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Budget Buddy: An AI-Powered Finance Tracking Solution for Smarter Money Management

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Abstract: Budget Buddy is an AI-powered finance tracking application that simplifies personal financial management while prioritizing user security and privacy. Developed with Next.js, Tailwind CSS, and Supabase (Prisma), it offers a seamless experience for tracking expenses and managing budgets. Secure authentication is handled by Clerk, allowing users to maintain multiple accounts and set a default account for automatic transaction entries. Transactions are categorized as income or expense, with attributes such as description, recurrence, and receipt data extraction powered by Google Generative AI API, which enables automatic transaction detail filling from scanned receipts. The platform includes data visualization tools like bar graphs and pie charts, helping users gain insights into their financial activity. Users can set monthly budgets and receive email notifications when expenditures exceed 90% of the budget, along with a financial report on the 1st of each month, enriched by Google AI with tailored suggestions to stay on track. Budget Buddy also ensures platform security through Arcjet's rate-limiting (10 transactions per day) and bot protection middleware, which blocks malicious bots while permitting trusted ones like search engines and Inngest. The app supports recurring transactions, automatically recording them at specified intervals, and allows users to edit, delete, filter, and search transactions based on preferences. With advanced AI and security features, Budget Buddy enables users to track finances effectively, gain actionable insights, and achieve financial goals securely.

Keywords: AI-Powered Finance Tracking, Personal Financial Management, Secure Authentication, Expense and Budget Tracking, Google Generative AI, Data Visualization in Finance

I. INTRODUCTION

In today's fast-paced digital economy, personal financial management remains a significant challenge, with over 60% of Indians struggling to maintain budgets, track expenses, and make informed financial decisions. This financial literacy gap leads to increased stress, debt accumulation, and reduced economic mobility, particularly affecting young professionals and middle-income households. Budget Buddy addresses this issue by providing an AI-powered finance tracking application that simplifies financial management while ensuring security and privacy. Built on Next.js, Tailwind CSS, and Supabase with Prisma, it offers intuitive expense tracking, automated categorization, and insightful data visualization to help users understand spending patterns and make informed choices. Financial stress impacts mental health, workplace productivity, and overall quality of life, making effective financial management crucial. Studies show that individuals with structured finance systems save an average of 15% more annually and experience 30% lower financial anxiety levels. Budget Buddy enhances financial well-being through intelligent receipt scanning, recurring transaction management, and personalized budget notifications. Leveraging Google Generative AI for receipt data extraction and tailored financial insights, it transforms financial management from a burdensome task into an accessible and rewarding experience. With features like secure authentication via Clerk, multi-account support, and seamless financial tracking, users can efficiently manage expenses while receiving AI-driven insights. The platform's visualization tools, including bar graphs and pie charts, offer a clear financial overview. Monthly budget notifications alert users when spending exceeds 90%, promoting disciplined financial habits. Additionally, financial reports with personalized recommendations are sent on the 1st of each month, assisting users in staying on track. Budget Buddy also ensures security through Arcjet's rate-limiting and bot protection middleware. By simplifying financial management and prioritizing user security, Budget Buddy empowers individuals to take control of their finances, reduce stress, and achieve long-term financial stability.

The main objectives of this project are:

1. Provide an easy-to-use platform for tracking transactions and setting budgets.
2. Enable automatic expense categorization and financial insights using data visualization.

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3. Implement real-time alerts for budget limits and recurring transactions.
4. Ensure secure and seamless user authentication.
5. Integrate AI-powered receipt scanning to automatically extract transaction details and reduce manual data entry.

