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Novel Technique for Price Prediction by Using Logistic, Linear and Decision Tree Algorithm on Deep Belief Network

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Abstract--- *The aim is to provide a house price prediction system which helps in finding the exact price of the house based on various parameters. In today's world, House prices keep changing day in and day out and sometimes are hyped rather than being based on valuation. Predicting housing prices with real factors is the main motive of our project. Here we aim to make our evaluations based on every basic parameter that is considered while determining the price. We use various regression techniques in this pathway, and our results are not only based on one technique rather it is the weighted mean of various techniques to give most accurate results. This approach will help us get minimum error and maximum accuracy than individual algorithms applied. The existing system involves in calculation of house prices without the necessary prediction about future market trends and price increase. Houses are very expensive sometimes which are totally not worth the price. To avoid this problem where the customers are forced in paying high amount of price we propose our system.*

Keywords--- *Linear Regression, Machine Learning, Parameters, Logical Regression, Prediction*.

I. INTRODUCTION

The real estate is a requirement for everybody with different requirements. It's also the least transparent industry present around. The price fluctuation of a real estate is really high. There is variation in the price on different days. The fluctuation may impact the household investment highly. It is a very important impact factor for investing companies, real estates, banks and policy makers. Hence, it can be taken as an important economic index[1]. However, there have been too many influence variables and parameters, also the effects are too complicated to understand or predict easily [1]. The housing market is also one crucial element of the national economy. Therefore, forecasting housing values is not only beneficial for buyers, but also for real estate agents and economic professionals. One particular reason to decide to make such a model is that there are many factors that influence the potential price of a house, making it more complicated for an individual to decide how much a house is worth on their own without any external help [3]. This can lead to people making poorly informed decisions about whether to buy or sell their houses and which prices are reasonable. Because houses are long term investments, it is imperative that people make their decisions with the most accurate information possible. This paper would help efficiently

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analyzing previous market trends and price ranges, to predict future prices [3-4]. This proposed system brings together the latest research on prediction markets to further their use by economic forecasters. It provides a description of prediction markets, and also the current markets which are useful in understanding the market which helps in making useful predictions [2]. Thus, there is an arge to predict the efficient house pricing for real estate customers with respect to their unique budgets and priorities. This paper uses linear regression algorithm [1] to predict prices by analyzing current house prices, thereby forecasting the future prices according to the user's requirements. It uses various other algorithms and tests the accuracy and precision between all of them. Now, Property prices depend on various parameters in the economy and society. However, previous analyses show that house prices are strongly dependent on the size of the house and its geographical location. We have also considered various intrinsic parameters (such as number of bedrooms, living area and construction material) and also external parameters (such as location, proximity, upcoming projects, etc.) [8]. Then we have applied these parameter values to different machine learning algorithms. We use various regression techniques in this pathway, and our results are not sole determination of one technique rather it is the weighted mean of various techniques to give most accurate results. The results proved that this approach yields minimum error and maximum accuracy than individual algorithms applied [5].

II. PROPOSED SYSTEM

The proposed system of our project is a very novel approach towards prediction of the house prices in various localities in and around the city. As the algorithms used in the previous systems which were used for the purpose of prediction of house prices gave very vague results and also their implementation is quite difficult as compared to those which are being used in the proposed system of house price prediction. The previous house price prediction systems did not take future market trends and future price increases into consideration while calculating the price whereas the proposed system takes care of such factors very efficiently while calculating the price. Moreover the previous price prediction system were much less efficient as they did not even considered parameters like condition of the house, age of the house, location of the house and a few more similar parameters while predicting the price of the house. On the other hand the proposed system is taking care of parameters like condition of the house, age of the house, location of the house very coherently. Apart from the various above mentioned flaws the existing system lacks very crucial features like searching a property in a specific location as per the demand of the customer. In the proposed system the feature of searching the property at a specific location as per the demand of the customer is added and will be implemented using the concept of data mining. The proposed system is very advance in its functionalities as it is having the capability to calculate the price of the house by taking care of various parameters like square feet area, number of bedrooms, number of washrooms, type of flooring, type of furnishing, lift availability, parking availability, safety and security features, children play area, condition of the house, age of the house and many more similar parameters. The algorithms used in this proposed system are Linear Regression, Logistic Regression and Decision Tree Regression algorithm. All these algorithms that are being used in the proposed system are very accurate and quite easy to be learnt and implemented whereas the algorithms which were being used in the existing house price prediction systems were Ridge Regression, Forest Regression, Lasso Regression and Boosted Regression. All of these algorithms are quite vague while decision making and also a bit

