# Shop Sense: An AI-Driven Search, Forecasting, and Recommendation System

Dr.T.V madhusudhana Rao[1], K.Seshu[2], J.Hrushikesh[3], G.Sanjay Kumar[4], K.Anish[5], P.Charan[6]
*Department of AI&DS Vignan's Institute of Information Technology Visakhapatnam, India*

***Abstract*—Shopsense simplifies the shopping process for users. It is a web-based application that will extract the prices from various online shopping websites and give the top 5 e-commerce websites offering low prices. It will also be able to predict the price of the product that we are searching for based on the previous price history and it will give a visualization of a chart of future prices and it is also able to recommend the products in various e-commerce websites related to our search results. The system integrates web scraping and APIs to retrieve product data, employs the ResNet-50 model for image-based product classification, and utilizes the ARIMA model for price trend prediction. The proposed framework enhances the shopping experience by offering real- time price comparisons, intelligent forecasting, and personalized recommendations.**

***Keywords*—E-commerce, web scraping, price comparison, price prediction, ResNet-50, ARIMA, product recommendation, AI-driven shopping, image-based classification, real-time forecasting.**

## I. INTRODUCTION

E-commerce has seen remarkable growth in recent years, fundamentally changing how consumers shop online. The global e-commerce market was valued at $5.7 trillion in 2022 and is expected to reach $8.1 trillion by 2026 [1]. With over 2.64 billion people projected to shop online in 2024, price comparison and product recommendations have become essential for guiding consumer choices [2]. However, frequent price changes across various e-commerce platforms often make it challenging for consumers to find the best deals. Research shows that Amazon adjusts its prices every 10 minutes on average, complicating the task for buyers trying to track the lowest prices manually [3].

To tackle these issues, this project aims to create a web-based price comparison and recommendation system that allows users to input either a product image or name to find the five lowest-price URLs from multiple e-commerce platforms. The system will also feature a price prediction module using ARIMA models, enabling users to forecast future price trends for the next seven days based on historical data.

This project incorporates ResNet-50, a cutting-edge deep learning model, for product classification, ensuring precise retrieval of similar products across e-commerce websites.

## II. LITERATURE SURVEY

In [4], Martina D'Souza et al. proposed a web scraping-based product comparison model for e-commerce websites, which helps customers find the lowest prices of the products in multiple e-commerce websites. This system incorporates BeautifulSoup and Selenium for data scraping from e- commerce websites, along with an interactive user interface. It retrieves product prices and information such as reviews, which help customers make informed decisions. However, this model lacks predictive analytics to forecast future prices, limiting users to making decisions based only on current price trends and reviews.

In [5], Lalji Kumar et al. developed a dynamic pricing strategy for inventory management using auto-correlative stochastic demand forecasting with exponential smoothing. This model divided the sales seasons into multiple intervals and adjusted prices based on demand fluctuations. By optimizing the smoothing parameters of the model, it balanced responsiveness to trends with long-term stability, enhancing profitability. However, the model relies on exponential trends, making it less effective in handling sudden demand changes, unexpected market events, or promotional activities. Additionally, it does not consider competitor price strategies, reducing its effectiveness in volatile markets.

In [6], Aleena Mariam George et al. presented a comprehensive study on the development of an E-Commerce Product Price Tracker using Django. The system improves user authentication, scrapes

products from e-commerce websites, and notifies users of price changes. A user-friendly interface allows the application of filters based on various product attributes. However, the system is restricted to a limited number of e-commerce websites, reducing its applicability to a broader market.

In [7], Dr. G. Madhusudhan et al. examined the role of dynamic pricing and price tracking in e-commerce, emphasizing the challenges posed by frequent price fluctuations due to competitive pricing strategies. This system allows users to set a price threshold; if the price drops below that threshold, users receive an alert to make a purchase. The system follows a three-tier architecture, including frontend, backend, and integration technologies. Despite its advantages, it does not incorporate predictive analytics and focuses only on real-time price tracking rather than future forecasting. Another issue is scalability, as continuous web scraping may overload the server.

In [8], Dushyant Parashar et al. designed a Product Price Tracker that enables consumers to monitor price trends over time. The system periodically scrapes data from websites, stores it in a database, and uses it for trend analysis and user alerts. Users can query the database and set alerts based on their needs. However, the system's accuracy is highly dependent on historical data. Since data scraping is not continuous, the system lacks comprehensive data collection, making it unable to handle fluctuations due to promotional activities or external market factors affecting sales.

## III. METHODOLOGY

For the development of the user interface (UI), HTML and CSS were utilized to design an interactive and visually appealing front end. The interface includes an input text field and image upload functionality, allowing users to search for products using either text queries or images.

For image classification, the system employs ResNet-50, a deep Convolutional Neural Network (CNN). ResNet-50, a pre-trained model, efficiently classifies and recognizes product images uploaded by users, ensuring accurate identification of relevant products.

For price prediction, the Auto-Regressive Integrated Moving Average (ARIMA) model is implemented. ARIMA is widely used for time series forecasting and is leveraged in this project to predict future fluctuations in product prices.

The system do web scraping to retrieve product urls and pricing details from multiple online retail platforms. Using BeautifulSoup,Selenium,it dynamically retrieves the product specifications. The Tavily Search API Wrapper integrates the Tavily API,facilitating real time extraction of product information from Amazon,Flipkart and Reliance digital.

