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Using Machine Learning to Forecast Mobile Phone Prices

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Abstract

People rely on their smartphones more and more every day. Technological improvements have made telephones indispensable in every facet of life, from personal to professional. You can use it for more than just making phone calls. It lets you access the internet and read your email even when you're not at your computer. When shopping for a mobile phone, it's important to think about its features. Finding the optimal method to use machine learning to predict the retail price of smartphones based on their specific features is the overarching goal of this study. People who use their phones often pay more attention when choosing features. People look at the price-performance ratio as a metric to compare mobile phones. Functions of a phone are considered performance metrics. The purpose of this study is to provide a prediction about the relative cost of various mobile phone functions. By enhancing features while limiting prices, this approach may be used in different marketing and commercial situations to help people make educated purchase choices.

Keywords— Machine learning, SVM Method, Decision Tree, Phone Price Prediction.

INTRODUCTION

Increased social media communication and changes in work and payment processes have contributed to the growth of the mobile phone market. Circumstances. People pick their phones based on a variety of factors, considering this trend will likely continue. Factors like as battery life, color selections, RAM capacity, and Wi-Fi capabilities influence users' preferences for items that provide excellent value. Value for money is the user's first

consideration when making a purchase [1]. With 83.3% of the population owning a mobile phone and 91% of the population owning a landline, mobile phones are quickly becoming an essential tool for many people. current cellphones [2]. On both the domestic and global stages, you may find more than 170 different mobile phone brands, representing 38 different nations [3]. At the moment, a wide-ranging engineering subject is artificial intelligence (AI), which allows robots to answer intelligently to questions. There are several AI methods and solutions available, such as supervised and unsupervised learning, decision trees, Naïve Bayes, and others. Selecting the best features while decreasing the dataset size is possible using a variety of feature selection algorithms. A reduction in the computational complexity of the problem will result from this. Reducing the number of dimensions in the information requires a lot of tweaking different methods, as this is an optimization problem. For a long time, researchers have looked at consumer behavior and the impact of factors like mobile phone features and prices using economic theories and phenomena. One consideration is the intense rivalry among mobile phone makers to release new and improved models. Market uncertainty and the forecaster's subjective factors impact analysis and prediction processes, which may lead to unstable and erroneous forecast outputs. Machine learning is a rapidly developing branch of computer science that has widespread use in many fields, such as AI, image processing, and natural language processing [4]. Among the most sought-after commodities on the market today are mobile gadgets. Every day brings new smartphone models with updated software and even more functions. The number of mobile devices is enormous. Transacted daily. The goal of this case study is to find the best product by forecasting the price class of mobile phones. Vehicles, motorcycles, generators, motors, food, and medication are just a few examples of things that may be priced using the same method. For a long time, researchers have looked at consumer behavior and the impact of factors like mobile phone features and prices using economic theories and phenomena. Things like

rivalry

The evolution of mobile phone technology is impacted by competition among manufacturers [5]. Market unpredictability and the forecaster's subjective factors influence analysis and prediction processes, leading to unstable and erroneous forecast outcomes. Computer technology is growing swiftly, with machine learning being actively applied in fields such as image processing, natural language processing, and artificial intelligence. A variety of methods and classifiers, such as Decision trees, Naïve Bayes, and others, are used in machine learning. Many different feature selection methods are part of machine learning. Pick the best characteristics for reducing the dataset by using any of these. It has the potential to reduce the effort required to address the problem. It is also possible to use optimization methods to lower the dataset's dimensionality. There is a near-universal agreement that mobile phones are indispensable in the modern world. I can't even begin to fathom a world without this device. Mobile devices are always being updated with new features and versions because of how popular they are. A prospective customer may insert their desired features into the model to get an idea of how much a mobile phone would cost. There is very little text. It is possible to create a model for estimating the prices of commodities using the same methods as one for prediction, provided that the parameters for the independent variable remain the same. In today's fast-paced lives, the efficiency of a mobile phone's battery is essential, and this, among other aspects, determines the phone's price. Along with storage capacity, camera quality, and video quality, the mobile device's thickness and size are crucial considerations. In today's technological world, an internet browser is an essential component. A mobile phone's pricing is based on its several stated characteristics. Based on these characteristics, we will classify the phone as either very cheap, inexpensive, expensive, or very costly. When evaluating mobile price prediction, our major emphasis is on the mobile pricing. Considering the mobile's CPU and battery life are crucial considerations in the modern day. Important factors to think about include the mobile device's size and weight [6][7]. Quality, internal storage, camera resolution, and the ability to record video are all important factors to consider. To put it simply, these are the main considerations for mobile phone price. To find out if the portable device would be expensive or very inexpensive, we have used a few of the given specs.

