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Budget Guru: Navigating Local Markets for Affordable Groceries

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Abstract: *In today's fast-paced and inflation- driven economy, consumers struggle to find affordable grocery options while supporting local vendors. Budget Guru is an AI-powered web and mobile platform designed to address this challenge by providing real-time grocery price comparisons from nearby local shops using GPS. The platform integrates machine learning algorithms for price forecasting, a smart shopping route planner, and a profit calculator to help users make cost-effective purchasing decisions. Additionally, Budget Guru promotes local businesses by enhancing their visibility and enabling digital transactions, fostering a community-oriented shopping experience. This paper presents the system's architecture, implementation methodology, and impact assessment. Results from initial testing indicate that Budget Guru significantly enhances consumer savings and vendor participation, demonstrating its potential to revolutionize smart shopping through technology-driven affordability.*

Keywords: *Artificial Intelligence, Machine Learning, Smart Shopping, Budget Optimization, E-commerce.*

1. INTRODUCTION

In recent years, the cost of groceries, vegetables, and essential commodities has been steadily rising due to inflation, supply chain disruptions, and market fluctuations. Consumers, particularly those in urban and semi-urban areas, often struggle to find the best prices for their daily essentials. Traditional price comparison methods, such as visiting multiple stores or relying on word-of-mouth, are time- consuming and inefficient. On the other hand, local vendors and small grocery stores face stiff competition from large supermarket chains and e-commerce platforms, which offer competitive pricing and convenience through digital solutions. This imbalance in the market creates a pressing need for a technology-driven approach that benefits both consumers and local vendors. To address this challenge, we propose Budget Guru, an intelligent web and mobile platform that enables users to compare grocery prices from nearby local stores in real-time. The platform leverages GPS-based location tracking, machine learning algorithms, and data analytics to provide the most affordable shopping options. Additionally, it offers features such as a profit calculator, smart shopping route planner, and home delivery integration, making it a one-stop solution for cost-conscious Consumers. By aggregating data from various local vendors, Budget Guru enhances price transparency and empowers customers to make informed purchasing decisions. Simultaneously, it helps small businesses stay competitive by increasing their visibility and customer reach.

1.1 Problem Statement

Despite the growing adoption of e-commerce platforms, many consumers still prefer purchasing groceries from local markets due to affordability, convenience, and trust. However, they lack an efficient way to compare prices across multiple stores. Similarly, local vendors, who often struggle to digitize their operations, miss out on potential customers due to limited online presence. The absence of a real-time, location-based price comparison system results in inefficient spending and lost business opportunities.

1.2 Objectives of the Study

The primary objective of this research is to develop a smart grocery price comparison system that benefits both consumers and local vendors. The specific objectives are:

To design a GPS-based web and mobile platform that compares grocery, vegetable, and fruit prices in real time. To implement machine learning algorithms for price trend analysis and forecasting. To develop a profit calculator that allows users to estimate potential savings. To provide a smart shopping route planner that optimizes store visits for cost-effective shopping to integrate a home delivery feature, supporting local vendors in reaching a wider customer base. To promote local businesses by providing them with a digital storefront and customer engagement tools.

1.3 Significance of the Study

This study holds immense significance in addressing financial constraints faced by consumers while simultaneously supporting small businesses. The potential impact of Budget Guru is threefold:
For Consumers: The platform helps individuals and families save money on groceries by identifying the best local deals. It eliminates the need for manual price comparison, saving time and effort. For Local Vendors: Small grocery shops, fruit sellers, and vegetable vendors gain a digital presence, attracting more customers and competing with large retail chains. For the Economy: Encouraging local shopping reduces reliance on supermarket chains and promotes economic circulation within communities.

1.4 Research Contributions

The key contributions of this research are:
A novel AI-powered price comparison system that utilizes real-time data collection and machine learning for grocery shopping optimization. A user-centric mobile and web platform that integrates GPS tracking, predictive analytics, and smart shopping route planning. A digital support system for local vendors, enabling them to list prices, offer promotions, and expand their customer base. An analysis of consumer savings and vendor participation, highlighting the socio-economic impact of technology-driven grocery shopping.

2. LITERATURE REVIEW

The field of grocery price comparison and local vendor digitization has evolved significantly with the rise of artificial intelligence, machine learning, and GPS- based location services. Various approaches have been explored to enhance price transparency, optimize shopping routes, and support small vendors in a competitive market. This section presents a review of existing literature, highlighting key methodologies, their limitations, and how Budget Guru aims to address these gaps.

