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PREDICTING PRICE RANGE OF A MOBILE

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ABSTRACT

To predict “If the mobile with given features will be Economical or Expensive” is the main motive of this research work. Different feature selection algorithms are used to identify and remove less important and redundant features and have minimum computational complexity. Different classifiers are used to achieve as higher accuracy as possible. Results are compared in terms of highest accuracy achieved and minimum features selected. Conclusion is made on the base of best feature selection algorithm and best classifier for the given dataset. This work can be used in any type of marketing and business to find optimal product (with minimum cost and maximum features).Future work is suggested to extend this research and find more sophisticated solution to the given problem and more accurate tool for price estimation.

INTRODUCTION

Predicting the price range for mobile phones involves using various factors and data analysis techniques. Key elements to consider include Analyze the specifications of the mobile phone, such as processor, camera quality, RAM, storage, and screen size, as these significantly impact pricing. Different brands and models carry varying price tags due to their reputation and unique features. Monitor market trends and consumer preferences to understand how they affect mobile phone prices. Examine pricing strategies of competitors to determine where a phone's price may fall in relation to similar models. Customer feedback can provide insights into the perceived value of a phone and how it affects its price range. Consider macroeconomic factors like inflation, currency exchange rates, and consumer purchasing power, as they can influence pricing. Historical price data can be used to identify patterns and trends, helping predict future price ranges. Implement machine learning models, such as regression or decision trees, to make predictions based on the data collected. Gather data from reliable sources like e-

commerce websites, official manufacturer listings, and market research reports. Remember that mobile phone prices can vary by region, so account for geographic differences in your analysis. By combining these factors and employing data analysis techniques, you can create a predictive model to estimate the price range for mobile phones accurately. Collect a diverse and comprehensive dataset that includes a wide range of mobile phones from different manufacturers, regions, and price points. Ensure the data is up-to-date. Create meaningful features from the raw data that can influence price, such as the number of camera lenses, screen resolution, battery capacity, and the presence of special features like 5G connectivity or wireless charging. Clean and preprocess the data by handling missing values, outliers, and normalizing or scaling features as needed. Split your dataset into training and testing sets to evaluate your model's performance. Choose an appropriate machine learning model for your prediction task. Common choices include linear regression, decision trees, random forests, or gradient boosting. Fine-tune the hyperparameters of your chosen model to optimize its performance. Implement cross- validation techniques to assess the model's generalization capabilities and reduce overfitting. Select appropriate evaluation metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), or Root Mean Squared Error (RMSE) to measure the model's accuracy. Use techniques like feature importance scores to identify which features have the most significant impact on the predicted price. Consider applying regularization techniques to prevent model overfitting. Experiment with ensemble methods like stacking or bagging to combine multiple models for better predictions. Continuously monitor market dynamics, as the pricing of mobile phones can change rapidly due to factors like technological advancements, new product releases, and consumer preferences. Incorporate user feedback and ratings into your model to capture the real-world user experience. Regularly update and retrain your model to adapt to changing market conditions. Use data visualizations to gain insights into the data and model results, making it easier to explain your predictions.
Remember that the quality of your predictions depends on the quality of your data and the choice of the appropriate machine learning algorithm. Regular updates to the model may be necessary to account for changing market trends. Once satisfied with the model's accuracy, you can deploy it to make real-time predictions or integrate it into a mobile app or website. Validate the model's performance on the testing set, and if necessary, fine-tune the model to improve accuracy. Use the trained model to predict the price range of a mobile phone based on its features. Train the selected model on the training data, adjusting hyperparameters as needed. Choose an appropriate machine learning model for regression or classification, depending on whether you want to predict a specific price or a price range category. Split the dataset into training and testing sets to evaluate the model's performance.

LITERATURE SURVEY

A literature survey on predicting the price range of mobile phones involves reviewing relevant research, papers, and articles in the field of data science, machine learning, and mobile technology. Here are some key topics and studies to consider Explore research that focuses on developing predictive models for mobile phone prices. Look for studies that discuss the choice of algorithms, feature selection, and model evaluation. Investigate studies that analyze which features have the most significant impact on mobile phone prices. Understanding feature importance can aid in building accurate models. Research papers that discuss data collection methods and sources for mobile phone price prediction. This may include web scraping, market research, and data extraction from e-commerce websites. Review research that covers various machine learning techniques used for price prediction. This might include regression models, decision trees, neural networks, and ensemble methods. Explore studies that discuss the fine-tuning of model hyperparameters to optimize predictive performance. Look for papers that detail the use of cross-validation techniques and the choice of appropriate evaluation metrics

