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Earthquake Depth Prediction Using Machine Learning

K. Sai Sri Ramya[1], S. Venkatesh[2], J. Keerthi[3], T. Sudha Rani[4], Ravi Kishore Veluri[5]

[1,2,3] Student, [4,5]Associate Professor

[1,2,3,4,5]Department of CSE, Aditya Engineering College (A), Surampalem, A.P, India

ABSTRACT:

Earthquakes are one of the most dangerous natural hazards and the damage they cause is enormous. Geologists used various methods to predict the probability of earthquakes, but studies have still failed to determine the likelihood of an earthquake occurring in a particular area. The depth of earthquakes can be predicted, which is more beneficial in protecting people and making them aware of the damage that will occur. By using various machine learning algorithms, we can predict the depth of an earthquake. Compare different algorithms to produce the best accuracy results. The proposed method extracts relevant features from seismic data and trains a random forest regression model to predict earthquake depth. The performance of the proposed method is assessed using various evaluation metrics including R2 score, root mean square error (MSE), and root mean square error (RMSE). The results show that the method achieves good accuracy in predicting the depth of possible earthquakes in various regions in the future.

Keywords: Machine Learning, Linear Regression, Short term prediction, Support vector Regressor, Random Forest Regressor

1. Introduction:

Earthquake Most Preventing destructive natural disasters by building various decision trees Predicting the depth of earthquake-prone areas can help mitigate the effects of these hazards. In this paper, we propose a machine learning model for earthquake depth prediction using a random forest regressor. Increased urbanization has led to an increase in earthquakes, a major disaster that accounts for 65% of all deaths from natural disasters. People cannot prevent natural disasters, but they can take necessary preventive measures by using the application of machine learning, as a new field of study in geology, it is a personalized and applicable technique for people. geologists to predict natural disasters, which has a great impact on nature Fewer deaths from disasters. ML is a branch of AI that allows users to generate large amounts of data through computer algorithms and analyze the computer to make recommendations and results based on the input data. The most popular machine learning methods are supervised and unsupervised learning. Supervised algorithms There are two types of classification and regression algorithms. The main advantage of using machine learning is that once a model has learned what to do, it can automatically derive its operations. Recommendation engines are the most common use of machine learning. Others are more commonly used in fraud detection, spam filtering, malware threat detection, business process automation (BPA), and predictive maintenance. A random forest regressor is a regression algorithm. This is method of the learning phase. Consider the average output of a decision tree. By using the jar framework, it is possible to give input and show in-depth output. Have used the flask framework The depth of earthquakes in an area can be predicted.

2. Related Work:

Geologists and researchers have done a lot of research on earthquakes from different perspectives in terms of prediction and prospective analysis. During earthquakes above the surface, they will perform various types of geophysical processes. These underground activities lead to changes in underground emissions, electric fields and the ionosphere. These changes have been analyzed and mapped respectively with large earthquakes [1]. Earthquake prediction has also been learnt by observing physical and atmospheric changes in different animals [2]. A study of physical and atmospheric animals relies on motion-activated cameras in a Peruvian national park. Rejection of animal activity was observed before 7.0 Contaman earthquake in 2011. The main aim of this research is to understand the prediction of earthquakes using computer and machine learning methods [2]. Based on the work of Thomas Bayes, the Naive Bayes algorithm is a simplified model that counts frequent occurrences by considering given combinations of values and frequencies in a data set. Bayesian classification assumes that the data belongs to a certain class and then calculates the probability that this assumption is true. Naïve Bayes It is based on a strong assumption of independence, in other words, the result of a condition on a data field does not affect the result of another characteristic .However, assumptions can be updated each time a new field is added. Bayes' theorem calculates the probability that x will occur given that another event y has occurred: A(XY) = A(YX). A(X) A(Y) where A(X) and A(Y) event X and event Y occur, P(X)Y) represents the possible occurrences of X given Y, and P(YX) is the result of Y given X [3]. Classic applications of meta-learning are used and found in classification, regression and reinforcement learning, and can be combined with the most commonly used machine learning algorithms and models, backpropagation (BP) . Although many existing techniques attempt to address this model, mostly they used explicit features proposed by geologists and implicit features observed by deep learning models to analyze earthquakes for earthquake prediction. Using ANN algorithm to predict the magnitude, accuracy reaches 78%.79 Earthquake prediction accuracy at hours [4]. Mixing these two categories of factors to enrich the earthquake's prediction performance is still relatively easy and easily achievable. To solve this problem, they proposed a DL method called DLEP to effectively use indirect and direct features for

accurate prediction of earthquake. In DLEP, we employ 8 key causal factors as indirect features and use a CNN to take the features embedded in [5] region.

3. Proposed Methodology:

The proposed model uses latitude, longitude and size to predict depth. The dataset for training the model is extracted from Kaggle and contains data from 1965 to 2016. Use the data trained by the Random Forest regressor to predict depth of earthquakes. Evaluate model performance using root mean square errors (MSE), root mean square errors (RMSE), and R2 scores. The Random Forest algorithm is a supervised learning technique that used for classification and regression problems in the field of machine learning. The Random Forest algorithm is the widely used technique for regression problems. The true random regression algorithm is randomly generated and decisions are made through generated random draws. Random Forest Regression calculates the average of all predictions to produce a good estimate of the expected depth of the earthquake. Random Forest Regression is used to predict real-time methods and business criteria and can be used for future product prices/costs, revenue forecasting, and performance comparison. It offers excellent accuracy, scales data well, is interpretable, and easy to use. Random Forest Random Forest Regression produces a two-step process:

1. Building Decision Trees

2. Mean Predictions on Estimators.

This will be the default 100 scikit leather estimators. scikit-learn is a machine learning python library for data modelling. These trees are constructed using the hyperparameters specified in the model. Each resulting decision tree predicts an output number for a given input. The average number of predictions made by random forest regression, considered its "final" result.