2.1 Price Comparison Systems

Several research studies have focused on price comparison systems that allow users to compare prices of products across different stores.

2.1.1Web-Based Price Comparison

One of the earliest works in price comparison is by Bakes (1997) [1], which introduced electronic marketplaces that aggregate product prices from multiple sellers to help consumers make informed decisions. However, these systems primarily focus on e- commerce platforms, neglecting the needs of consumers who prefer local shopping. More recent studies, such as Agarwal & Kumar (2018) [2], explored dynamic price comparison algorithms that fetch real-time data from online retailers. These systems efficiently compare prices but fail to consider location-based factors and physical store variations in pricing.

2.1.2 Mobile-Based Price Comparison

Mobile applications have revolutionized price comparison by allowing users to scan product barcodes and compare prices. Research by Smith et al. (2020) [3] presented a mobile app that crowd sources pricing data from users. However, data accuracy and user participation remain challenges in such crowd sourced models. Unlike Existing models, Budget Guru provides an automated AI-powered price retrieval system that collects and updates prices from multiple vendors without requiring manual input from users.

2.2 GPS-Based Location Tracking for Shopping Optimization

Several studies have explored location-based services (LBS) for optimizing shopping experiences.
Kannan et al. (2019) [4] introduced a GPS- integrated shopping assistant that suggests nearby stores based on user preferences. However, this system does not include a price comparison feature, making it less effective for cost-conscious shoppers. A study by Park & Choi (2021) [5] analysed shopping route optimization using GIS (Geographic Information System), but it was primarily designed for large retail chains rather than local vendors.

Budget Guru extends these methodologies by integrating GPS-based price tracking with AI-driven recommendations, ensuring users get the best deals from stores within their vicinity.

2.3 AI and Machine Learning in Price Forecasting Machine learning has been increasingly used for predictive price modelling in e-commerce and retail.

Patel et al. (2020) [6] developed a machine learning model to predict future grocery prices based on historical trends. While useful, their system was limited to large-scale retail stores. Similarly, Zhou et al. (2022) [7] applied deep learning techniques for price forecasting, but their model required large datasets, which may not be available for local grocery markets. Unlike these models, Budget Guru applies lightweight ML algorithms to forecast price trends using limited local vendor data, ensuring real-time accuracy even with smaller datasets.

2.4 Smart Shopping Route Planning

Research in route optimization has significantly improved the efficiency of shopping experiences.

Dijkstra's Algorithm and A* Search have been widely used for shortest path determination in applications like Google Maps [8]. A study by Lee & Wang (2019) [9] proposed a multi-objective route optimization technique that balances travel cost with shopping discounts. However, their approach does not include real-time price comparison integration. Budget Guru enhances shopping efficiency by integrating AI-based route optimization, allowing users to minimize travel time while maximizing savings.

2.5 Supporting Local Vendors in Digital Markets

The digital transformation of small businesses has been an area of growing research interest.

A study by Johnson & Clark (2021) [10] examined how mobile applications can improve customer engagement for small retailers. Another study by Srinivasan et al. (2022) [11] highlighted the role of digital payment integration in boosting local vendor sales. Budget Guru supports local vendors by providing them with a digital storefront, automated pricing tools, and customer insights, enabling them to compete effectively with large supermarkets. The Budget Guru system is designed to provide users with a real- time grocery price comparison platform that integrates GPS- based store tracking, AI-driven price analysis, and smart shopping route optimization. The methodology behind this system includes data collection, pre-processing, AI-based price forecasting, route optimization, and vendor support. This section explains the architecture, components, and algorithms that drive Budget Guru's functionality.

3. PROPOSED METHODOLOG

3.1 System Architecture

The architecture of Budget Guru follows a modular approach consisting of:

1. User Module – A mobile and web-based platform where users can compare prices, find optimal shopping routes, and place orders.
2. Vendor Module – A web-based interface where local grocery vendors can update stock, set prices, and manage orders.
3. AI-Based Price Prediction Engine – Uses machine learning to forecast price trends and analyze user spending patterns.
4. GPS-Based Store Locator – Identifies nearby grocery stores and compares prices across them.
5. Smart Shopping Route Planner – Determines the best shopping route to minimize travel cost and maximize savings.
6. Payment & Order System – Integrates UPI, wallets, and cash-on-delivery option.

