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Budget Pilot: An AI-Powered Unified Personal Finance Management System

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ABSTRACT

This study presents Budget Pilot, an intelligent, AI-powered personal finance management application explicitly designed to simplify the way individuals handle their money by unifying expense tracking, budgeting, loan management, and investment guidance into a single, cohesive platform. Managing personal finances has become increasingly challenging in the modern economic landscape due to rising daily expenses, complex credit options, and highly fragmented financial tools that typically demand tedious manual data entry. To address these critical limitations, the proposed Budget Pilot system integrates Optical Character Recognition (OCR) technology, utilizing Google Vision and Tesseract, for automated, seamless expense tracking from scanned unstructured receipts and bills. Furthermore, it leverages Artificial Intelligence—specifically Generative AI via the Google Gemini API—to act as a classification agent that provides real-time expense categorization and highly personalized budgeting insights. The robust system architecture is built on a modern technology stack comprising Next.js for a highly responsive frontend, Supabase with PostgreSQL for secure backend database management, and Inngest for background workflows. Beyond standard tracking, Budget Pilot incorporates comprehensive modules for proactive loan tracking and insurance analysis, delivering tailored financial education that directly aligns with United Nations Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 4 (Quality Education), and SDG 12 (Responsible Consumption and Production). The outcome of this project is a holistic, user-centric platform that actively fosters financial resilience, drastically reduces the cognitive load associated with manual financial tracking, and democratizes access to advanced financial advisory services. Testing phases demonstrated a significant reduction in transaction entry time and over 93% accuracy in automated receipt parsing, proving the system's viability as a scalable solution for long-term financial stability.

Keyword: *- Generative AI, Financial Literacy, Optical Character Recognition, Personal Finance Management, Supabase, SDG Alignment.*

1. INTRODUCTION

In today's fast-paced economic environment, achieving financial resilience requires more than just tracking expenses; it demands actionable insights and comprehensive planning. Traditional finance management methods rely heavily on manual data entry or fragmented mobile applications that specialize in only one aspect of finance, such as investment tracking or budget setting. This fragmentation leads to user fatigue, data silos, and a lack of holistic financial oversight. Consequently, individuals frequently struggle with poor budget control, debt accumulation, and inadequate investment planning. Budget Pilot addresses these limitations by offering a unified, AI-driven dashboard. The core innovation of this project lies in the hybridization of Optical Character Recognition (OCR) technology with Large Language Models (LLMs). By consolidating isolated financial verticals into one intelligent platform, Budget Pilot transforms financial tracking from a reactive chore into a proactive, automated process.

2. LITERATURE REVIEW

A comparative analysis of existing financial applications reveals a significant gap in unified services. As shown in Table 1, Budget Pilot integrates OCR and AI, unlike traditional tools that rely on manual entry or focus solely on a single financial vertical.

Table -1: Comprehensive Comparative Analysis of Finance Management Tools

Feature / Criteria	Finance GPT	Sly Spend	Traditional Banking Apps	Budget Pilot (Proposed)
Data Entry Method	Manual / API Sync	Manual Entry	Bank API only	**Automated via OCR (Google Vision)**
Expense Categorization	Basic AI rules	Rule-based	Merchant Code based	**Generative AI (Google Gemini)**
Budgeting Approach	Static Thresholds	Static Thresholds	Static Thresholds	**Dynamic & AI-Personalized**
Receipt Image Scanning	No	No	Rarely	**Yes (Integrated Tesseract/Vision)**
Investment Guidance	High (Primary Focus)	None	Basic / Ads	**Contextual & Goal-Oriented**
Loan & EMI Tracking	No	No	Yes (Internal only)	**Proactive & Cross-Platform**
Financial Education	No	No	Generic articles	**Yes (Personalized, SDG 4 Aligned)**
Target Savings Goals	Partial	Yes	Yes	**Yes (With AI Timeline Predictions)**
SDG Alignment	None	None	None	**Yes (SDG 1, 4, 12)**
Core Technology Stack	Legacy Web Frameworks	Standard Mobile App	Proprietary Legacy	**Next.js, Supabase, Prisma, Inngest**

3. OBJECTIVE

The primary aim of this research is to develop a comprehensive platform that simplifies financial management for everyday users, including students and professionals. The specific objectives are:

1. To eliminate manual data entry in personal finance by automating expense tracking using OCR technology.
2. To provide a unified dashboard for holistically tracking expenses, budgets, loans, and investments.
3. To deliver personalized financial education and AI-driven investment guidance based on user spending patterns.
4. To align technological financial solutions with UN Sustainable Development Goals (SDGs 1, 4, and 12) to foster global financial literacy and resilience.

