct format). If the input does not meet the specified criteria, informative alert messages are displayed to prompt the user to correct their input. The below message prompts the user to change the username since it's already in use




Finflow allows users to reset their password if forgotten.



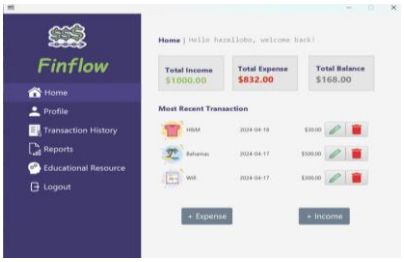

Users can enter the username associated with their account to reset their password. Informative alert messages are prompted to guide the user through the password reset process.



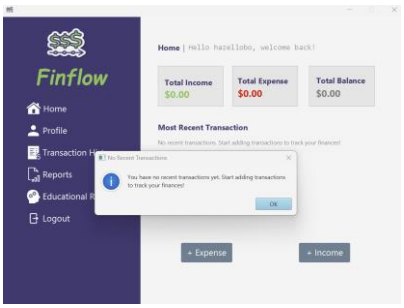

Overall, these screens work together seamlessly to provide users with a secure and user-friendly experience when accessing and interacting with the Finflow application.

***Transaction Management***

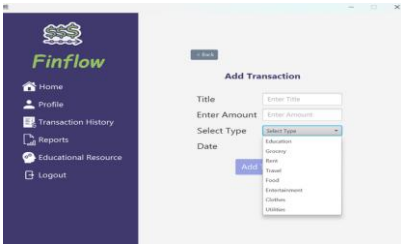
After successful login, the user lands on the Home Screen. Home Screen provides an overview of all transactions. It displays a summary of the user's transactions, including income, expenses, and any other financial activities. Allows users to see their most recent transactions and add income and expenses.



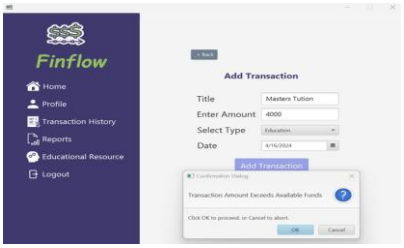

Finflow ensures that all edge case validations are addressed to prevent the system from behaving unexpectedly. The below image shows if a user with no transactions attempts to access the reports/ transaction history. They are prompted to the home screen to add transactions.



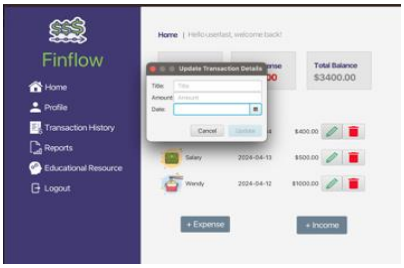

Finflow offers a user-friendly interface to streamline the transaction entry process. Users need to click on one of the buttons at the bottom of the Home Screen to be directed to the respective transaction page. Users can enter transaction details such as amount, date, category, and description. Finflow provides automatic categorization to save users time from manual category management.



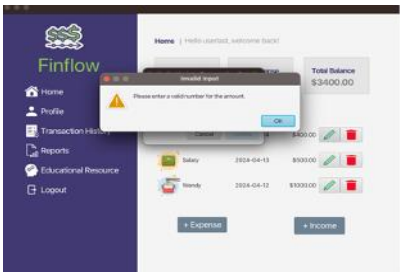

Ensuring correct input is crucial to prevent runtime errors and maintain system reliability. In Finflow, validation during transaction entry is paramount for financial integrity. When users attempt to submit an expense transaction exceeding their available balance, the system displays an alert message or confirmation dialog, serving as a reminder to review and potentially adjust the transaction amount. This proactive approach not only prevents errors but also reinforces prudent financial management practices, promoting responsible spending habits and minimizing the risk of overdrafts or financial discrepancies.



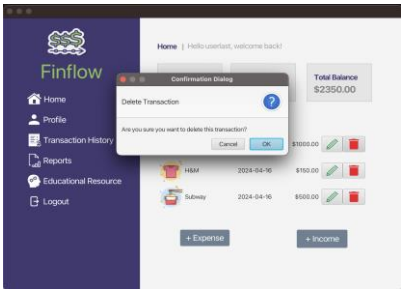

If users wish to modify their transactions, Finflow offers both update and delete functionalities. Users have the option to update recent transactions directly from the home screen or older transactions from the transaction history page.



