Smart Personal Finance Manager with Intelligent Reminders and Analytical Insights

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***Abstract*—Managing finances has become increasingly complex in an era dominated by digital payments, online subscriptions, and recurring financial commitments. Individuals often struggle to track due dates spread across fragmented sources such as SMS alerts, emails, and various service applications. This fragmentation results in missed payments, penalties, and inefficient financial planning. This research proposes an Smart Personal Finance Manager that automates bill tracking, generates intelligent reminders, predicts future expenses, and provides visually intuitive insights to enhance user decision-making and financial discipline. The system integrates machine learning algorithms, secure cloud-backed storage, real-time notifications, and behavioral analytics to enhance user engagement and financial discipline. Through automated reminders, forecasting models, and expense categorization, the proposed solution aims to reduce user burden, improve budgeting habits, and support long-term financial stability.**

***Index Terms*—Personal Finance, Bill Reminder System, MoM based bill prediction, Expense Forecasting, Mobile Application, Financial Planning.**

I. Introduction

The rapid rise of digital payments, subscriptions, and online billing has made transactions easier but has also fragmented financial information across UPI apps, bank portals, emails, and SMS alerts. Because this information is scattered, users frequently miss due dates, struggle to track monthly bills, and lack a consolidated view of their expenses. Existing reminder apps are mainly based on manual input and offer limited automation, resulting in inconsistent bill management. To overcome these problems, this project introduces a Progressive Web Application (PWA) that centralizes all bill-related data, automates reminders using rule-based logic, and presents a calendar-based visualization of upcoming and overdue payments. By integrating notifications, payments, and spending insights into one platform, the solution strengthens payment discipline and enables smarter, more organized financial planning.

II. Literature Survey

Research on digital personal finance management has progressed steadily with increasing adoption of online transactions and subscription-based services. Early studies focused on developing simple, web-based tools for payment tracking and organisation. Baibhav et al. [1] presented a basic system for recording bills and preventing missed payments, establishing the need for centralised financial information. Subsequent work expanded toward analytical budget planning. Grobler-Debska et al. [2] demonstrated the effectiveness of time-series methods and business-intelligence tools in improving budget forecasts, while Saini et al. [3] explored practical implementations of finance management applications.

Fintech adoption has been widely examined in behavioural and economic contexts. Handayani et al. [4] analysed app usage among millennials, identifying convenience and timely reminders as key drivers. Digital financial literacy also plays a major role; studies by Mishra et al. [5] and Amnas et al. [6] showed that informed users make better financial decisions and engage more confidently with digital finance platforms. The trend toward intelligent assistance is further supported by Agarwal et al. [7], who discussed personal finance assistants aimed at enhancing literacy and financial organisation.

Application-oriented developments continue to strengthen this field. Stefanov et al. [8] introduced a comprehensive personal finance management application with expense categorisation and visual insights, while Rani et al. [9] examined awareness of AI-powered financial services. Broader financial literacy insights are provided by Koskelainen et al. [10]. Technical enhancements such as chatbot interaction [11], simple re-

minder systems [12], and smart-finance frameworks [13] have improved user experience and accessibility. Gamified finance applications also demonstrate strong engagement outcomes [14].

Earlier foundational works include deep-learning surveys for financial analysis [15], IoT-based bill estimation systems [16], and studies on automated reminders improving credit outcomes [17]. Income-expense tracking models [18], notification-system research [19], and reviews on financial behaviour [20] further highlight the evolution of digital personal finance solutions.

III. Motivation

The system is motivated by several practical challenges faced by users. Financial information is scattered across SMS alerts, emails, service apps, and receipts, making it difficult to maintain a consolidated view of monthly expenses. The rise of subscription-based services further increases the number of recurring payments that users often forget.

Most existing reminder tools lack forecasting, spending trends, and budgeting assistance, leaving users unable to anticipate high-expense months. Missed payments frequently lead to penalties due to delayed reminders or oversight. Additionally, users follow different payment behaviors, requiring personalized reminder schedules rather than fixed notifications.

Managing multiple bills also increases cognitive load. Automating reminders, predictions, and expense tracking helps reduce this burden and supports better financial discipline.