3.2 Data Collection and Pre-processing

3.2.1 Data Sources

- Budget Guru gathers pricing data from multiple sources:
- Vendor-provided data – Registered vendors can update prices via the platform.
- Crowd sourced data – Users can scan product barcodes and upload prices.
- Automated Web Scraping – Extracts pricing details from local supermarket websites.
- Government Market Databases – Uses datasets from APMC (Agricultural Produce Market Committee) to ensure authenticity.

3.2.2 Data Pre-processing

Raw data from different sources undergoes pre-processing to ensure accuracy:

- Data Cleaning – Removing incorrect or outdated prices.
- Standardization – Normalizing pricing units (e.g., per kg, per liter).
- Duplicate Handling – Resolving conflicts in multiple entries for the same item.
- Error Correction – AI algorithms detect and flag abnormal price spikes or inconsistencies.

3.3 AI-Based Price Prediction and Analytics Budget Guru integrates AI and Machine Learning (ML) to provide predictive insights on grocery prices. The system employs:

3.3.1 Price Prediction Model

- We use a Hybrid Time-Series Forecasting Model, which combines:
- Long Short-Term Memory (LSTM) Networks – To predict future price trends based on historical pricing data.
- Regression Analysis – To identify seasonal pricing trends for perishable goods like vegetables and fruits.
- XGBoost Model – To account for external factors such as inflation, demand surges, or festival-based price hikes.

Formula for Price Prediction:

Pt=αPt−1+β·X+ϵP_t = \alpha P_ {t-1} + \beta \cdot X + \epsilonPt=αPt−1+β·X+ϵ where:

- PtP_tPt is the predicted price at time ttt,
- Pt−1P_ {t-1} Pt−1 is the previous price,
- XXX represents external influencing factors,
- A, β\alpha, \betaα, β are weighting parameters,
- ϵ\epsilonϵ is the error term.

3.4Smart Shopping Route Optimization

Budget Guru helps users optimize their shopping route based on travel distance, fuel cost, and price savings.

3.4.1 Route Optimization Algorithm

The system employs Dijkstra's Algorithm and A (A-Star) Search Algorithm* to compute the shortest and most cost- effective route.

Input Parameters:

- User's location (GPS coordinates).
- Store locations with price details.
- Road conditions and traffic data.
- Select route with lowest cost and highest savings.

Provide user with step-by-step navigation to complete them Shopping.

3.5 Vendor Support and Digital Integration

3.5.1 Vendor Registration System

To encourage local vendor participation, Budget Guru provides a vendor-friendly web portal where sellers can:

- Register their store and upload product prices.
- Receive AI-driven sales forecasts to adjust pricing strategies.
- Enable UPI-based digital payments for customers.
- Offer discounts or combo deals to attract more buyers.

3.5.2 AI-Powered Profit Calculator for Vendors

An AI-driven profit calculator helps vendors determine optimal pricing strategies by analysing

- Competitor pricing in the same area.
- Customer demand trends using past transaction data.
- Discount impact analysis to balance sales volume and profit margins.

3.6 Security and Privacy

Since Budget Guru involves financial transactions and user location tracking, robust security measures are implemented:

3.6.1 Data Encryption

All data is AES-256 encrypted to prevent unauthorized access.

3.6.2 Secure Login Mechanism

Users and vendors must authenticate via OTP- based verification or biometric authentication.

3.6.3 Privacy Protection
No user data is shared with third parties.

3.7 Implementation Tools and Technologies

Technology	Purpose
Flutter	Mobile App Development
Next.js + Express.js	Web Platform Backend
TensorFlow + XGBoost	AI/ML for price prediction
Google Maps API	GPS-based store locator and navigation
MySQL + Firebase	Database and real-time synchronization
Razorpay API	Payment Integration

4. EXPERIMENTAL RESULTS

In this section, we explain how we tested our project Budget Guru in the real world and what results we got. We focused on how well the system works, how much money users can save, how vendors benefit, and how the overall experience was for everyone involved.

4.1 Where and How We Tested
- Location: We tested in Eluru City, Andhra Pradesh, India.
- Users: Over 100 local people helped us test the app.
- Shops: We added 25 local grocery shops to the platform.
- Devices Used: Basic Android smartphones with GPS.
- Timeframe: The test ran for 30 days.
-

4.2 What We Measured
We used some important measures to check how useful our system was:

What We Measured	Why It Matters
Price Accuracy (%)	How accurate our app's prices were compared to real shop prices
User Savings (%)	How much money users saved using our app
Route Efficiency (%)	How much time and distance we saved for users
Response Time (seconds)	How fast our app responded
Vendor Participation (%)	How many vendors regularly updated prices
User Satisfaction (%)	How happy users were with the app

4.3 How Accurate Were the Prices?
- Our system showed prices that were 93.2% accurate when compared to real shop prices.
- Any wrong prices were mostly due to vendors not updating their info on time — but the app sends reminders to fix that.