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difficult to be understood and implemented. Considering numerous such factors which do not give the accurate result a new proposed system is developed whose some of the details are mentioned above. In the proposed system for house price prediction the algorithms used are Linear Regression, Logistic regression and Decision Tree Regression. The network that is used to read these algorithms without any error and efficiently use them to the maximum of their capabilities to obtain the most efficient result to satisfy the requirements of the customer to the maximum extent the Deep Belief Network (DBN) is being used. By the combination of various regression algorithms and the Deep Belief Network (DBN) the results obtained by the proposed house price prediction system are very reliable unlike the results which were obtained by the previous house price prediction system on which the customer absolutely could not rely on. One of the important feature that is added in the proposed system of house price prediction is that it helps in finding the area in which the customer wants the house. This feature is implemented using the concept of data mining. So the proposed system is considered to be quite efficient and reliable as compared to the previous house price prediction system.

Table 1: Parameters

Parameters	**Data types**	**Description**
Over all Qual	Numerical	Rates the overall material of the house
Garage Cars	Numerical	Calculates the size of garage in capacities
Full Bath	Numerical	Full Bathrooms
Year Built	Numerical	Date of the original construction
Year Sold	Numerical	The year house was sold
Pool Area	Numerical	Area of pool in square feet
Garage Area	Numerical	Size of garage in square feet
Sale Price (Dependent Variable)	Numerical	Selling price of the house
Basement	Numerical	Size of the basement in square feet
No_of_balcony	Numerical	The number of balcony in the house
Living Area	Numerical	Size of living area in square feet

2.2.1 Methodologies

Methodology is basic representation of the description that is to be followed. It is consisted of numerous milestones that are to be achieved in order to accomplish the desired objective. Some of the steps that have been undertaken by us are represented underneath.

2.2.1.1 Linear Regression

Linear regression will be termed as a linear approach to modeling the connection between a scalar response and one or an additional freelance variable. The case regarding to only one explanatory variable is called simple linear regression. For the case where more than one explanatory variable are present, the process is called multiple linear regression. This term is totally distinct from multivariate linear regression, where multiple correlated dependent variables are predicted, rather than just a single scalar variable which is in the case of multiple linear regressions. In linear regression algorithm, the given relationships are systematically modeled using linear predictor functions for which the unknown model parameters are estimated from the pre-acquired data. The models of this category are called linear models. Just like various all other regression analysis techniques, linear regression emphasizes on the conditional probability distribution of the response. Linear regression was the very first type of regression

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analysis technique to be studied thoroughly, and to be used widely in numerous practical applications. The reason behind the wide usage of such models is that such models depend linearly on their unknown parameters and are easier to fit than the models which are non-linearly related to their respective parameters.

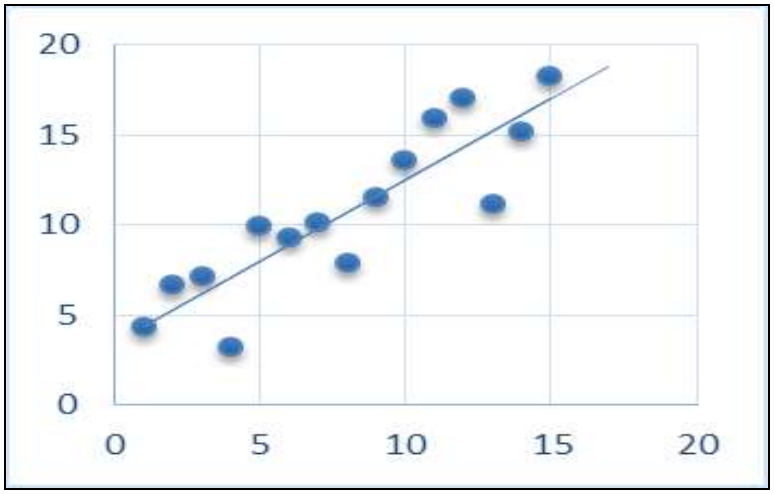

Fig. 1: Linear Regression Graph

Regression analysis explains the relationship between a dependent variable, which is usually denoted by Y, and a number of independent variables, X1, X2, X3...., Xp. In most regression analyses, the variables are assumed to be continuous. In this regression, there is only one independent variable. The model for Multiple Linear Regression is be represented as:

$$E\,(Y/X) = \beta 0 + \beta 1X1 + \cdots + \beta pXp \quad (1)$$

where β0 is known as intercept and βj is called slopes or regression coefficients. These coefficents play an important role. The distinction between the different, anticipated and also the actual price of Y is termed the error (ε) or can be written as $\varepsilon = Y - Y$. Then, regression equation without errors can be express as:

$$Yi = \beta 0 + \beta 1Xi,1 + \cdots + \beta pXi,p + \varepsilon i \qquad (2)$$

where Yi is that the actual price and εi is that the error for the ith observation. We write Xi,j for the jth variable measured for the ith found observation. The main assumptions taken for the errors εi is shown that E(εi) = 0 and var(εi) = σ^2.

2.2.1.2 Logistic Regression

According to the different regressions, the logistic model is a broadly used statistical model that uses easy logistic functions to model a variable which gives binary resultant. In this regression many more complex extensions exist. In the various regression analysis techniques, logistic regression is used for various purposes including estimating the parameters of a logistic model which are in the form of binomial regression [16-21]. Mathematically, a binary logistic model always has a dependent variable with two possible values for each variable, such as pass/fail, win/lose, alive/dead or healthy/sick and various other possible complementary conditions. These conditions are represented by an indicator variable, where in the two possible values are labeled as "0" and "1".

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The unit of activity for the log-odds scale is termed as logit. To establish baseline performance with a logistic classifier, we used Logistic Regression to predict the price targets, Si, as a logistic function of the data, X

$$Si = 1 \div (1 + e^{-Xi\beta + \varepsilon i}) \quad (3)$$

Si represents the continuous variable which lies between zero and one. Xi represents the independent data and represents some errors which are symmetrically distributed around zero and variance, our dependent variable is continuous in nature and not bounded. However, this function gives us a binary output whose probability is bound in between zero and one, thus we transform this logistic distribution into a simple linear regression function.

$$\log(Si \div (1 - Si)) = Xi\beta + \varepsilon i \quad (4)$$

Assume that Si is a logistic function of a vector of independent variable like X. The actual values of Si can then be described by the equation:

$$Si = 1 \div (1 + e^{-Xi\beta}) \quad (5)$$

The resulting error term can be given by:

$$\mu i = \log(S'i \div (1 - S'i)) - \log(Si \div (1 - Si)) \quad (6)$$

2.2.1.3 Decision Tree

In computer science and industrial engineering and machine learning, Decision tree learning algorithm uses a decision tree to start from observations about an item and proceed up to the conclusions about the item's desired value which is represented in the leaves [22-29]. It is one of the best predictive modeling approaches that are being used in statistics, data mining and machine learning. Tree models in which the target variable can take a discrete set of values are known as classification trees. In these tree structures, the leaves represent class labels and the branches in these tree structures represent conjunctions of features.

Decision trees in which the target variable can take continuous values are called regression trees. In decision analysis, a decision tree can be used for representing the decisions and the decision making visually and explicitly. In regard to data mining, a decision tree describes data. We use binary trees that will continuously and repeatedly partition the predictor vector into different subsets such that our target value **y** is more homogenous. **x** represents the vector of predictors x=x1,x2,x3,...,xn. A decision tree with **t** terminal nodes is used for communicating the classification decision. A parameter Ø = (Ø1, Ø2, Ø3,…. Øt) associates the parameter value Øi(i=1,2,3,...,t) with ith terminal node. The partitioning procedure searches through all the present values of predictor variables to find the variable x that provides best partition into child nodes. The best partition will be the one that minimizes the weighted variance. A special case of a decision tree is a decision list, which is a simple one-sided decision tree, so that each and every internal node has exactly 1 leaf node and only 1 internal node as a child. Anyway the least expressive, decision lists are comparatively with others are easier to understand than general decision trees due to their increased efficiency, sacristy, permit non-greedy learning methods and various constraints which are to be imposed.