II. LITERATURE SURVEY

A literature survey examines existing research relevant to our project, providing an overview of AI-powered finance tracking applications. It explores methodologies, technologies, and their impact on financial management. Modern applications integrate AI-driven transaction categorization, receipt scanning, real-time visualization, multi-account management, and secure authentication. Research highlights advancements in financial literacy, automation, and security using AI and cloud-based architectures. The following research papers were reviewed in this study:

1. Title: Personal Finance Tracker [1] Authors**:** Samar Verma, Samarjeet Singh Kheda, Shivam Kuwale Year: 2024 Publisher: IRJMETS Description: The Personal Finance Tracker paper presents a Next.js, Tailwind CSS, and PostgreSQL-based web app for budgeting, expense tracking, and data visualization. However, it has limitations like API dependency, scalability issues, lack of investment tracking, and maintenance needs. In contrast, Budget Buddy addresses these with AI-powered receipt scanning via Google Generative AI, enhanced security through Clerk Authentication, Arcjet's rate limiting, and Zod validation. It also offers AI-driven financial reports, real-time budget notifications, and a scalable stack with Supabase and Prisma, ensuring a more secure, comprehensive, and user-friendly financial management experience.

2. Title: Smart Expense Tracking System Using Machine Learning [2] Authors: S. Aishwarya and S. Hemalatha Year: 2023 Publisher: SCITEPRESS - Science and Technology Publications, Lda. Description: The Smart Expense Tracking System Using Machine Learning automates expense tracking by collecting, preprocessing, and training models to predict expenses, using data visualization for insights. A user study showed high accuracy and improved financial management, but limitations include data quality dependency, unique expense categorization challenges, and manual corrections. In contrast, Budget Buddy overcomes these with Google Generative AI for receipt scanning, reducing reliance on user input, continuous learning for better categorization, user customization, and Zod-based input validation, ensuring greater accuracy, minimal manual correction, and a seamless financial management experience.

3. Title: Personal Finance Management Application [3] Authors: Tihomir Stefanov P, Milena Stefanova P, Silviya Varbanova P, Stanislav Temelkov P Year: 2024 Publisher: TEM Journal Description: The "Personal Finance Management Application" paper details the development of an Android-based mobile application with features like budgeting, financial reporting, and barcode scanning, addressing the need for localized financial tools; however, it is limited by the lack of cryptocurrency support, exclusive Android availability, a need for statistical validation, and limited analysis of emerging financial technologies. In contrast, "Budget Buddy" overcomes these limitations by potentially integrating cryptocurrency APIs, ensuring cross-platform compatibility through Next.js, continuously validating usability with data analytics and user feedback, and adapting to new technologies with its AI-driven approach, which also enables proactive financial advice, thus providing a more comprehensive and future-proof financial management solution.

These studies provide valuable insights into AI-powered financial management applications, emphasizing the importance of automation, secure data handling, and intelligent financial insights. Our project, Budget Buddy, builds on these findings by integrating AI-driven receipt scanning, automated budgeting, real-time transaction tracking, and secure authentication to enhance user financial management while maintaining privacy and security.

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III. PROPOSED METHODOLOGY

1. System Architecture:

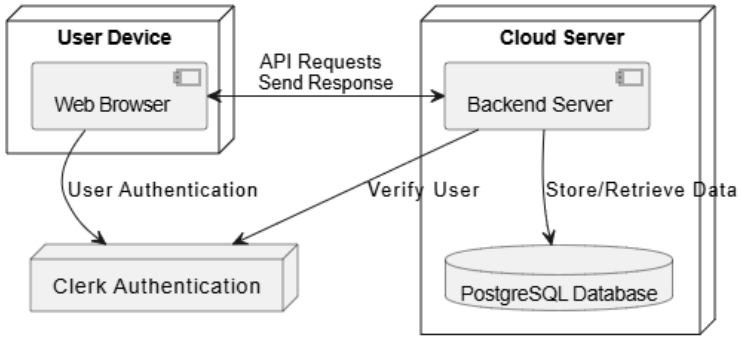

Fig. 1. System Architecture

The system architecture of Budget Buddy is designed as a modern, distributed web application with clear separation of concerns. The architecture consists of a user device (web browser) interacting with a cloud server infrastructure through a backend server. The system implements a robust authentication mechanism via Clerk Authentication, which verifies user credentials before allowing access to the application. The cloud server, represented by a backend server, manages API requests, user verification, and data interactions with a PostgreSQL database. This architecture ensures secure, efficient, and scalable financial tracking, with each component playing a critical role in delivering a seamless user experience.