LITERATURE REVIEW

Another group that did similar work was Shonda Kuiper et al. [8]. Authors utilized a multivariate regression model to forecast how much General Motors automobiles will cost in 2005. The information comes from www.pakwheels.com, an online source. In order to identify the most useful and relevant variables to include into the model, this study is focused on creating efficient variable selection algorithms. By shedding light on the necessary prerequisites for doing research and directing them toward suitable methodologies, his work aids students and academics across disciplines. Asim et al [9], this research aims to forecast if a mobile device with particular characteristics will be deemed cost effective or pricey. The real dataset is sourced from the internet. There are a number of feature selection methods that may be used to locate and eliminate unnecessary or duplicate features with little computational expense. Using many classifiers together yields the best results in terms of accuracy. Both the maximum accuracy and the minimum amount of attributes chosen are used to compare the results. Findings are drawn from the dataset by using the best feature selection approach and classifier.

Any marketing or business body may use this content to find the best product. One study by Noor et al. [10] The goal of this research was to create a technique for forecasting car prices using supervised machine learning. The prediction made by the AI system. The study's 98% prediction accuracy was the result of using multiple linear regression. Multiple linear regression is a statistical method that uses a number of independent variables to make predictions about a dependent variable. The findings are then compared to the actual values to see how accurate the predictions were. The price is used as a dependent variable that may be predicted according to this study. The price of a car may vary depending on a number of variables, including the model, the manufacturer, the city, the version, the color, the mileage, the alloy wheels, and the power steering. This study's dataset will be very useful for future research that uses different prediction methods. K Noor et al. [11] have also used several approaches to predict car prices. The findings were most accurate when the experts used multivariate linear regression. The price of an automobile is predicted by criteria such as its model, manufacturer, city, version, color, mileage, alloy wheels, and power steering. One approach is shown in this publication. Kumuda et al

[12] described the most commonly bought item is usually a cell phone, which has become a popular commodity. Annually, various varied New mobile phone models with unique features, specs, and designs are introduced. In order to successfully launch and sell the product, it is crucial to determine the mobile's actual price and assess its position in the market. Financial stability is essential for market longevity, along with adhering to norms and desired designs. It is common practice for customers to check whether the item can be purchased at the anticipated price. Prior to releasing a mobile device, it is vital to determine the pricing plan and undertake extensive market and competitive study. Accurate data comparison and the identification of critical selection features are achieved by collecting a dataset from the current market, which simplifies the process and improves accuracy. When compared to other tools, this one provides the most features for the money. The primary goal stated by Renuka et al. [13] is to determine the cost-effectiveness or cost-prohibitiveness of a mobile phone with a set of specified characteristics. Online sources are used to create the actual dataset. Finding and removing unnecessary or unimportant components with little computational cost is achieved via the use of various selecting out characteristics approaches. We use a variety of classifiers to get the best possible results. Both the maximum accuracy and the minimum amount of attributes chosen are used to compare the results. To draw inferences from the dataset, the best feature selection approach and classifier will be used for analysis. Any industry or marketing group may use this research to find the best product in terms of price and characteristics.

Kiran et al [14] attempted to construct a model for forecasting mobile phone costs based on phone features and recognizing the machine. Using a 20% test data sample, a learning system was evaluated for its ability to reliably predict prices. With a result of 95% accuracy, Linear Discriminant Analysis is the most accurate prediction algorithm. Section III: Suggested Approach I. Matrix The Kaggle dataset was used for this investigation. There are 178 columns and 11500 rows in the collection. Examine the starting prices of different brand-name mobile phones sold in Europe from 2018 to 2021. The 8 qualities give specialized information for each item. Name, Model, Storage, Random Access Memory, Display, Megapixels, Battery Life, and Price are all part of the brand's specifications. Part B: Extracting features Feature Selection, Data Normalization, Converting Categorical Features, Feature Scaling,

Feature Extraction approaches, Choosing Number of Features, and Training Models are the procedures to follow while extracting features for mobile price prediction utilizing Support Vector Machine (SVM) and Decision Tree approaches. Isolating relevant information improves prediction models by making them more accurate and efficient. C. Algorithms for Classification This estimating approach will aid firms in anticipating mobile pricing to compete successfully with competing manufacturers. Those customers who are planning to get a mobile device at the best possible price with the best features will benefit from this. To reach the project result, we gathered data from multiple websites, evaluated patterns in the data, used Machine learning algorithms for classification and forecasting, and obtained the output with surprising accuracy.

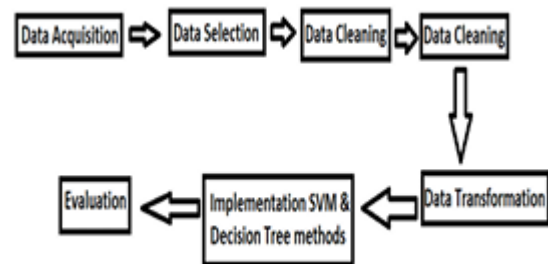


Fig. 1 Shows that Basic Classification System

Designing a System to Identify Mobile Prices. 1) SVM Algorithm A linear support vector machine (SVM) is a sorting tool that may be used with training data that is roughly divided in a linear fashion. You should use kernel methods when your data isn't easily separated into linear categories. Achieving maximal flexibility for nonlinear SVMs by optimizing the range [15]. Two sets of data are created and then laid down on a surface. The edge line is also known as. Consideration of two nearby classes These lines are called support vectors. Finding the hyperplane that maximizes the distance between two data points is the responsibility of Support Vector Machine [16–18].