to assess model accuracy. Investigate literature that considers the influence of market dynamics, technological advancements, and consumer preferences on mobile phone prices. Examine studies that incorporate user reviews and ratings as features for predicting mobile phone prices. These can provide valuable insights into user satisfaction and perceived value. Research how different geographical regions impact mobile phone pricing, considering factors like currency exchange rates and regional market conditions. Analyze studies that discuss challenges and limitations in predicting mobile phone prices, such as data availability, pricing fluctuations, and the need for real-time updates. Consider literature that compares different machine learning approaches and their effectiveness in predicting mobile phone prices. Explore the use of big data analytics in mobile pricing prediction, including how large datasets and advanced analytics techniques can improve accuracy. Investigate how price prediction models are applied in e-commerce platforms to assist customers in making informed purchasing decisions. When conducting a literature survey, be sure to assess the relevance, methodology, and findings of each study to build a comprehensive understanding of the field and identify gaps or opportunities for further research in predicting mobile phone prices.

PROPOSED SYSTEM

Proposing a system for predicting the price range of a mobile phone involves outlining the components, architecture, and key steps involved in creating such a system. Here's a high-level overview of a proposed system for predicting the price range of a mobile phone: Gather mobile phone specifications, prices, and related data from various sources, such as e-commerce websites, manufacturers, and APIs. Utilize web scraping techniques to extract data from websites. Ensure that data collection respects the terms of service and policies of the sources. Clean the collected data to handle missing values, duplicates, outliers, and inconsistencies. Feature Engineering: Create new features from the existing data, if necessary. Normalization/Standardization: Scale numerical features to ensure consistency. Define and assign price range labels (e.g., low, medium, high) to each mobile phone based on their actual prices. Divide the labeled dataset into training, validation, and test sets for model training and evaluation. Select relevant features based on feature importance analysis, domain knowledge, and machine learning techniques. Choose an appropriate machine learning model for classification, such as decision trees, random forests, support vector machines, or deep learning models (e.g., neural networks).Train the selected model on the training dataset using suitable training techniques and hyperparameter tuning.

Assess the model's performance on the validation and test datasets using classification metrics like accuracy, precision, recall, F1-score, and confusion matrices. Deploy the trained model in a production environment, which could be a mobile app, a website, or an API that accepts mobile phone specifications as input and returns predicted price ranges as output. Implement a mechanism for regularly updating the dataset to account for changes in mobile phone specifications and prices over time. Design a user-friendly interface for users to input mobile phone specifications and receive predicted price ranges. The interface could be a web application or a mobile app. Ensure the security of the system, especially if it collects and stores user data. Implement necessary security measures and comply with data protection regulations. Continuously monitor the performance of the model in a production environment. Implement maintenance procedures to address issues or updates. Address ethical and legal considerations related to data collection, privacy, and bias in the model predictions. Encourage users to provide feedback on the model's predictions to help improve its accuracy over time. Creating a system for predicting the price range of mobile phones involves a combination of data collection, preprocessing, machine learning, deployment, and ongoing maintenance. It's important to continuously improve the system's accuracy and ensure it meets the needs.

It's essential to stay up-to-date with the latest advancements in machine learning and data analysis to continually improve the system's accuracy and reliability. Additionally, user feedback and real-world testing are crucial for refining the model and its predictions over time. Provide comprehensive documentation and support for users and developers who wish to integrate the system. Implement a feedback mechanism that allows users to provide input on predicted prices, helping improve the system's accuracy. Ensure the security and privacy of the collected data, especially if it includes user inputs. Maintain the system with regular updates to keep up with evolving market trends, new mobile phone releases, and changes in consumer preferences. Develop a user-friendly mobile app or website that allows users to input mobile phone details and receive a predicted price range. Utilize time series analysis techniques to predict price trends over time, accounting for seasonality and historical fluctuations.

The proposed system aims to predict the price range of mobile phones using advanced data analytics and machine learning algorithms. By leveraging historical pricing data, key features, and market trends, the system will provide accurate estimations of mobile phone prices, aiding consumers in making informed purchasing decisions. The system will utilize a diverse dataset encompassing various mobile phone models, specifications, and corresponding prices. Features such as processor type, camera quality, storage capacity, brand reputation, and release year will be considered as input variables.

Through machine learning techniques, the system will learn and identify patterns in the data, developing a predictive model capable of estimating the price range based on the specified features. The predictive model will be continuously refined and updated as new mobile phones enter the market and pricing dynamics evolve. The goal is to offer users a reliable tool that considers multiple factors influencing mobile phone prices, ultimately assisting them in understanding the expected price range for a particular device. This predictive system not only facilitates consumer decision-making but also provides valuable insights for manufacturers, retailers, and market analysts in understanding the dynamics of the mobile phone market.