2. Technology Stack:

Budget Buddy leverages a contemporary technology stack that prioritizes performance, scalability, and developer experience. Next.js serves as the primary web framework, providing server-side rendering and robust routing capabilities. Tailwind CSS handles styling with its utility-first approach, enabling rapid UI development. Supabase acts as the backend platform, offering authentication, real-time database functionality, and seamless integration with Prisma ORM for database operations. Clerk provides authentication services, ensuring secure user management. The application further incorporates Google Generative AI API for intelligent receipt scanning and transaction detail extraction, and Arcjet middleware for enhanced security through rate limiting and bot protection.

3. Key Technological Components:

Budget Buddy leverages a contemporary technology stack that prioritizes performance, scalability, and developer experience. Next.js serves as the primary web framework, providing server-side rendering and robust routing capabilities. Tailwind CSS handles styling with its utility-first approach, enabling rapid UI development. Supabase acts as the backend platform, offering authentication, real-time database functionality, and seamless integration with Prisma ORM for database operations. Clerk provides authentication services, ensuring secure user management. The application further incorporates Google Generative AI API for intelligent receipt scanning and transaction detail extraction, and Arcjet middleware for enhanced security through rate limiting and bot protection.

4. System Workflow:

The system workflow of Budget Buddy is a meticulously designed process that ensures smooth financial tracking and user interaction. When a user initiates an interaction, their web browser sends API requests through the Clerk Authentication layer for verification. Once authenticated, the backend server processes the request, communicating with the PostgreSQL database to store or retrieve financial data. For transaction entry, users can manually input details or leverage the Google Generative AI API for automatic receipt scanning. The system supports various operations like creating, editing, deleting, and filtering transactions. Monthly budget tracking is integrated with email notification systems that alert users when expenditures approach budget limits. Background processes managed potentially by Inngest handle recurring transactions, ensuring consistent financial record-keeping. The workflow is designed to be secure, intelligent, and user-friendly, with multiple layers of verification and smart data processing.

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IV. SECURITY IMPLEMENTATION

1. Authentication Mechanisms: Clerk Authentication:

Budget Buddy implements a robust authentication system powered by Clerk, offering multiple secure login methods to enhance user accessibility and security. The OAuth integration allows users to authenticate using trusted third-party providers, with Google Login providing a seamless and verified authentication pathway. Traditional password-based login is supported, complemented by a comprehensive "forgot password" feature that ensures users can securely recover account access. The authentication process includes multi-layered security checks, including email verification, device recognition, and optional two-factor authentication. By leveraging Clerk's advanced authentication framework, the application provides users with flexible yet highly secure access options that protect sensitive financial information while maintaining a user-friendly login experience.

2. Bot Protection: Arcjet Rate Limiting:

To safeguard the application against potential automated attacks and unnecessary system load, Budget Buddy employs Arcjet's sophisticated rate-limiting mechanism. The system restricts users to a maximum of 10 transactions per day, creating a robust defense against potential bot-driven abuse. The intelligent bot detection algorithm is strategically configured to allow access only to trusted entities such as search engines and Google's web crawlers. This selective approach ensures that legitimate automated services can interact with the platform while blocking malicious bot traffic. The rate-limiting strategy not only protects the system's resources but also maintains the integrity of user data by preventing potential automated scraping or attack attempts.

3. Input Validation: Zod Library:

Budget Buddy leverages the Zod library to implement comprehensive input validation, ensuring data integrity and preventing potential security vulnerabilities. Zod provides a TypeScript-first schema declaration and validation system that meticulously validates all user inputs before they are processed or stored in the database. This approach creates multiple defensive layers, protecting against common input-related security risks such as SQL injection, cross-site scripting (XSS), and malformed data submissions. By defining strict validation schemas for each input type—including transactions, user profiles, and configuration settings—the application ensures that only correctly formatted and sanitized data enters the system, significantly reducing the risk of data corruption or unauthorized data manipulation.