IV. Problem Statement

Users face difficulty managing recurring bills because financial information is scattered across multiple platforms. Existing tools are dependent on manual entry and offer only basic reminders, providing little insight or automation. This highlights the need for a unified system across-devices that centralizes bills, automates notifications, and delivers clear, actionable spending insights.

V. Proposed Solution

The Smart Personal Finance Manager centralizes all bill-related information into a single PWA, automating reminders, payments, and spending insights. The system addresses data fragmentation across SMS, emails, and service portals by providing a unified, real-time financial management interface.

A. Key Features

- Simple bill entry with categories and priorities
- Automated recurring reminders via cron jobs
- Colour-coded calendar for overdue and upcoming bills
- Integrated Razorpay/UPI payments
- Dashboards showing totals, trends, and categories
- Secure MongoDB cloud storage
- PWA installation, caching, and offline use

B. System Architecture

A modular client–server architecture links a React PWA frontend, Node.js backend, MongoDB database, notification engine, and payment gateway, as illustrated in Fig. 1. The figure shows how user requests are processed by the backend, stored in the database, and coordinated with notification and payment services.

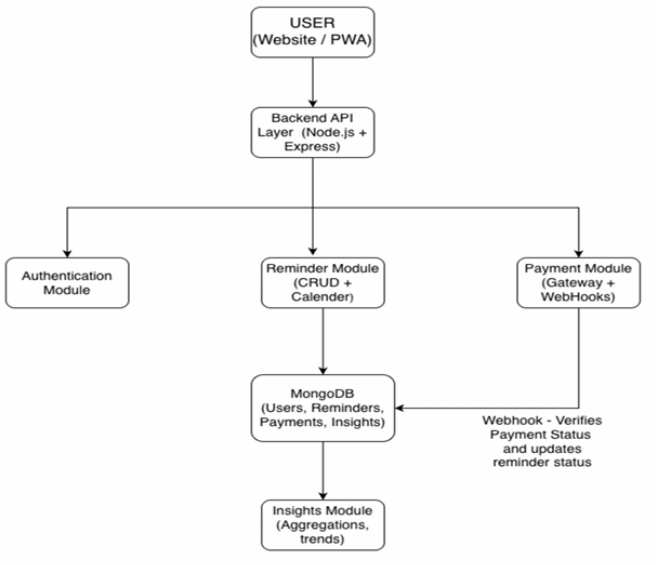

Fig. 1. Overall System Flow Diagram

C. Frontend Layer

The frontend supports authentication, bill management, dashboards, calendar visualization, notifications, and PWA features.

D. Backend Layer

The backend manages authentication, CRUD operations, reminder scheduling, payment processing, webhook verification, notifications, and data aggregation.

E. Database Design

1) User details: MongoDB stores users, bills, and transactions. The structure of the user information stored in the database is summarized in Table I.

Field	Description
userId	User identifier
email	Login email
deviceToken	Notification token
preferences	Reminder settings

TABLE I
User Details

2) Bills Collection: The bill-related attributes maintained by the system are listed in Table II.

billId	Bill identifier
category	Bill type
amount	Bill amount
dueDate	Due date
status	Paid/Unpaid/Overdue

TABLE II
BILLS DETAILS

3) Transactions Collection: The transaction records captured during payment processing are shown in Table III.

timestamp	Payment time
paymentMode	UPI/Card
billReference	Linked bill

TABLE III
TRANSACTION DETAILS

F. Notification Service

Brevo emails and PWA push alerts notify users of due, overdue, and same-day payments.

G. Payment and Notification Flow

The payment and notification flow is illustrated in Fig. 2, showing how payment requests are securely processed through the gateway and how confirmation triggers automated user notifications. It ensures real-time payment status updates and timely reminder delivery.

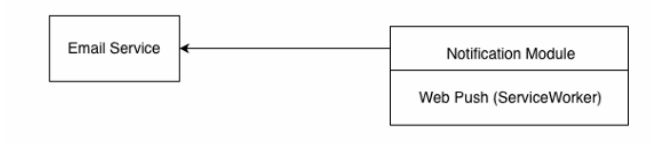

Fig. 2. Payment and Notification Flow

H. Data Flow

1) User adds bill.
2) Cron detects upcoming dues.
3) Email/push reminders sent.
4) User pays via Razorpay.
5) Webhook verifies and updates status.
6) Dashboard insights refreshed.
7) PWA provides offline access.