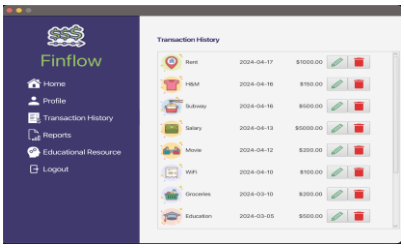

Like other input screens, Finflow ensures correct input data is passed to the system. The user is prompted with informative alert messages to change their input if they enter an invalid entry. The below images show the case when a user enters an alphabet in the amount field, leading to the prompt message.




Users can also delete transactions added from the transaction history screen. Finflow prompts the user before deleting the transaction, to avoid accidental deletion.

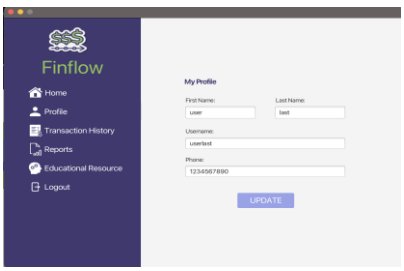



Finflow's transaction history page facilitates users in tracking all income and expense transactions efficiently. Each transaction is displayed with a clear title, date, and amount, accompanied by UI symbols for quick identification of transaction types. Additionally, users have the flexibility to update or delete transactions based on their needs.

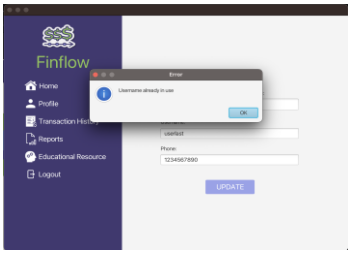



***Profile Management***

Within the profile section, users can access details such as their first name, last name, username, and phone number. Additionally, users have the option to update their information as needed.

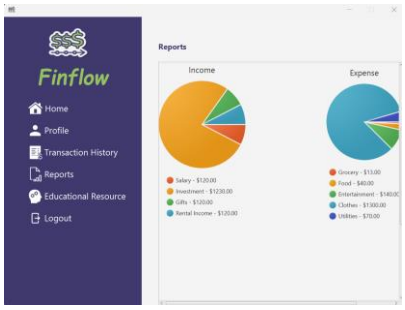


If users attempt to use an existing username when updating, an alert message will appear, prompting them to choose a different username.



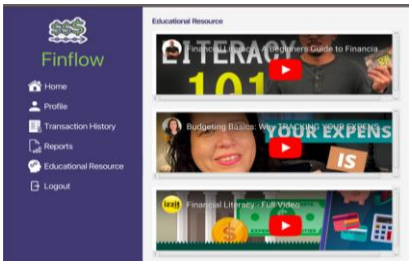

***Visualized Transactions***

Finflow's report section provides users with comprehensive insights into their income and expenses through various charts. These charts include comparisons between income and expenses, as well as separate breakdowns for income and expenses categorized by type. By presenting this data in a visual format, users gain detailed information in a pictorial format, allowing for a better understanding and analysis of their financial activities.




***Financial Literacy***

Promoting financial literacy is crucial for empowering individuals to make informed financial decisions. Finflow aims to achieve this by providing easily understandable and up-to-date content. By offering accessible education, practical application, continuous learning opportunities, engagement, and personalization, Finflow ensures that users have the knowledge and skills they need to manage their finances effectively and plan for their future.




Finflow stands out among its competitors due to its robust feature set, rigorous security measures, and user-focused design. With customizable options and regular updates, users can rely on Finflow for a dependable and smooth experience.

In addition, Finflow demonstrates excellence in code design by adhering to best practices. Each component is modular and encapsulated, facilitating code reuse and enhancing maintainability. Our streamlined architecture enables easy scalability and the addition of new features, making Finflow an ideal choice for both developers and users.

## VI. Discussion (Reflection)

The development and implementation of the Finflow have provided valuable insights into the intersection of technology and personal finance management. Through the creation of this JavaFX GUI application, several key discussions and reflections have emerged, shaping the project's direction and potential impact.

*A. User-Centric Design*

One of the primary considerations throughout the project was the user experience. By prioritizing simplicity, intuitiveness, and accessibility in the application's interface, we aimed to empower users with effective financial management tools. The iterative design process involved soliciting feedback from potential end-users, which helped refine features and improve usability.

*B. Financial Literacy Promotion*

The integration of an education resource tab within the Finflow application represents a proactive approach to promoting financial literacy among users. By providing curated educational content in the form of YouTube videos, the application seeks to bridge knowledge gaps and empower users with essential financial planning skills. This initiative reflects a broader commitment to societal well-being beyond mere transaction tracking.