V. EXPERIMENTAL RESULTS AND ANALYSIS

1. Screenshots of the Application:

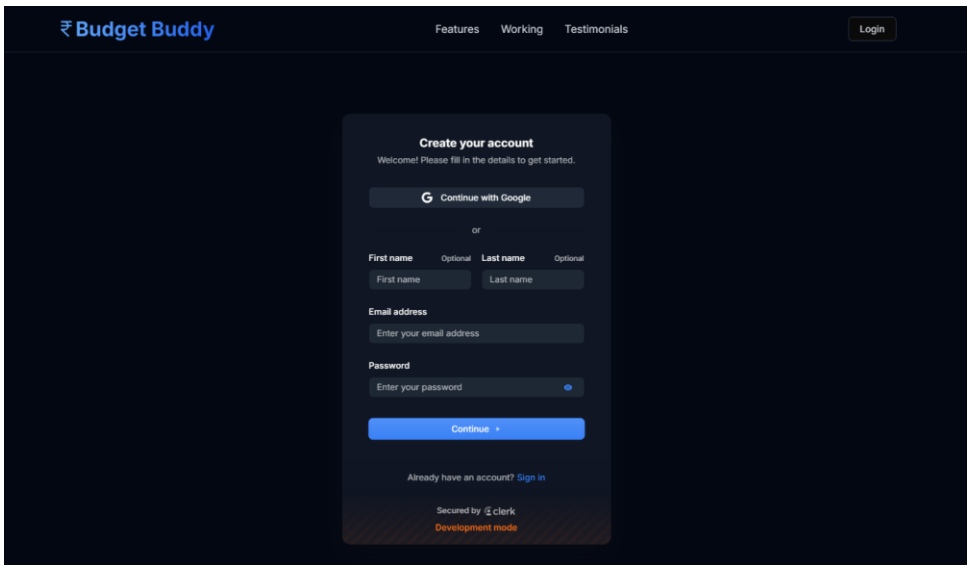

Fig. 2. Registration Page

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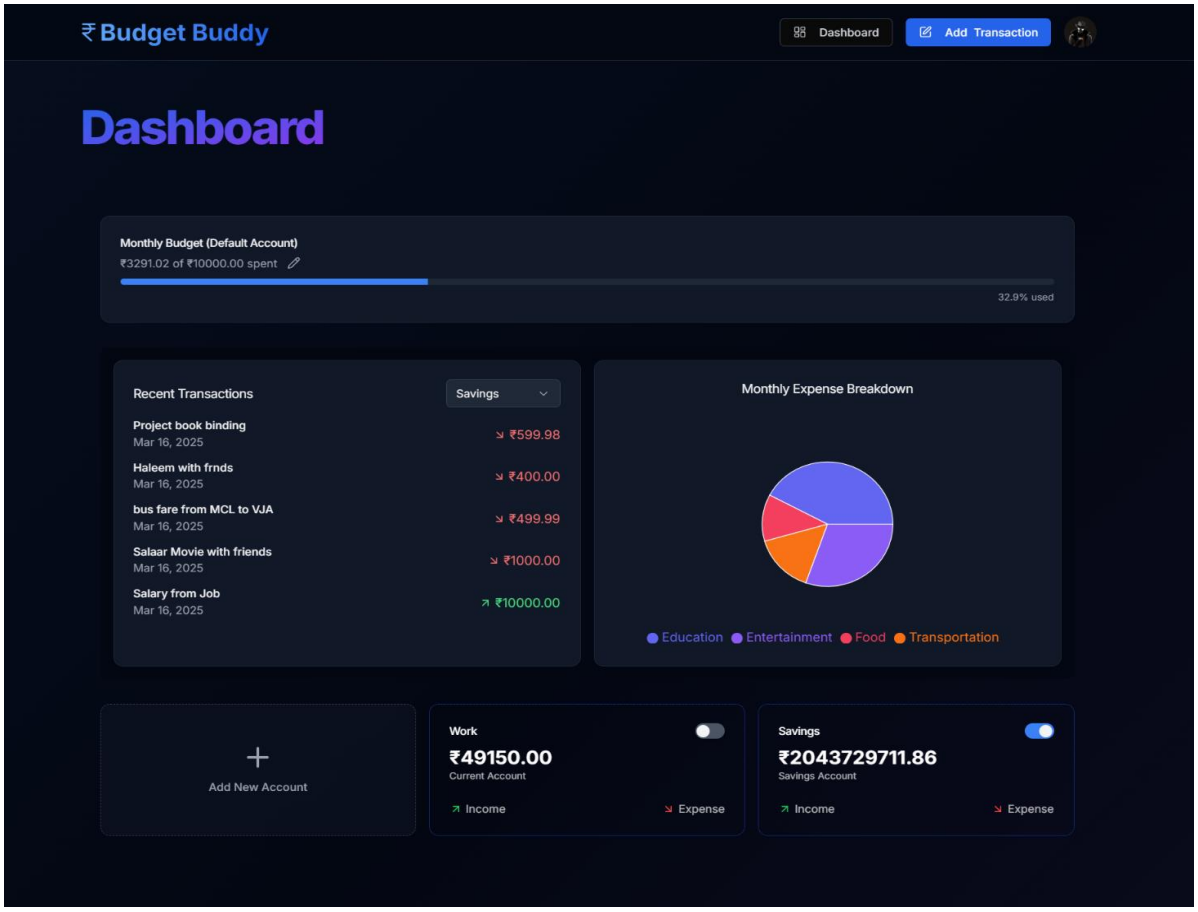