I. System Modules

Authentication, bill management, reminders, insights, and payment modules work together to deliver seamless financial organization.

J. Performance

Optimized MongoDB queries, asynchronous backend operations, and PWA caching ensure smooth performance and reliability.

VI. METHODOLOGY

The system adopts a modular and algorithm-driven methodology. Features such as reminders, payments, analytics, notifications, and PWA caching operate as independent modules to ensure scalability and simple maintenance.

A. Module-Based Development

The architecture is divided into functional modules for:

- Reminder processing
- Calendar and priority mapping
- Payment handling
- Insights and analytics
- Notification delivery
- Offline caching (PWA)

B. Algorithm-Centric Implementation

Core operations rely on lightweight deterministic logic, including date-difference reminder checks, priority assignment, colour-coded calendar mapping, secure payment verification, and MongoDB aggregation for analytical outputs. A service worker enables offline capabilities.

C. Automated Scheduling and Notifications

A daily cron job identifies upcoming and overdue bills and triggers email or in-app notifications. The PWA service worker ensures alerts remain functional even when the app is inactive.

D. Data Processing and Insight Generation

The system computes several financial indicators for the dashboard.

1) Total Unpaid Bills:

$$\text{TotalDue} = \sum_{i=1}^{n} (amount_i \cdot 1(is\_paid_i = false)) \quad (1)$$

2) Total Paid Amount:

$$\text{TotalPaid} = \sum_{i=1}^{n} (amount_i \cdot 1(is\_paid_i = true)) \quad (2)$$

3) Upcoming Payments (7 Days):

$$Upcoming = \{r_i \mid 0 \leq due\_date_i - today \leq 7\} \quad (3)$$

4) Monthly Spending:

$$MonthlySum(m) = \sum_{i:month(r_i)=m} amount_i \quad (4)$$

5) Daily Totals:

$$DailyTotal(d) = \sum_{i:date(r_i)=d} amount_i \quad (5)$$

6) Month-over-Month Change:

$$MoM = \begin{cases} 0, & y_t = 0 \wedge y_{t-1} = 0 \\ 100, & y_{t-1} = 0 \wedge y_t > 0 \\ \frac{y_t - y_{t-1}}{y_{t-1}} \times 100, & otherwise \end{cases} \quad (6)$$

7) Category Breakdown:

$$CategoryTotal(c) = \sum_{i:category(r_i)=c} amount_i \quad (7)$$

8) Days Left:

$$DaysLeft = \frac{due\_date - today}{24 \times 60 \times 60 \times 1000} \quad (8)$$

9) Budget Usage:

$$BudgetUsed\% = \min(100, (\frac{TotalDue}{Budget}) \times 100) \quad (9)$$

E. Prediction Algorithms

Three classical forecasting techniques are used.

1) Weighted Prediction:

$$\hat{y}_{t+1} = w \cdot y_t + (1 - w) \cdot y_{t-1} \quad (10)$$

$$\hat{y}_{t+1} = \min(\hat{y}_{t+1}, clip \cdot y_t) \quad (11)$$

2) Linear Trend:

$$\hat{y}_{t+1} = y_t + (y_t - y_{t-1}) \quad (12)$$

3) Average Prediction:

$$\hat{y}_{t+1} = \frac{y_t + y_{t-1}}{2} \quad (13)$$

F. Payment Verification and State Updates

Payment gateways send verification callbacks, after which the system updates bill status and recalculates insights. Manual updates follow the same pipeline.

G. Frontend Logic and Performance

React components render bills, calendar views, charts, and priorities. PWA caching accelerates load times and supports offline use. Background workers enable non-blocking operations.

H. Overall Flow Summary

The overall system workflow is illustrated in Fig. 3, which shows the sequential interaction between the user, frontend interface, backend server, database, notification engine, and payment gateway. It highlights the end-to-end data flow from user input to reminder generation and payment confirmation.

