BnBudget: Real-Time Airbnb Property Management and Financial Analytics Platform

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***Abstract*—Abstract—BnBudget is a modular Airbnb Expense Management System designed to empower small-scale rental hosts with transparent, real-time visibility into property profitability. It integrates a React + Vite frontend deployed on Vercel, a Flask backend, a PostgreSQL database hosted on AWS RDS, Apache Kafka for real-time data streaming, and interactive Metabase dashboards — all orchestrated through Docker Compose. This project stands apart from generic budget software by focusing on ingestion-to-insight automation using real-time pipelines tailored for Airbnb income and expense tracking. The system emphasizes modularity, scalability, and simplicity, making it ideal for independent property managers.**

I. Motivation and Problem Statement

Managing short-term rentals on platforms like Airbnb often involves more than just accepting bookings. Hosts frequently struggle with fragmented financial visibility — tracking income from Airbnb separately, manually logging expenses for cleaning, maintenance, utilities, or supplies, and compiling profitability data only during tax season or major financial reviews.

While enterprise-level property management tools like Hostaway and Lodgify offer advanced automation, they are often expensive for small-scale hosts managing 1–3 properties, overwhelming with irrelevant features, and closed-source or rigid in data integration.

BnBudget addresses this niche — individual or small-group Airbnb hosts — who need a lightweight, modular, and open system to:

- Automatically sync booking income (via CSV/API)
- Track property-level expenses across categories (utilities, repairs, cleaning)
- Visualize trends and profits in Metabase dashboards
- Integrate with Kafka to automate reporting workflows

II. System Architecture Overview

The BnBudget system consists of:

- **Frontend:** React app with CSV upload and login/register interface
- **Backend:** Flask API for authentication, properties, booking, and expense endpoints
- **Database:** PostgreSQL for storing owners, properties, bookings, expenses
- **Kafka:** Streaming property-level bookings and expenses
- **Vercel:**Deploys the frontend globally with secure HTTPS, optimized build pipelines, and CDN-backed performance
- **Metabase:** Dashboards shown under View Financials

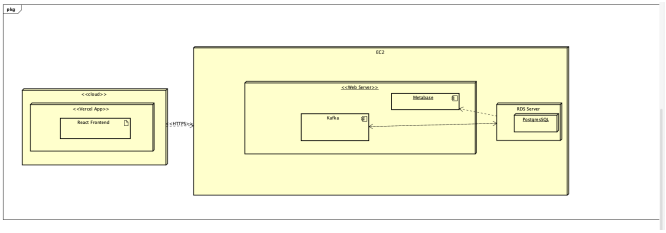

Fig. 1: BnBudget System Architecture Flow Diagram

A. Real-Time Data Pipeline Flow

It shows how booking and expense events are propagated through the BnBudget pipeline — from the frontend input to Kafka, stored in PostgreSQL, and visualized in Metabase.

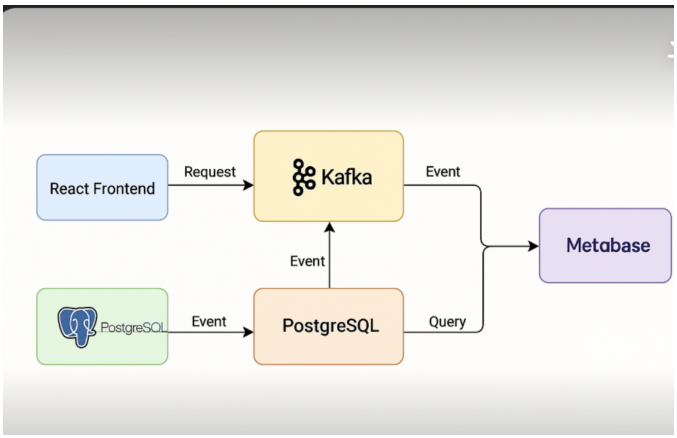

Fig. 2: Real-time data pipeline flow in BnBudget from input through Kafka to PostgreSQL and Metabase.

III. Key Interfaces

The frontend consists of multiple key views:

- **Login and Register**
- **Properties Page**
- **Expense and Booking Dashboards**
- **Financial Dashboard (Metabase Embedded)**

IV. Docker-Based Deployment

All services are containerized using Docker Compose:

- Backend: `localhost:5001`
- Frontend: `localhost:3001`

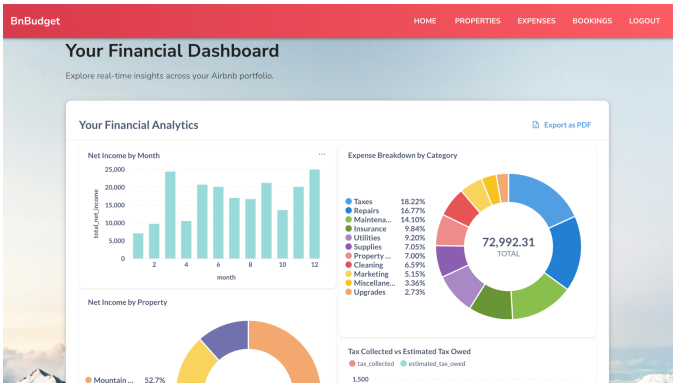

Fig. 3: BnBudget Financial Dashboard with Real-Time Analytics

V. Conclusion and Future Work

BnBudget demonstrates the feasibility of building a full-stack DataOps-driven solution for a real-world niche problem. Future improvements include:

- Integrating Airbnb APIs for real-time booking income ingestion
- Incorporating Grafana and Prometheus for observability
- Adding ML-based profitability forecasting within Metabase
- Role-based access control and audit logging for enterprise readiness