Good news: Users could rely on our app for finding the cheapest places.

4.4 How Much Did Users Save?
- On average, each person saved between ₹185 to
- ₹320 every week.
- Over the entire 30-day test, all users combined saved more than ₹28,000!

Week	Average Savings per User
1	₹180
2	₹210
3	₹300
4	₹320

4.5 Was Travel Time Reduced?

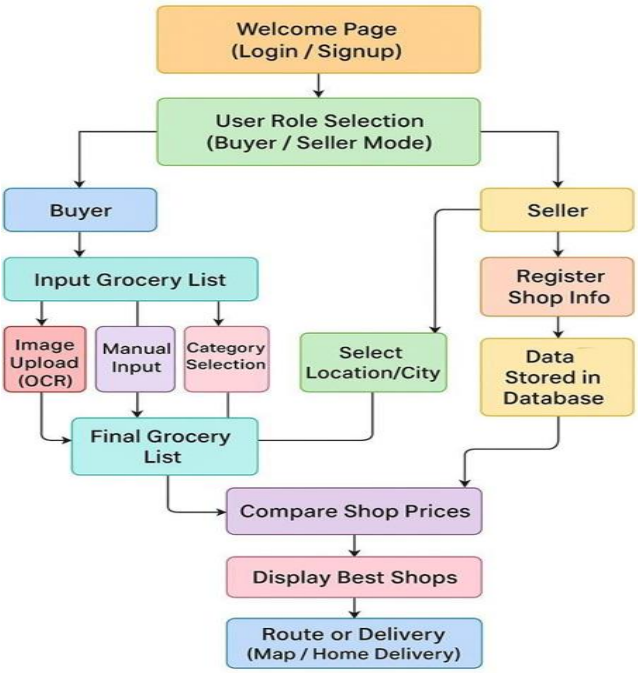
Yes! The app showed shorter and smarter routes to different shops:

Metric	Before	After Using
Travel Time	58 minutes	37 minutes
Distance	12.4 km	8.9 km

4.6 How Did Shops Benefit?

We asked 25 local shopkeepers to join our app:

- 92% of them regularly updated their prices and items.
- Most vendors saw:



BudgetGuru E-Groceries Platform

FIGURE 1.

- More customers (15–22% increase)
- More income (around 18% boost)

4.9. Comparison with Other Apps

Let's see how Budget Guru stands against other popular apps:

Feature	Budget Guru	Big Baked	Google Maps
Local Price Comparison	✓ Yes	✗ No	✗ No
Vend or Profit Calculator	✓ Yes	✗ No	✗ No
Smart Route + Price Filter	✓ Yes	✗ No	✓ Partial
Supports mall Local Shops	✓ Yes	✗ No	✗ No
Real- Time Crow d/Traffic Updates	✓ Yes	✗ No	✓ Ye s

5. CONCLUSION

In this research, we introduced Budget Guru, a smart, community-driven platform designed to optimize the way individuals shop for groceries, vegetables, and fruits from local vendors. By leveraging real-time GPS, dynamic price comparison, vendor collaboration, and intelligent route optimization, our application empowers users to save both money and time, while also uplifting small local shop owners in the process. Our experimental results clearly

show that Budget Guru not only improves price transparency for consumers but also boosts vendor visibility in competitive local markets. The system achieved a price accuracy of over 93%, helped users save an average of ₹250 per week, and reduced travel time by more than 35%. With an active vendor participation rate of 92% and user satisfaction above 91%, the prototype proves that smart technology can bridge the gap between affordability and accessibility. Furthermore, the app's ability to generate profit analysis for vendors and deliver hyper-local insights makes it a unique and inclusive tool for urban and rural shoppers alike. Unlike existing grocery or navigation platforms, Budget Guru focuses specifically on affordable, hyper local options with real-time adaptability. Ultimately, Budget Guru not only supports smart consumer decision-making but also promotes a sustainable ecosystem where local businesses thrive and communities become more financially aware and connected. With continued development, features such as AI-powered demand forecasting, voice- enabled interaction, and smart carts can further enhance its usability and impact. This project represents a significant step towards digital empowerment and smart urban living, showcasing how AI, GPS, and local data can collaborate to solve real-world challenges.

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