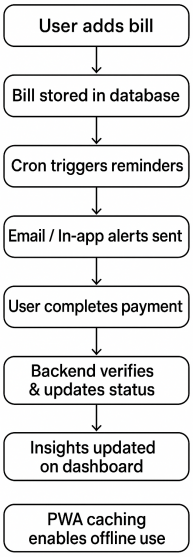

Fig. 3. Flow Diagram

VII. Results and Discussion

The implemented system integrates reminder management, automated notifications, payment processing, progressive web application (PWA) capabilities, and analytical insights into a unified bill-management platform. The system's functional outcomes and interface results are illustrated in Figs. 4–10, while this section presents the performance and outcomes in a structured IEEE-style tabular format.

A. Summary of Results

The performance of reminder creation and calendar updates is presented in Table IV.

Feature	Observed Result
Reminder Creation/Editing	Users successfully created, edited, and deleted reminders. All updates were stored in MongoDB and reflected instantly on the frontend.
Calendar View	A colour-coded calendar clearly displayed upcoming, overdue, and paid bills, improving user clarity.
Real-time Updates	Frontend updated automatically upon any CRUD action.

TABLE IV
Reminder Management Results

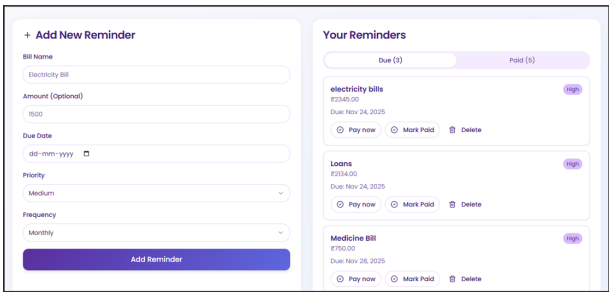

Fig. 4. Reminders Screen

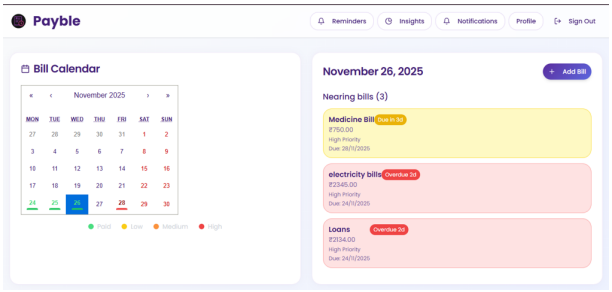

Fig. 5. Dashboard and Calendar Screen

The reliability of scheduled alerts and notification delivery is evaluated in Table V.

Feature	Observed Result
Cron-Based Alerts	Daily reminders executed at 8 AM using rule-based scheduling.
Email Notifications	Correctly delivered email alerts for upcoming, overdue, and same-day dues using Brevo API.
In-App Notifications	PWA service worker showed browser notifications when the user was active online.
Spam Prevention	No duplicate or unnecessary notifications were triggered.

TABLE V
AUTOMATED NOTIFICATION RESULTS

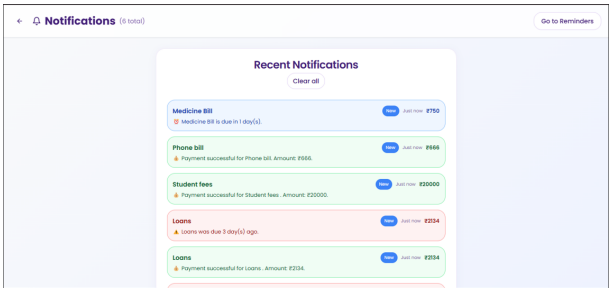

Fig. 6. Notifications Screen

The performance of digital payment handling and verification is summarized in Table VI.

Feature	Observed Result
UPI/Razorpay Payments	Users completed secure digital payments directly inside the application.
Webhook Verification	Backend correctly validated payment status and updated bill records accordingly.
Instant Status Update	Insights and calendar reflected the updated "Paid" status immediately.
Manual Payment Support	Users could manually mark bills as paid when paying externally.