Fig. 3. Dashboard Page

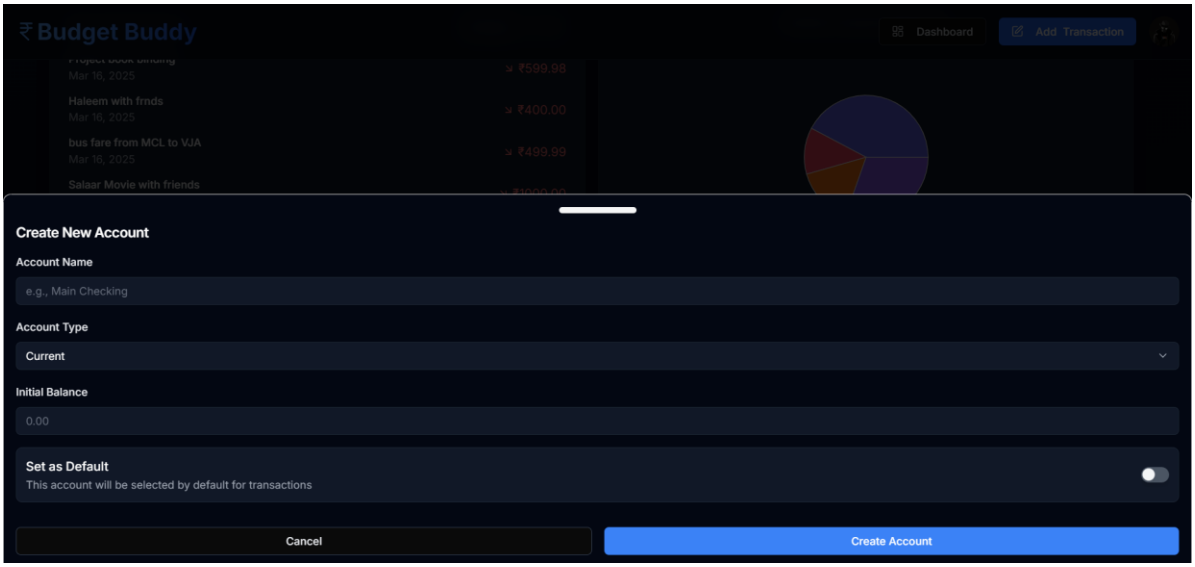

Fig. 4. Add New Transaction Account

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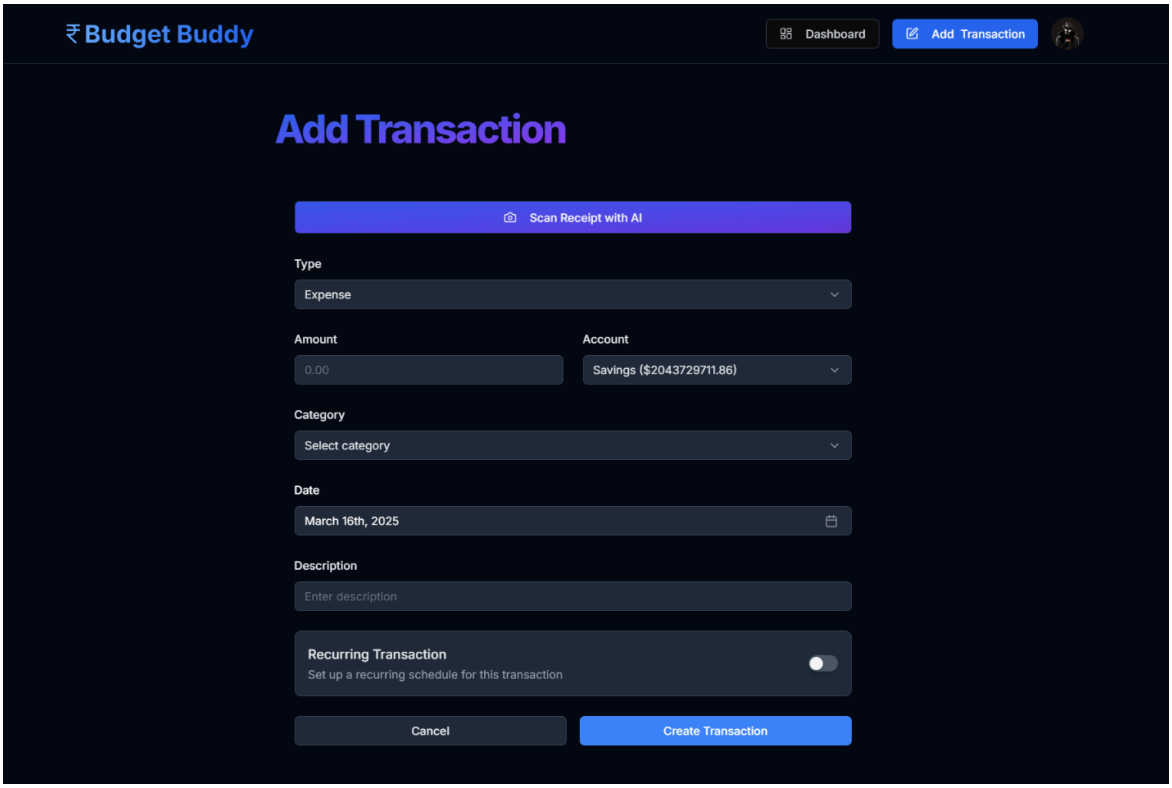

