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House Price Prediction using Machine Learning

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Abstract - House price prediction is an essential task in the real estate sector, which proves to be helpful for buyers, sellers, and investors. The goal of this study is to forecast the price of a house using different parameters through **Machine Learning (ML) methods.** Here, we utilize regression **models like Linear Regression, Decision** Tree, and Random Forest to examine and forecast house prices. The used dataset has various features such as location, area, the number of bedrooms, amenities, and construction year. The accuracy level of the Random Forest model is higher than other models as indicated by the results. The suggested model offers a precise method of estimating house prices, thus supporting stakeholders in making the right decisions.

Key Words: House Price Prediction, Machine Learning, Regression Models, Random Forest, Linear Regression.

1.INTRODUCTION

The property market is one of the biggest and most active industries in the world, attracting investors, consumers, and vendors. With increasing urbanization, there has been a tremendous increase in demand for houses. Nevertheless, consumers of property often encounter problems like price manipulation and unequal pricing by brokers and websites. Many customers end up overpaying for properties that are not worth their quoted prices due to a lack of standardized pricing models.

In order to solve this problem, this study investigates the application of Artificial Intelligence (AI) and Machine Learning (ML) for accurate prediction of house prices. Using different supervised learning methods and algorithms, this research tries to find the most efficient way of estimating house prices based on various attributes. Also, a comparison analysis will be carried out to verify the correctness of various ML models in predicting house prices.

Between 2019 and 2025, the global real estate market has experienced volatility occasioned by economic fluctuations, pandemics, and changes in consumer preferences. This situation underscores the importance of having a standardized pricing mechanism to promote equitable and transparent transactions in the housing market.

Some studies have been performed on house price prediction, but few of them have addressed combining real-time data and sophisticated ML methods. The purpose of this paper is to fill that void by presenting a practical solution to price residential houses using real-world datasets. Data for this study is obtained from websites such as Kaggle, government housing records, and web scraping of actual real estate postings.

House price forecasting demands extensive knowledge of the property sector and its various contributing elements. There are several characteristics that contribute to determining a house's worth, including location, size, number of bedrooms and bathrooms, construction year, closeness to facilities, and area quality.

Also, market conditions, interest rates, and economic trends can affect house prices.
Most customers are not familiar with technical details regarding these parameters and thus are prone to overcharging while buying houses. To avoid such exploitation, this study suggests an AI-based solution that can accurately forecast house prices from past sales records. By training an ML model on large datasets with prominent property attributes, a trustworthy pricing mechanism can be created to help stakeholders make sound decisions.
This paper introduces a number of machine learning methods, which can be utilized in developing a sound house price forecasting model. The aim is to design a tool for AI that enables users to interpret the actual value of a house and thus promote fairness and transparency in the real estate business.

1.1 Problem Statement

Pricing a house depends upon numerous variables like location, size, number of rooms, facilities, and market conditions. Classical methods do not take into account the intricate interdependence among these variables, prompting an ML-based solution.

1.2 Objectives

- To investigate the variables that affect house prices.
- To create machine learning models to forecast prices.
- To compare the performance of models using suitable metrics.
- To validate the accuracy of various ML methods for house price forecasting.

2. Literature Review

A variety of machine learning-based studies have made predictions about house prices. Linear Regression is extensively used because of its ease but tends to perform poorly with non-linear data. Decision Trees and Random Forest models have performed better as they tend to learn complex relationships.

Artificial neural networks (ANN) or deep learning models have also been used to predict house prices but need large sets of data to train effectively.

2.1 Existing Research and Approaches

- Linear Regression: Suitable for continuous variables but has difficulty with complicated interactions.
- Decision Trees: Offer interpretability but are susceptible to overfitting.
- Random Forest: Mitigates overfitting by taking averages of many decision trees.
- Support Vector Machines (SVM): Suitable for dealing with high-dimensional data but computationally intensive.
- Deep Learning: Needs large datasets and computational power.

2.2 Data Preprocessing

- Data preprocessing is an essential step in Machine Learning. The data is processed and cleaned with the following methods:
- Missing Value Handling: Missing values are dropped or replaced by suitable estimates.
- Detection of Outliers: Outliers are detected and treated to avoid biased predictions.
- Feature Normalization: Standardization methods are used to transform data to a common scale.

2.3 Feature Selection

- Proper selection of features enhances model accuracy. Important attributes are:
- Area: The larger the property, the more costly it is likely to be.
- Number of Bedrooms and Bathrooms: The greater the number of rooms, the higher the cost.
- Amenities: If the property is close to a school, hospital, or public transport, value increases.

2.4 Model Selection

- Three Machine Learning models are chosen and compared with each other:
- Linear Regression: Defines a connection between independent features and the target variable.
- Decision Tree: Tree-based model for dividing data in accordance with attributes.
- Random Forest: A type of ensemble learning that uses a combination of several decision trees to provide a more accurate prediction.

2.5 Model Evaluation

- Models are measured based on the following:
- Mean Squared Error (MSE): It measures the average squared difference between the actual and predicted values.
- R-Squared Score: It measures how well the model predicts variance in the data.

3. Results and Discussion

3.1 Model Performance

- The three models were trained and tested based on actual house price data. The following results were achieved for each model:
- Linear Regression: Reasonable performance with an R-squared value of 0.75.
- Decision Tree: Improved performance with an R-squared value of 0.83 but overfitting.
- Random Forest: Best performance with an R-squared value of 0.91, the most dependable model.

3.2 Feature Importance

- Random Forest gave us the most significant features:
- Location: Being close to the city greatly enhances price.
- Area: The larger the property, the higher the price.
- Number of Bedrooms: The more bedrooms, the higher the price.

4. Comparison with Existing Models

- Historic house price estimation techniques are based on manual appraisal, which can be inexact and subjective. In comparison with traditional techniques, ML models provide:
- Increased Accuracy: Computerized analysis of large data samples enhances accuracy.
- Efficiency: Speedier price estimations compared to human assessment.
- Scalability: Able to process enormous property data in a range of markets.

5. Challenges and Limitations

- Despite its precision, the ML approach to house price forecasting has a few challenges:
- Data Quality: Inaccurate or incomplete data can affect predictions.
- Feature Selection: Features that are irrelevant can decrease model efficiency.
- Market Fluctuations: External factors and economic changes influence house prices.

6. Future Scope

- Future work can include:
- Incorporating Deep Learning Models: Neural networks to improve accuracy.
- Real-time Price Prediction: Web application integration with the model for real-time updates.
- Geographical Factors: Adding location-based pricing information.

7. Conclusion

- The real estate sector is an intricate and dynamic business that necessitates correct and transparent pricing frameworks. This paper offers a data-driven methodology by applying AI and ML to provide effective house price predictions. Leveraging past records and sophisticated algorithms, we were able to come up with a strong model capable of surpassing conventional techniques. The Random Forest model was found to be the most accurate model, yielding strong price estimates of residential houses.
- Future developments may involve real-time data integration and deep learning methods to enhance accuracy further. This research provides a basis for the development of a standardized pricing system that will be beneficial to all the stakeholders in the real estate industry.

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