TABLE VI
PAYMENT INTEGRATION RESULTS

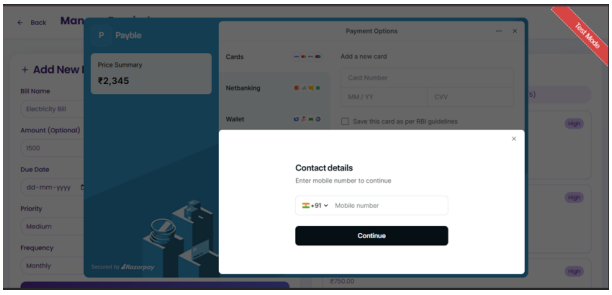

Fig. 7. Razorpay Dashboard

The accuracy of analytical outputs and visual indicators is reported in Table VII.

Insight Output	Observed Result
Monthly Spending	System computed total monthly expenditure accurately.
Previous Month Comparison	Displayed increase/decrease percentage clearly.
Category-Wise Trends	Visual charts improved understanding of spending habits.
Overdue/Upcoming Counts	Correctly calculated counts for planning.
UI Experience	Skeleton loaders ensured smooth experience.

TABLE VII
INSIGHTS AND ANALYTICS RESULTS

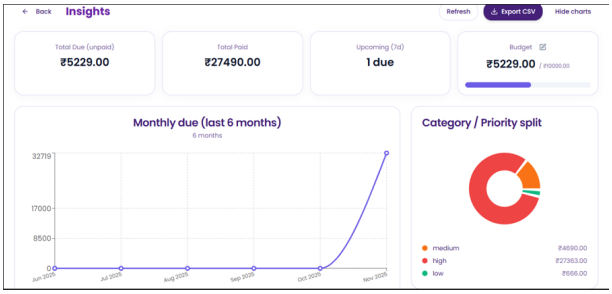

Fig. 8. Graphical Representation of monthly bills and priority splits

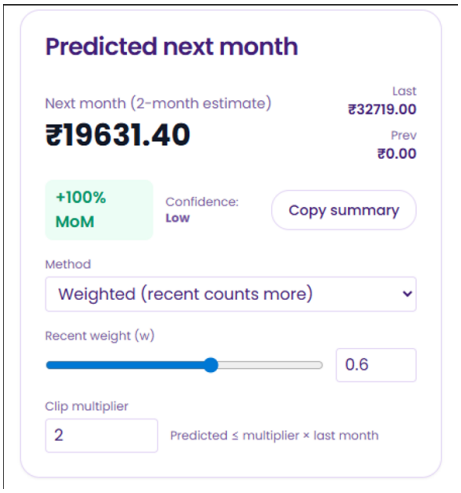

Fig. 9. Next Month prediction system

Fig. 10. Graphical representation of previous 30 days bills

The application's progressive web capabilities and offline performance are summarized in Table VIII.

Feature	Observed Result
Load Speed	Fast loading facilitated by Vite optimization.
Offline Support	Cached assets allowed offline access to UI components.
Cross-Platform Support	Smooth experience across Android, iOS, Windows, macOS.
Add-to-Home-Screen	PWA installation worked reliably.

TABLE VIII
PWA PERFORMANCE RESULTS

VIII. CONCLUSION AND FUTURE WORK

The system simplifies bill management by unifying reminders, payments, and visual insights into a single platform. Automated notifications, colour-coded calendars, and clear spending summaries help users stay updated on upcoming and overdue bills. With a responsive frontend and reliable backend, the application achieves its goal of providing an organized, user-friendly bill-tracking experience while forming a solid base for future enhancements.

Future improvements will focus on increasing intelligence and personalization. A chatbot will be introduced for natural-language queries, enabling quick access to due bills and spending details. Additional budgeting features—such as income tracking, savings analysis, and personalized financial suggestions—will further enhance user support. These upgrades will develop the system into a more comprehensive personal finance assistant.

The overall system reliability, scalability, and responsiveness are evaluated in Table IX.

Aspect	Observed Result
API Performance	Quick responses with efficient routing and optimized queries.
Module Interaction	All modules—reminders, payments, insights, notifications—worked smoothly together.
Scalability Readiness	Stable behaviour observed under typical load; modular backend reduces conflicts.
Data Flow	Seamless communication between frontend, backend, and database.

TABLE IX
SYSTEM RELIABILITY AND RESPONSIVENESS

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