The proposed system for predicting the price range of a mobile device utilizes machine learning algorithms to analyze various features and factors influencing the pricing of mobile phones. The implementation involves collecting a dataset containing information such as processor type, RAM, storage capacity, camera specifications, brand reputation, and other relevant features. Feature engineering is a critical step where the dataset is preprocessed to extract valuable insights and eliminate irrelevant information. Machine learning models, such as decision trees, random forests, or support vector machines, are trained on this processed data to learn patterns and relationships between features and mobile prices.

Cross-validation techniques ensure the robustness of the model by assessing its performance on different subsets of the data. The trained model is then deployed to predict the price range of a given mobile device based on its features. Regular updates to the model can be facilitated by incorporating additional data and retraining the system. User feedback on predicted prices versus actual market prices can also contribute to model refinement, enhancing its accuracy over time. This implementation offers a dynamic and data-driven approach to predicting mobile prices, providing valuable insights for consumers, manufacturers, and retailers in the ever-evolving mobile market. The system contributes to informed decision-making and market competitiveness by leveraging machine learning to anticipate mobile device pricing trends.

RESULTS

Predicted Price Range:

Logistic Regression:

```
In [16]: ypred_m1=m1.predict(x_test)
         print(ypred_m1)

[3 0 2 1 3 0 0 2 2 2 1 3 0 1 2 0 3 2 2 1 1 0 3 2 1 2 3 1 3 1 2 0 1 1 2 3 0
 0 3 2 3 3 3 3 2 2 0 1 3 1 0 2 0 3 0 3 3 1 0 3 3 2 2 1 1 3 3 3 2 2 3 2 1 0
 1 3 3 1 1 1 3 1 3 0 0 0 1 0 1 3 1 2 1 1 0 3 2 3 0 2 1 2 2 0 3 2 3 2 3 3 2
 0 0 2 3 3 1 0 1 0 0 3 2 2 1 2 0 1 0 3 1 3 3 2 3 3 3 3 0 1 1 3 2 3 0 3 0 0
 2 0 1 1 1 1 3 0 0 3 1 3 1 2 2 1 3 3 3 3 0 1 3 2 1 3 3 0 1 1 3 0 3 1 0 1 2
 1 3 0 3 3 3 3 1 1 2 1 0 2 2 0 3 3 3 0 1 3 2 2 0 0 0 2 2 2 0 0 0 2 2 2 2 3
 0 0 3 3 2 2 0 3 1 0 0 3 2 0 2 2 0 0 0 2 3 2 0 0 2 3 3 1 3 0 2 1 1 0 1 2 3
 2 0 0 1 3 3 3 2 3 3 2 1 2 2 2 1 3 2 2 2 1 0 2 1 0 0 0 1 3 3 3 0 1 2 0 2 2
 3 0 1 0 1 1 3 0 0 1 3 1 2 1 1 0 3 0 2 3 2 2 0 1 3 1 0 1 0 1 0 3 1 2 2 0 0
 2 3 0 3 1 1 0 1 3 0 2 1 1 2 2 2 0 3 0 0 2 1 2 3 2 2 0 3 2 3 2 2 2 2 3 3 0
 2 1 1 0 1 1 2 2 1 3 1 1 0 1 1 3 1 0 0 3 0 3 0 2 3 1 1 0 2 1 0 0 3 0 3 3 0
 3 3 3 2 2 3 2 1 3 1 2 1 0 2 1 1 1 1 3 1 2 2 0 3 1 1 1 3 0 2 3 2 2 2 3 0 0
 1 2 1 2 0 3 3 0 3 3 0 3 1 2 0 2 2 0 3 3 2 0 2 0 3 3 2 2 1 3 1 2 0 1 1 3 0
 2 0 0 1 3 0 1 2 0 3 3 3 3 0 3 1 2 2 3]
```

Fig. 1: Logistic Regression for Predicting Price Range of a mobile

Accuracy Score:

```
In [17]: print('accuracy score=',accuracy_score(y_test,ypred_m1))
         print('testing score=',m1.score(x_test,y_test))

         accuracy score= 0.65
         testing score= 0.65
```

Fig. 2. Accuracy Score for Predicting Price range of a mobile

KNN Classifier:

Fig. 3.KNN Classifier for Predicting Price range of a mobile

```
In [26]: ypred_m2=m2.predict(x_test)
         print(ypred_m2)
```

```
[3 0 2 2 2 0 0 2 3 1 0 3 0 2 3 0 3 2 2 1 0 0 3 1 2 2 3 1 3 1 1 0 2 0 1 3 0
 0 3 3 3 1 3 3 1 3 0 1 3 1 1 3 0 3 0 2 2 2 0 3 3 1 3 2 1 2 3 2 2 2 3 2 1 0
 1 3 2 1 1 2 3 3 3 0 0 0 2 1 2 3 1 2 2 1 0 3 2 3 0 3 1 1 2 1 3 2 2 3 2 3 3
 0 0 1 2 3 0 0 1 0 0 3 2 2 1 1 1 1 0 2 1 3 3 3 3 3 3 2 0 1 1 2 1 3 0 3 0 0
 2 0 1 1 1 1 3 0 0 3 1 3 2 1 3 1 2 3 3 2 1 0 3 1 2 3 3 0 2 2 3 0 2 1 0 1 2
 2 2 0 3 3 1 1 0 2 3 0 1 2 2 0 3 3 3 1 2 3 3 3 0 0 0 2 3 3 0 0 1 3 1 3 3 3
 0 0 2 2 3 1 0 2 0 0 0 3 2 0 2 2 1 1 0 2 3 3 0 0 1 3 3 2 3 0 3 0 1 0 2 3 2
 2 0 0 1 2 3 2 2 3 1 1 0 3 3 2 1 3 2 2 2 1 0 2 2 1 0 0 2 2 2 2 0 1 3 0 1 2
 3 0 2 0 1 1 3 0 0 1 3 1 2 0 2 0 3 0 3 3 2 3 1 2 2 1 1 1 0 1 0 3 1 0 3 0 0
 1 2 0 3 1 2 0 1 3 0 2 2 1 2 1 1 0 2 0 0 3 1 2 3 2 2 0 3 2 2 1 3 2 3 3 3 0
 2 0 3 0 1 1 2 2 1 2 1 2 0 1 2 3 0 0 1 3 0 3 0 1 2 1 1 0 3 1 0 1 3 0 3 3 0
 2 1 3 1 1 3 2 0 3 2 2 0 0 3 0 1 1 1 3 2 3 2 0 3 0 0 1 3 0 0 3 3 2 2 3 0 0
 1 2 0 2 0 3 3 0 2 3 0 2 2 1 0 2 2 1 3 2 2 0 2 0 3 3 2 1 0 3 0 2 0 0 1 3 0
 3 0 0 1 2 0 1 3 0 2 2 1 2 0 3 0 2 3 2]
```

Confusion Matrix:

```
In [27]: cm2=confusion_matrix(y_test,ypred_m2)
         print(cm2)
         print(classification_report(y_test,ypred_m2))
```

```
[[124   0   0   0]
 [  6 103   1   0]
 [  0   5 117   3]
 [  0   0  10 131]]
              precision    recall  f1-score   support

           0       0.95      1.00      0.98       124
           1       0.95      0.94      0.94       110
           2       0.91      0.94      0.92       125
           3       0.98      0.93      0.95       141

    accuracy                           0.95       500
   macro avg       0.95      0.95      0.95       500
weighted avg       0.95      0.95      0.95       500
```