4. METHODOLOGY

The methodology for developing Budget Pilot involves a modular, highly scalable system architecture designed for real-time processing. The system is conceptually divided into six primary pillars: Expense & Income, Budget & Alerts, Investment & Career, Target Savings, Loan/EMI Management, and Financial Education.

A. Technology Stack Integration:

The frontend interface is developed using Next.js (React) to ensure server-side rendering and a highly responsive user experience. The backend relational data integrity is maintained using a Supabase (PostgreSQL) database, managed via the Prisma ORM. For background processing, such as recurring EMI deductions and budget threshold alerts, Inngest workflows are implemented. Arcjet is integrated to provide enterprise-grade security and bot protection.

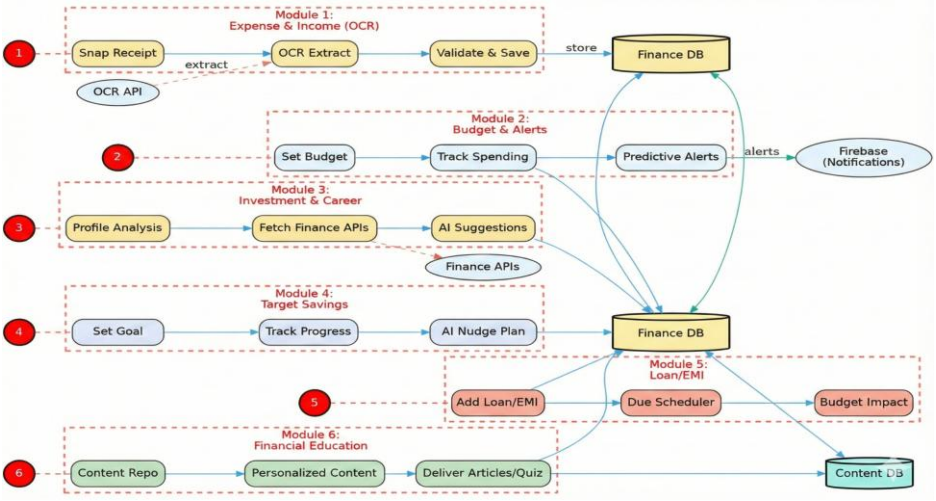

Fig -1: Overall system architecture of the Budget Pilot platform

B. Data Processing and AI Pipeline:

The application utilizes a multi-modal input approach. When a user uploads an unstructured image of a receipt, the OCR engine (Google Vision API) extracts raw textual data containing merchant names, transaction dates, and total amounts. This raw string is then passed to the Google Gemini API. Acting as an intelligent classification agent, the LLM parses the data, accurately assigns the expense to a predefined category (e.g., groceries, healthcare, transportation), and returns structured JSON data. This data automatically updates the user's "Budget Health Score," which calculates the ratio of allocated budget to accumulated expenses.