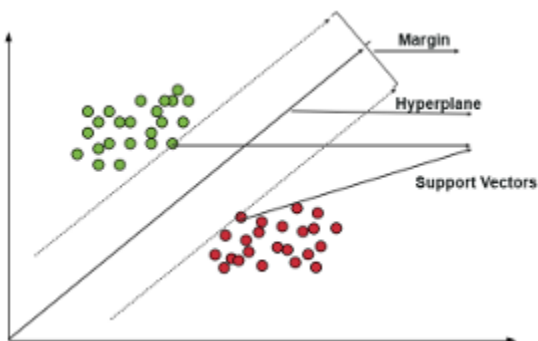


Fig. 2. SVM Model

The structure of the SVM model is shown in Figure 2. 2) Bayesian Decision Matrix In the decision tree approach, the goal and independent variables are used to determine the decision and leaf nodes. When a structure has a tree-like appearance, it is called a decision tree because of the way it uses categorization. Prior to running the classification technique, the data set's pieces are converted and grouped into a hierarchical tree. Algorithms may differ in their choosing of a root, node, and criteria for branching.



Fig. 3. .Proposed Decision Tree Architecture

RESULTS AND DISCUSSION

F1 score, recall, precision, and accuracy were some of the indicators used to assess performance. We may legitimately compare our method to regional systems using these indications, which are commonly utilized by most regional systems to diagnose heart disease. The following justifications are associated with these measures:

$$Accuracy = \frac{TP+TN}{Total\ Samples} \tag{1}$$

$$Recall(Sensitivity) = \frac{TP}{TP+FN} \tag{2}$$

$$Precision(Specificity) = \frac{TP}{TP+FP} \tag{3}$$

$$F1_{Score} = 2 * \frac{Precision*Recall}{Precision+Recall} \tag{4}$$

Here,

TP is True Positive
 TN is True Negative
 FN is False Negative

FP is False Positive

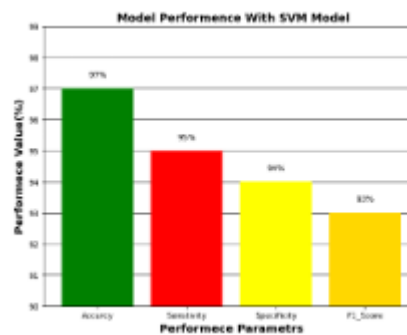


Fig. 4. Performance of SVM Model Fig. 4 Illustrate the performance evaluation of the SVM model.



fig. 5. Performance of Proposed Decision Tree Model

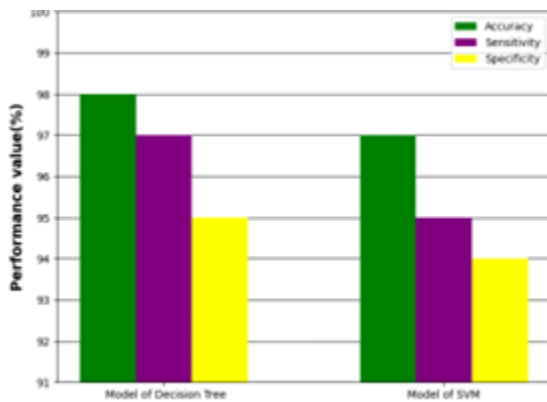


Fig. 6. Comparison of Decision Tree vs SVM

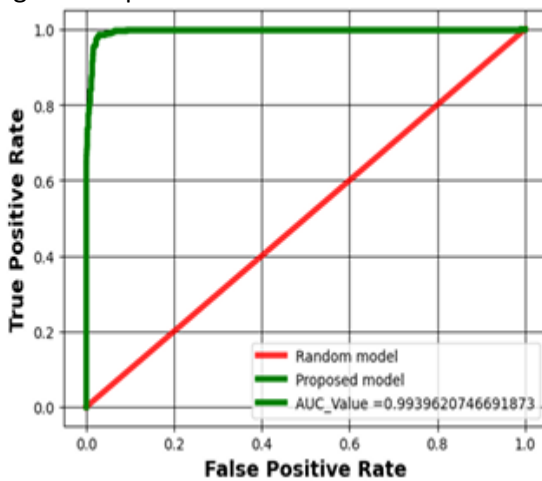


Fig. 7. ROC_AUC curve for proposed SVM

Fig. 7 Denotes the ROC_AUC value for the suggested Decision Tree. The AUC value is 0.993.

CONCLUSION

Using machine learning approaches, this research analyzes and forecasts phone pricing. A dataset with different properties is therefore subjected to two separate algorithms. The accuracy score is used to evaluate the results. Our research shows that the decision tree is the most effective method. decision tree technique outperforms support vector machine method. this technique offers the AUC value of 0.993. The methodology and modeling algorithm applied in this work may be adapted to other domains

like food, vehicles, housing, etc., to aid producers, sellers, and consumers in making well-informed choices regarding pricing and purchasing.

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