Fig. 5. Add New Transaction

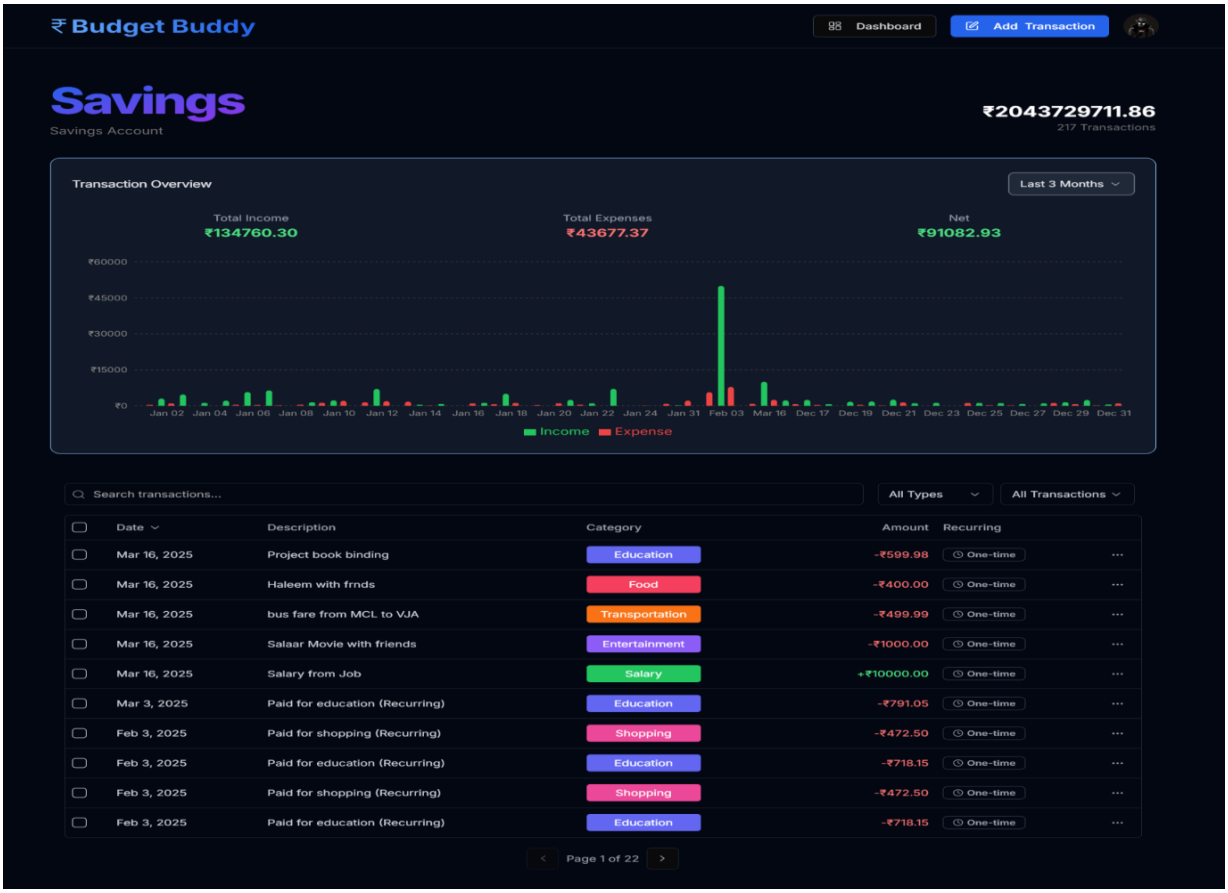

Fig. 6. Account page