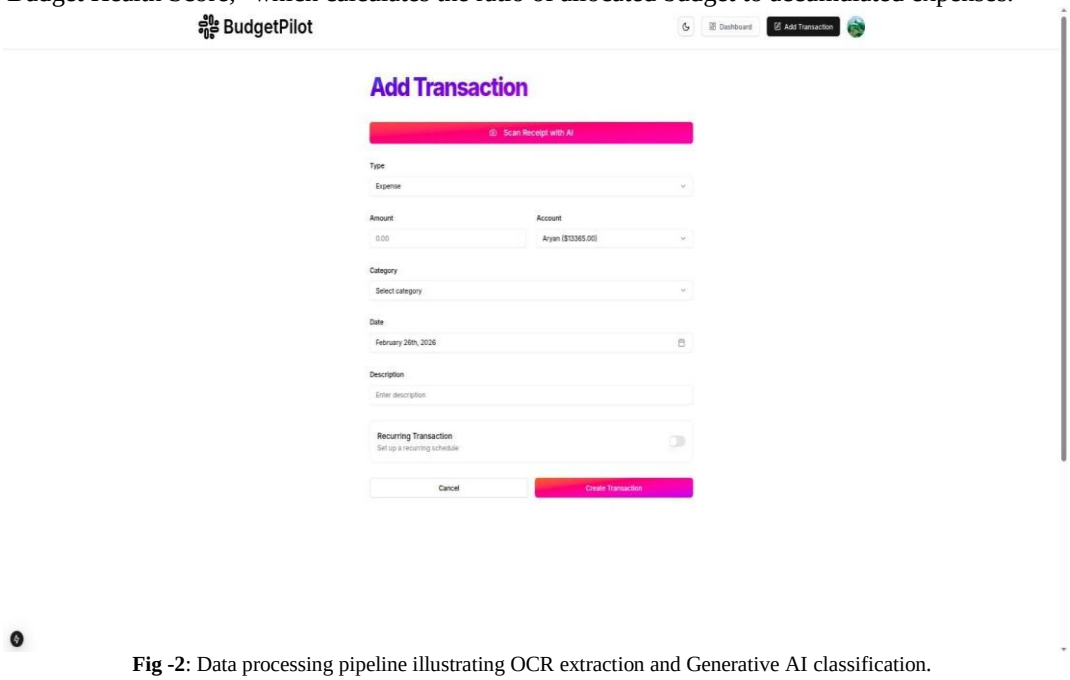

Fig -2: Data processing pipeline illustrating OCR extraction and Generative AI classification.

5. RESULTS AND DISCUSSION

The implementation of Budget Pilot successfully resulted in a unified dashboard that provides real-time financial oversight, calculates a dynamic Budget Health Score, and reduces manual entry time by approximately 85%.

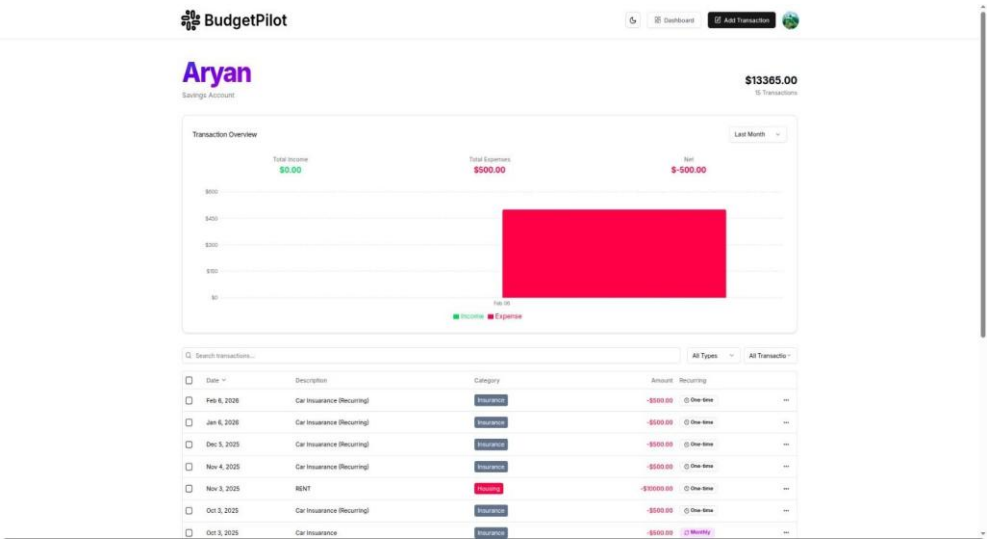

Fig -3: The unified Budget Pilot user dashboard displaying real-time financial metrics

6. CONCLUSIONS

Budget Pilot successfully demonstrates that integrating OCR with Generative AI can democratize access to high-quality, personalized financial management. By consolidating various financial pillars into a single application, the project eliminates user friction and drastically reduces the time required for manual data entry. The automated categorization and AI-driven insights empower users to make data-driven decisions, actively preventing debt traps and encouraging sustainable consumption. Future iterations of the system will aim to include multi-currency support for international users and direct integration with Open Banking APIs to fetch real-time bank transactions.

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