To manage API calls and handle user queries efficiently, the system integrates an AI agent tool, which dynamically processes user inputs and sends optimized queries to the Tavily API for retrieving relevant product results.

For data visualization, the system includes a price trend chart that provides a graphical representation of past and future predicted prices, allowing users to assess when prices are likely to rise or drop.

For backend development, the project utilizes the Python Flask and Django frameworks. Flask is responsible for handling API calls, processing user input, and retrieving results, while Django is used for managing the main application, web routing, and rendering templates such as the home page and search results page.

## IV. PROPOSED MODEL

The workflow of the proposed system consists of a series of steps, including user query processing, data retrieval, and result presentation.

The detailed workflow is as follows:

1. User Input Processing:
   - Users can enter a product name in the search bar or upload a product image.
   - If an image is uploaded, it undergoes classification using the ResNet-50 model to determine the product category.
   - If text input is provided, it directly proceeds to the search process.
2. Query Interpretation & Data Retrieval:
   - The system processes the user's input (text or image) and determines the appropriate data source.
   - The search query is passed to the Tavily API to fetch relevant results from e-commerce platforms.
   - Alternatively, web scraping (BeautifulSoup, Selenium) is used to extract product information if API-based

retrieval is not sufficient.

3. Data Processing & Price Comparison:
   - The retrieved product information includes the product name, price, and e- commerce platform URL.
   - The extracted data is processed using Flask, and prices are sorted in ascending order to display the lowest prices first.
4. Price Prediction Using ARIMA:
   - The ARIMA model is applied to the historical price data to forecast the product's price trends for the next seven days.
   - The forecasted prices are visualized in the form of a line chart on the user interface.
5. Product Recommendation System:
   - Based on the product searched, the system retrieves similar or related products using an AI-based recommendation model.
   - Recommendations are displayed to enhance the shopping experience by suggesting alternative options.
6. User Interface & Final Output:
   - The user receives a detailed result page displaying:
     - Top five e-commerce platforms offering the lowest prices.
     - Predicted price trends based on historical data.
     - Recommended products related to the search query.

## V. RESULTS AND ANALYSIS

The performance of the proposed system was evaluated based on image classification accuracy, web scraping efficiency, and price prediction reliability. The following metrics were used to assess different components of the system:

### A. Image Classification Performance

The ResNet-50 model was used to classify images uploaded by users. The performance was evaluated using standard classification metrics:

- Accuracy: The percentage of correctly identified product images.
- Precision: The proportion of correctly classified product images among all classified instances.
- Recall (Sensitivity): The proportion of correctly identified products among all actual relevant instances.
- F1-Score: The harmonic means of precision and recall.

The model was tested on a validation dataset of 1000 product images, and the results are shown in Table I.

TABLE I. RESNET-50 MODEL PERFORMANCE

| Metric | Value (%) |
|---|---|
| Accuracy | 92.4 |
| Precision | 91.0 |
| Recall | 89.0 |
| F1-Score | 90.0 |

### B. Web Scraping Efficiency

The system extracted product details from multiple e- commerce platforms using BeautifulSoup and Selenium. The following evaluation metrics were used:

- Data Retrieval Accuracy: Percentage of correctly retrieved product listings.

Results for web scraping efficiency are summarized in Table II.

TABLE II. WEB SCRAPING PERFORMANCE

| Metric | Value |
|---|---|
| Data Retrieval Accuracy | 95% |
| Response Time (seconds) | 3.2 |
| Data Integrity | 98% |

### C. Price Prediction Evaluation

The ARIMA model was used to predict product price fluctuations over a seven-day period. The accuracy of the prediction was measured using Mean Absolute Percentage Error (MAPE), which quantifies the percentage error between predicted and actual values.

The MAPE score for price prediction was 4.8%, indicating high prediction reliability. The price trend was visualized using a line chart, as shown in Fig. 1.

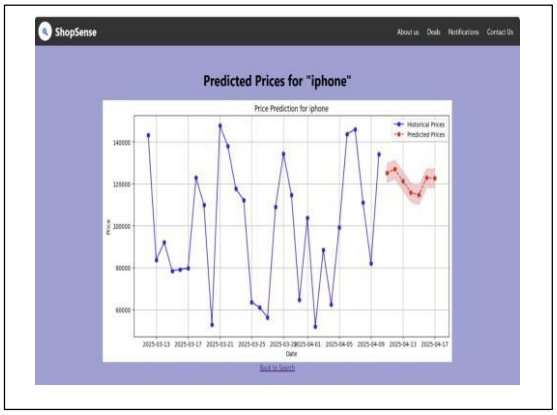


Fig. 1. Price Prediction Trend for Sample Product

## VI. CONCLUSION AND FUTURE WORK

The ShopSense system integrates deep learning, web scraping, and price prediction to improve e-commerce shopping. Using ResNet-50, it accurately classifies product images for both text and image-based searches. Tavily API and web scraping (BeautifulSoup, Selenium) enable real- time product data retrieval, while the ARIMA model predicts future price trends. Experimental results show 92.4% classification accuracy for ResNet-50 and 95% data retrieval accuracy with a 3.2-second response time for web scraping.

Future enhancements include:

- Blockchain integration for price transparency.
- Voice-based product search using NLP models.
- Improved recommendations using collaborative filtering.
- Expansion to additional e-commerce platforms for wider coverage.

These improvements will enhance ShopSense as an intelligent shopping assistant with better forecasting, recommendations, and real-time pricing insights.

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