Fig. 4. Confusion Matrix for Predicting Price range of a mobile

SVM Classifer with kernel
Linear:

```
In [32]: ypred_m3=m3.predict(x_test)
         print(ypred_m3)

[3 0 2 2 2 0 0 3 3 1 1 3 0 2 3 0 3 2 2 1 0 0 3 1 2 2 3 1 3 1 1 0 2 0 1 3 0
 0 3 3 2 1 3 3 1 3 0 1 3 1 1 3 0 3 0 2 2 2 0 3 3 1 3 2 1 2 3 2 2 2 3 2 1 0
 1 3 2 2 1 2 3 3 3 0 0 0 2 1 2 3 1 2 2 1 0 3 3 3 0 3 1 1 2 1 3 2 2 3 2 3 3
 0 0 1 3 3 0 0 1 0 0 3 2 2 1 1 1 1 0 2 1 3 3 3 3 3 3 2 0 1 1 2 1 3 1 3 0 0
 2 0 1 1 1 1 3 0 0 3 1 3 2 1 3 1 2 3 3 2 1 0 3 1 2 3 3 0 2 2 3 0 2 1 0 1 2
 1 2 0 3 3 1 1 0 2 3 0 1 2 2 0 3 3 3 1 2 3 3 3 0 0 0 2 3 3 0 0 1 3 2 3 3 3
 0 0 2 2 3 1 0 2 0 0 0 3 2 0 2 2 1 1 0 2 3 3 0 0 1 3 3 2 3 0 3 1 1 0 2 3 3
 2 0 0 1 2 3 2 2 3 1 1 0 3 3 2 1 3 2 2 2 1 0 2 2 1 0 0 2 2 2 2 0 1 3 0 2 2
 3 0 2 0 1 1 3 0 0 2 3 1 2 0 2 0 3 0 3 3 2 3 1 2 2 1 1 1 0 1 0 3 1 0 3 1 0
 1 3 0 3 1 2 0 1 3 0 2 2 1 2 1 1 0 2 0 0 3 1 2 3 2 2 0 3 2 2 1 3 2 3 3 3 0
 2 0 3 0 1 1 2 2 1 3 1 2 0 1 2 3 0 0 1 3 0 3 0 2 2 1 1 0 2 1 0 1 3 0 3 3 0
 2 1 3 1 1 3 2 0 3 2 2 0 0 3 0 1 1 1 3 2 3 2 0 3 0 0 1 3 0 0 3 2 2 2 3 0 0
 1 2 1 2 0 3 3 0 3 3 0 2 2 1 0 2 2 1 3 2 2 0 2 0 3 3 2 1 0 3 1 2 0 0 1 3 0
 3 0 0 1 2 0 1 3 0 2 2 1 2 0 3 0 2 3 2]
```

Fig. 5.SVM Classifier with kernel Linear

Accuracy Score:

```
In [34]: print('accuracy score=',accuracy_score(y_test,ypred_m3))
         print('testing score=',m3.score(x_test,y_test))

accuracy score= 0.978
testing score= 0.978
```

Fig .6.Accuracy Score for Predicting Price range of a mobile

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Confusion Matrix**:**

```
In [33]: cm3=confusion_matrix(y_test,ypred_m3)
         print(cm3)
         print(classification_report(y_test,ypred_m3))

[[123   1   0   0]
 [  1 107   2   0]
 [  0   2 122   1]
 [  0   0   4 137]]
              precision    recall  f1-score   support

           0       0.99      0.99      0.99       124
           1       0.97      0.97      0.97       110
           2       0.95      0.98      0.96       125
           3       0.99      0.97      0.98       141

    accuracy                           0.98       500
   macro avg       0.98      0.98      0.98       500
weighted avg       0.98      0.98      0.98       500
```

Fig. 7. Confusion Matrix for Predicting Price range of a mobile

SVM Classifier with rbf kernel:

```
In [38]: ypred_m4=m4.predict(x_test)
         print(ypred_m4)

[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1]
```

Fig. 8.SVM Classifier with rbf kernel:

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Accuracy Score:

```
In [40]: print('accuracy score=',accuracy_score(y_test,ypred_m4))
         print('testing score=',m4.score(x_test,y_test))

accuracy score= 0.22
testing score= 0.22
```

Fig. 9. Accuracy Score for Predicting Price range of a mobile

Confusion Matrix:

```
In [39]: cm4=confusion_matrix(y_test,ypred_m4)
         print(cm4)
         print(classification_report(y_test,ypred_m4,zero_division=0))

[[  0 124   0   0]
 [  0 110   0   0]
 [  0 125   0   0]
 [  0 141   0   0]]
              precision    recall  f1-score   support

           0       0.00      0.00      0.00       124
           1       0.22      1.00      0.36       110
           2       0.00      0.00      0.00       125
           3       0.00      0.00      0.00       141

    accuracy                           0.22       500
   macro avg       0.06      0.25      0.09       500
weighted avg       0.05      0.22      0.08       500
```

Fig.10. Confusion Matrix for Predicting Price range of a mobile

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CONCLUSION

As technology continues to advance and user expectations evolve, mobile price prediction systems are poised to become even more sophisticated, accurate, and user-friendly, providing consumers with valuable insights to make well-informed purchasing decisions. The future of predicting mobile phone prices is characterized by innovation, personalization, and a strong focus on environmental and ethical considerations. The feedback loop, user reviews, and ongoing data updates will remain essential for enhancing prediction accuracy and overall system performance. Systems will increasingly cater to users worldwide, offering real-time currency conversion, language support, and the ability to access pricing insights across international markets. Augmented reality, voice-activated interfaces, and blockchain technology are expected to play a significant role in shaping the future of mobile price prediction systems. Sustainability and eco-conscious purchasing will likely become integral, with users receiving insights into the environmental impact and long-term value of mobile phones. Future systems aim to provide personalized price predictions, real-time comparisons, and instant access to pricing information, making mobile phone shopping a convenient and user-centric experience.

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