*C. Data Privacy and Security*

The handling of sensitive financial data within the application necessitated robust measures to ensure user privacy and security. Discussions surrounding data encryption, secure authentication protocols, and compliance with regulatory standards were paramount. Implementing stringent security measures not only fosters user trust but also mitigates the risk of potential data breaches, safeguarding users' financial information.

*D. Continuous Improvement and Adaptation*

The agile development approach adopted for the Finflow project facilitated rapid iterations and continuous improvement cycles. Regular feedback loops and discussions among friends and peers provided valuable insights allowing the application to evolve in response to changing user needs and technological advancements. Trello tracked project progress, while GitHub facilitated collaborative development, ensuring seamless coordination among team members.

*E. Impact Assessment and Future Prospects:*

As the Finflow project moves forward, ongoing evaluation of its impact on user spending patterns and outcomes becomes essential. Quantitative metrics, such as user adoption rates,

transaction volumes, and educational engagement, can help assess the application's effectiveness in achieving its intended goals. Moreover, qualitative feedback from users regarding their perceived value and utility of the application will inform future development efforts.

*F. Collaboration and Community Engagement*
Beyond the technical aspects of development, the Finflow project underscores the importance of collaboration and community engagement. Engaging with stakeholders, including users, financial experts, and regulatory bodies, fosters a sense of ownership and collective responsibility towards promoting financial well-being. Collaboration also opens avenues for partnerships and synergies, enhancing the application's reach and impact.

*G. Ethical Considerations*
Discussions surrounding the ethical implications of financial technology (FinTech) applications like Finflow are paramount. Ensuring transparency in data usage, avoiding predatory practices, and promoting inclusivity are ethical imperatives that underpin the project's ethos. Ethical considerations guide decision-making processes, aligning the project's objectives with broader societal values and principles.

*H. Long-Term Sustainability and Scalability*
The sustainability of the Finflow project hinges on its ability to adapt to evolving user needs and technological landscapes. Discussions regarding long-term maintenance, scalability, and resource allocation are crucial for ensuring the application's viability and relevance in the years to come. Sustainable business models, coupled with a commitment to innovation, lay the groundwork for enduring success.

In conclusion, the Finflow project serves as a testament to the transformative potential of technology in empowering individuals to achieve financial well-being. Through thoughtful design, continuous improvement, and a commitment to ethical principles, the project seeks to make a meaningful impact in the lives of its users and contribute to a more financially literate society.

## VII. Conclusions and Future Work

***Advantages and benefits***
*A. Enhanced Financial Management*
Users can effectively track their income and expenses, leading to improved financial awareness and behavior.

*B. User-Centric Design*
The intuitive interface promotes user engagement and adoption, ensuring accessibility for individuals of varying levels of financial literacy.

*C. Educational Resources*
Integration of educational content fosters financial literacy, empowering users to make informed decisions about their finances.

*D. Agile Development Methodology*
Rapid iterations and feedback loops enable continuous improvement, ensuring that the application remains responsive to user needs and technological advancements.

*E. Collaborative Development*
Utilization of tools like Trello and GitHub facilitates seamless collaboration among team members, enhancing productivity and coordination.

***Problems Encountered and Future Improvements***
*A. Integration Challenges*
While the project successfully integrated educational resources, further enhancements could be made to personalize content based on user preferences and learning objectives.

*B. Security Considerations*
Ensuring robust security measures to protect sensitive financial data remains a priority for future iterations, addressing potential vulnerabilities and ensuring user trust.

*C. Feature Expansion*
With more time, the team aims to expand the application's feature set, potentially incorporating advanced budgeting tools, investment tracking, and personalized financial advice features.

*D. Enhanced Reporting*
Improving the reporting capabilities of the application, such as offering more comprehensive insights into spending habits and financial trends, would provide users with greater visibility and control over their finances.

***Conclusion and Future Work***
In conclusion, Finflow represents a significant step forward in leveraging technology to empower individuals to manage their finances effectively. Through user-centric design, collaborative development, and a commitment to continuous improvement, the application offers tangible benefits in promoting financial literacy and spending patterns. Future work for the Finflow project includes refining educational resources, enhancing security measures, expanding feature sets, and improving reporting capabilities. By addressing these areas and remaining responsive to user feedback, the project aims to further elevate its impact and reach, ultimately contributing to a more financially empowered society.

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