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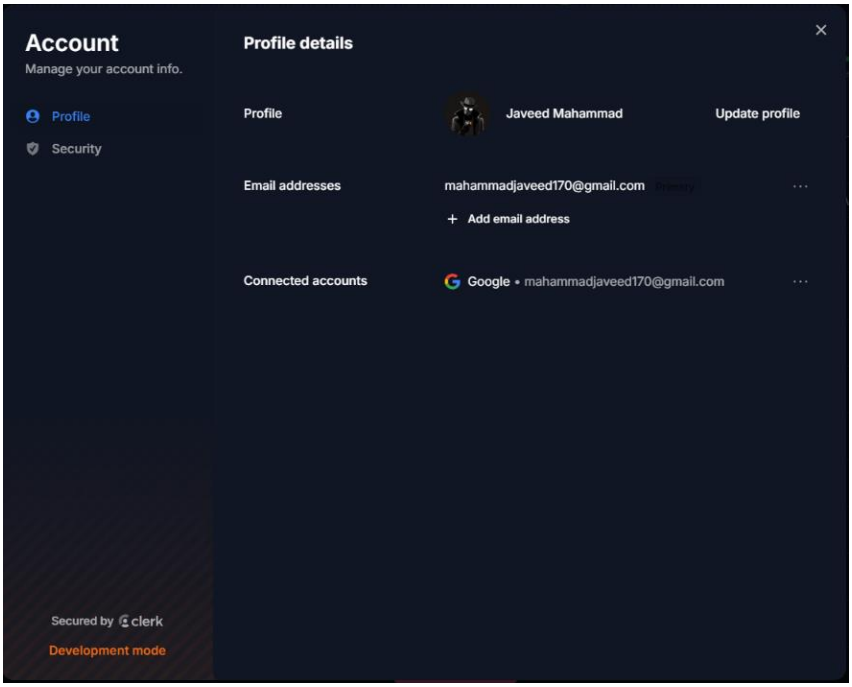