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2.2.1.4 Deep Belief Network

In machine learning and artificial intelligence concept, a deep belief network (DBN) is a simple generative graphical model, or in other words a class of deep neural network which is composed of numerous and various layers of latent variables, with interconnected layers but there should absolutely be no connection between units within each layer. Once trained on a set of examples without supervision, a DBN can learn to probabilistically regenerate its inputs.

The layers then acts simply as feature detectors [30-36]. After the learning step is concluded, a DBN can further be trained with supervision to perform varied classifications. DBNs can also be viewed as a mixture of simple, unsupervised networks like restricted Boltzmann machines (RBMs) or autoencoders, where the hidden layers of each sub network serve as the visible layer. An RBM is a single directed which generates high energy and therefore is an energy-based model with a "visible" input layer, hidden layer and connections between them but not within various layers [37-44]. This mixture leads to a fast and quick, layer by layer checking of an unsupervised training procedure, where multiple divergences is applied to each sub network possible, which in turn starts from the lowest pair of layers and ending on the highest. The observation that DBNs can be trained greedily, single layer at a time, led to the construction of one of the first effective deep learning algorithms. There are many attractive implementations of DBNs in real-life applications and scenarios.

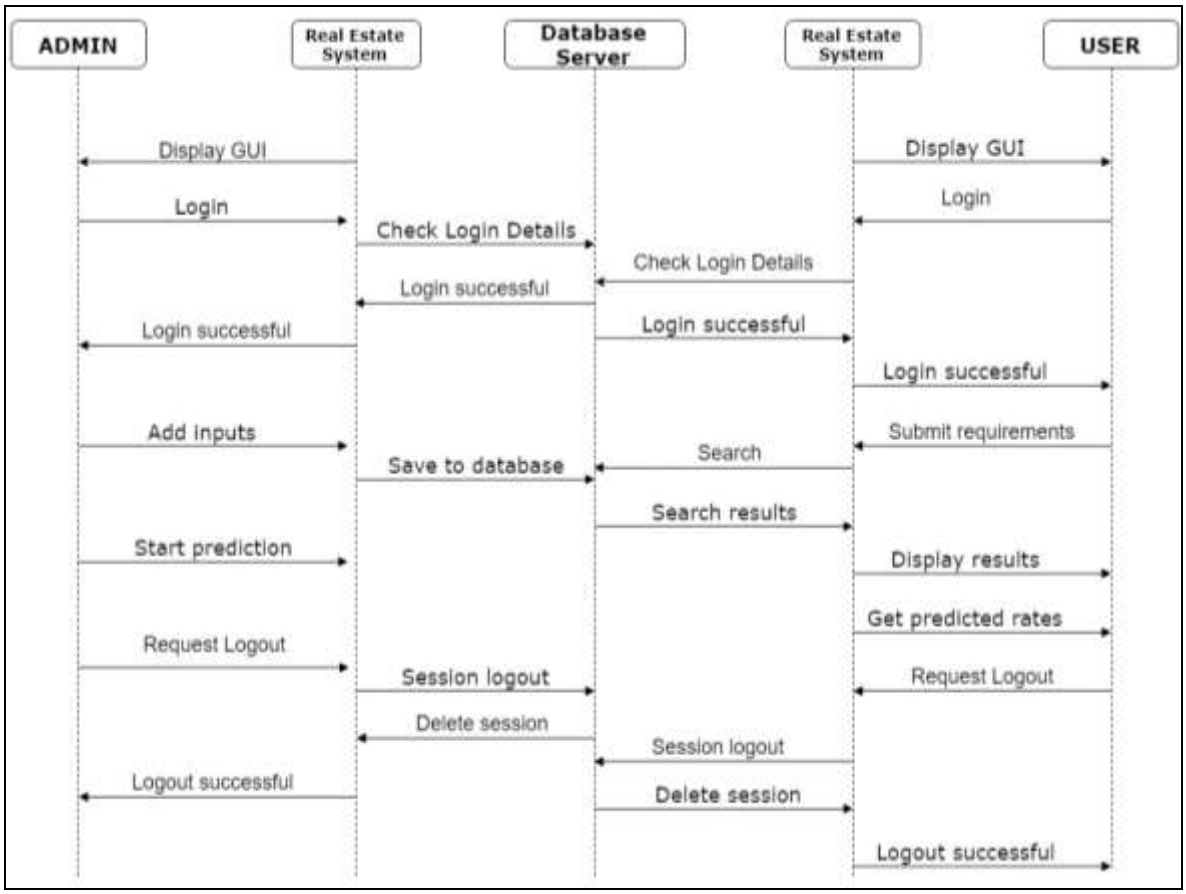

Fig. 2: Architecture Diagram

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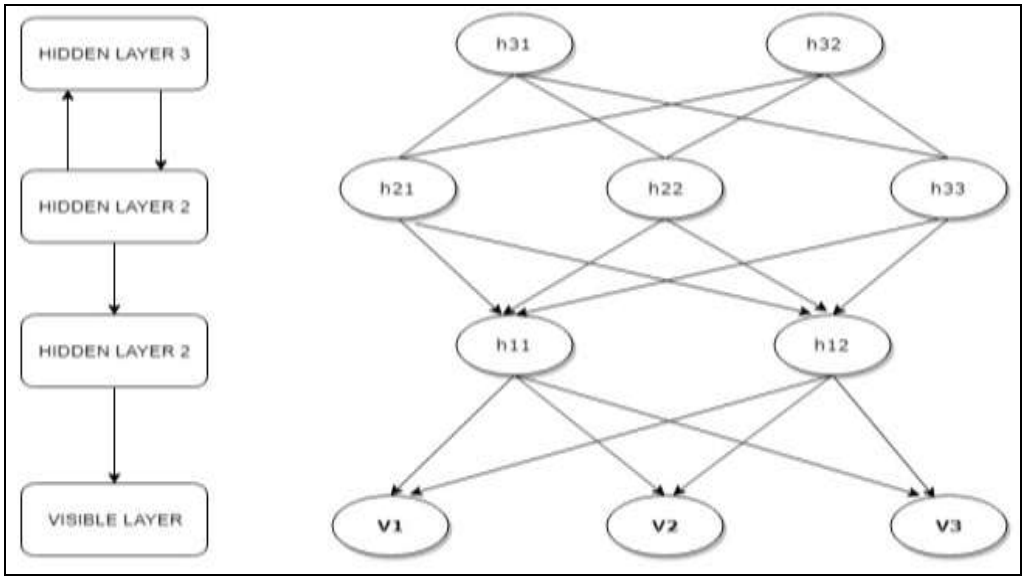

Fig. 3: Deep Belief Network

All the lower layers are directed with the pointed arrows. It converts the associative memory into the observed variables collected. The lower layer known as the visible layer receives the input which can be either binary or can be real [45-52]. The correlations in the data are captured and represented the hidden units in the representation.

III. RESULT

The following section involves the result of various algorithms that have been used to do the implementation of the project on house price prediction by considering various parameters like square feet area, number of bedrooms, number of washrooms, type of flooring, type of furnishing, lift availability, parking availability, safety and security features, children play area, condition of the house, age of the house and many more similar parameters. The major attraction of this project is that it is able to search the property in a specific location as per the demand of the customer. The statistical values of the results obtained by using various different algorithms are mentioned below in the tabular column.