Fig. 7. Manage User accounts

2. Comparative Analysis:

Feature	Personal Finance Tracker [1]	Smart Expense Tracking [2]	Personal Finance Management App [3]	Budget Buddy
Automated Receipt Scanning	No	No	No	Yes (Google Gen AI)
AI-Powered Insights	No	Yes (Predictions)	No	Yes (Personalized)
Secure Authentication	Yes (Clerk)	No	No	Yes (Clerk)
Cross-Platform Support	Web-based	Not specified	Android Only	Yes (Next.js)
Data Quality Dependence	No	Yes (Limiting Factor)	No	Addressed (Google Gen AI)
Emerging Tech Integration	No	No	Limited	Yes (AI, APIs)

Table 1. Comparison with other works

Budget Buddy distinguishes itself from the other applications through its integration of advanced features such as automated receipt scanning powered by Google Generative AI and personalized AI-driven insights, enhancing user experience and accuracy. Unlike the 'Smart Expense Tracking (ML)' which relies on machine learning predictions and faces data quality dependencies, and the 'Personal Finance Management App' limited to Android and basic functionalities, Budget Buddy offers cross-platform support via Next.js and secure authentication through Clerk. Moreover, it actively addresses data quality limitations and integrates emerging technologies, setting it apart from the more traditional approaches of the 'Personal Finance Tracker' and the 'Personal Finance Management App', which primarily focus on core functionalities like budgeting and expense tracking.

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VI. CONCLUSION

Budget Buddy is a smart and secure financial management solution that simplifies expense tracking, budgeting, and financial analysis. With features like AI-powered receipt extraction, automated budget tracking, recurring transactions, and interactive data visualizations, users can efficiently manage their finances. Strong security measures, including Clerk authentication, Arcjet rate limiting, and bot protection, ensure data privacy, while Google AI integration enhances usability by automating transaction details. Rigorous testing confirmed system stability, with all test cases passing successfully.

Compared to traditional budgeting tools, Budget Buddy offers a more adaptive and intuitive approach, allowing users to automate financial tracking while maintaining control over their expenses. Features like budget alerts, multi-account management, and audit trails provide better financial oversight. With a scalable and efficient design, Budget Buddy has the potential for future enhancements like AI-driven financial insights and predictive analytics, making it a valuable tool for effective financial planning.

VII. FUTURE SCOPE

The future development of Budget Buddy aims to enhance its capabilities by integrating advanced AI-driven predictive analytics to forecast spending patterns and suggest optimized budgeting strategies. Security enhancements, such as biometric authentication and blockchain-based transaction verification, can further strengthen data protection. Expanding multi-currency support and international transaction tracking would make the platform more accessible to a global audience, catering to users with diverse financial needs.

Additionally, the integration of Open Banking APIs could enable real-time synchronization with bank accounts, allowing for seamless and automatic transaction updates. Future iterations may also include personalized financial coaching through AI-driven recommendations and chatbot assistance, helping users make more informed financial decisions. Enhancing compatibility with wearable devices and voice assistants would improve accessibility and convenience. With continuous advancements in automation, security, and user experience, Budget Buddy has the potential to evolve into a fully intelligent financial assistant, transforming the landscape of personal finance management.

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