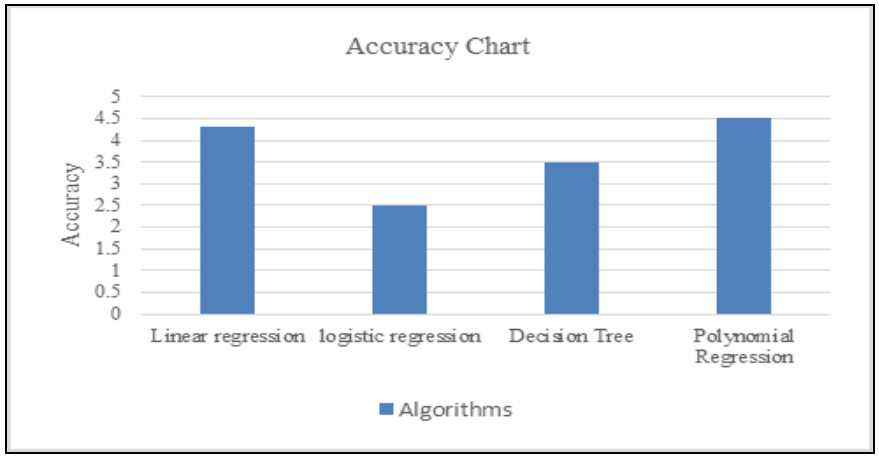

Fig. 4: Algorithm Accuracy

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Table 2: Results

Algorithms	Accuracy	R-Square	MAE
Linear Regression	87.25%	0.978	64532
Decision Tree	74.03%	0.990	6242
Logistic Regression	63.09%	0.73	21345
Polynomial	71.23%	0.968	5.17

On performing the comparison between the various models we can conclude that decision tree regression algorithm works best with the highest accuracy amongst all other regression algorithms.

IV. CONCLUSION

On undergoing a lot of thorough research from various sources and also studying and implementing our project it can be concluded that the previous models that were developed for the purpose of prediction of the house prices were not as efficient and accurate as the proposed model for house price prediction. The algorithms used in existing systems were Ridge Regression, Forest Regression, Lasso Regression and Boosted Regression. These algorithms were difficult to be understood and implemented. Moreover these algorithms did not assure the accuracy of the result and are mostly expected to give vague outputs. On the other hand the algorithms used in the proposed system are Linear Regression, Logistic Regression and Decision Tree Regression algorithm. All these algorithms that are being used in the proposed system are very accurate and quite easy to be learnt and implemented. The network that is used to read these algorithms without any error and efficiently use them to the maximum of their capabilities to obtain the most efficient result to satisfy the requirements of the customer to the maximum extent is the Deep Belief Network (DBN).

The proposed system is even very advance in its functionalities as it is having the capability to calculate the price of the house by taking care of various parameters like square feet area, number of bedrooms, number of washrooms, type of flooring, type of furnishing, lift availability, parking availability, safety and security features, children play area, condition of the house, age of the house and many more similar parameters. One of the important features that are added in the proposed system of house price prediction is that it helps in finding the area in which the customer wants the house. This feature is implemented using the concept of data mining. The previous house price prediction systems did not take future market trends and future price increases into consideration while calculating the price whereas the proposed system takes care of such factors very efficiently while calculating the price. So hereby it can be concluded that by the combination of various regression algorithms and the Deep Belief Network (DBN) the results obtained by the proposed house price prediction system are very reliable and therefore the proposed system is considered to be quite efficient and reliable as compared to the previous house price prediction systems.

V. FUTURE ENHANCEMENTS

After sincerely going through the entire implementation and documentation of the project it can be figured out that some future enhancements are possible and should be done in this project which firstly may include the use of various other regression algorithms like Stepwise Regression, Elasticnet Regression, Quantile Regression, Poisson Regression, Cox Regression etc. to get a wider range of outcomes from which we can choose the value of the result which we find the most accurate in terms of customer satisfaction. The benefit that we will be getting by

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implementing the same project with various different algorithms is that firstly we can check the robustness of the project and apart from that we will also get a range of outcomes to choose the best result from them. We will also use some other type of neural networks like Convolutional Neural Network, Radial Basis Function Neural Network, and Recurrent Neural Network etc. Secondly we will also try to implement this project with real time inputs where this project may be used for the purpose of prediction of house prices in some particular area or a small locality. By doing so the efficiency of this project can be judged accurately that it can function in real time situation or not. Apart from doing its implementation various other features can be added in this project which can beautify the user interface and will also help the customers by providing the desired output as per the needs of the customer. Furthermore, a different and a better UI/UX can be integrated to the project for better visualization of the results using augmented reality. Once the project is proved to be a success and has accomplished all the desired targets on a smaller scale then hence forth it can be made better and more polished so that it can be used on an even bigger scale with the most accurate outputs which are in turn quite helpful for the customers for obtaining some assistance at the time of predicting the house prices.

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