The proposed model consists of the following steps:

1. Data collection: We collected a dataset from Kaggle containing all earthquakes with magnitude greater than 5.5 from 1965 to 2016.
2. Data pre-processing: In this step, we cleaned the data, removed null values and removed unnecessary columns. 3.Split Data: In this step the dataset is split for training and testing
3. Feature scaling: In this step, we perform standard scaling on the dataset to normalize the independent variables in the dataset.
4. Implementation of Algorithm : Here we apply Random Forest Algorithm to train the model to get good accuracy in predicting earthquake depth. The model test accuracy was 98% and the model training accuracy was 88%. Algorithm Comparison: Here we compare various kinds of machine learning algorithms such as Multiple Linear Regression, KNN Regression, Decision Trees, and Support Vector Regression. We use the Random Forest algorithm because it offers good accuracy compared to other algorithms. Calculate various metrics such as R2 score, root mean square error for each model.
5. Evaluation of the model: We tested the performance of the model using mean squared errors, mean absolute errors, and R2 score. The training accuracy using the random forest regressor is 0.979053, the R2 score is 0.8744, and the value of root mean square error is 44.877, the average absolute error value is close to 5.

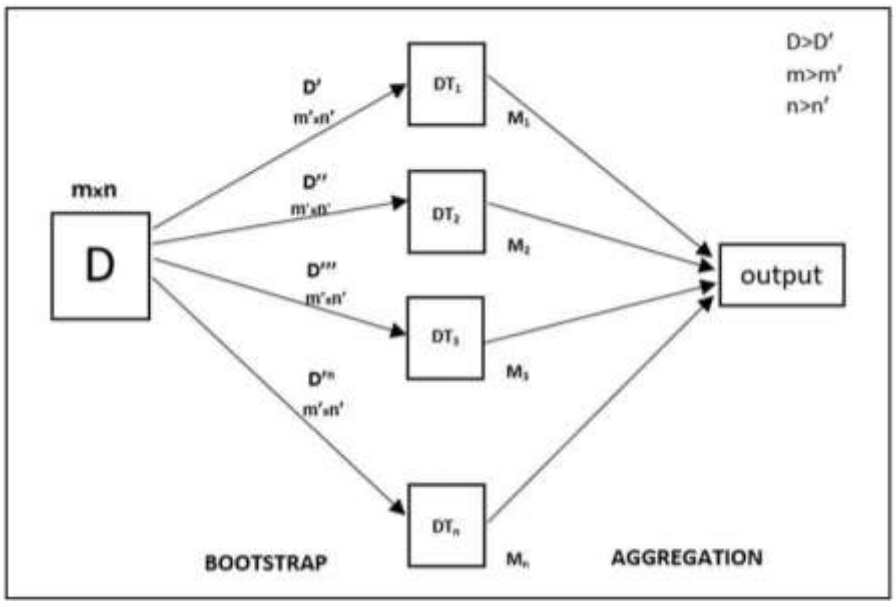

Fig.1. Random Forest working

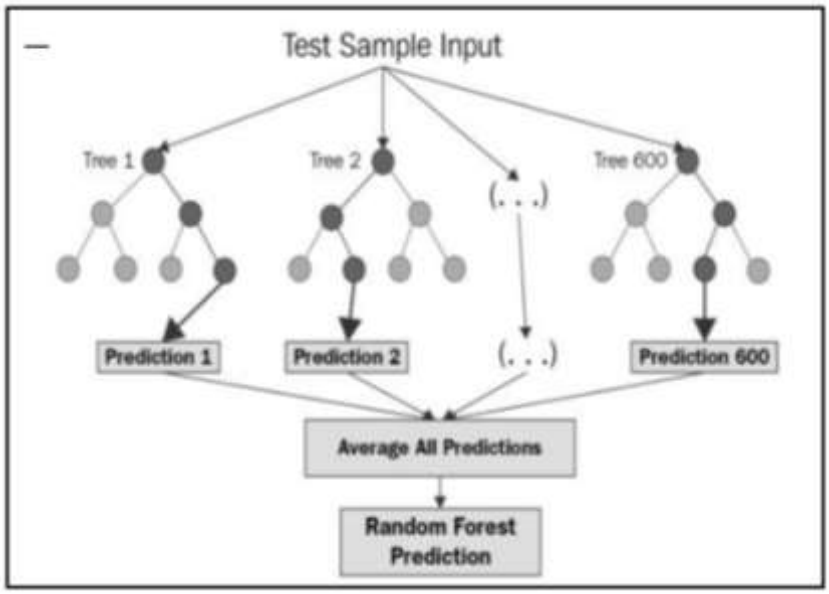

Fig 2. Overview of random forest regressor algorithm

4. Results and Discussions:

We have verified the proposed model using the dataset collected from Kaggle website and the results showed that proposed model obtained a good accuracy in predicting the depth of earthquake. The model obtained an accuracy of 88% in testing the model and 98% accuracy in training the model. The random forest regressor has a R2 score value of 0.8752, In result comparison module different ml algorithms like multiple linear regressions, KNN regressions, Decision trees and Support vector regression are used and when these algorithms are trained and accuracy is tested, multiple linear regressions gave R2 score of 0.011852, KNN regressions gave R2 score of (0.6080), Decision trees gave R2 score of (0.5165) and support vector regressions gave R2 score(- 0.09170).The mean square error is low by using the random forest algorithm that is 44.877. The model can predict the depth of the earthquake.

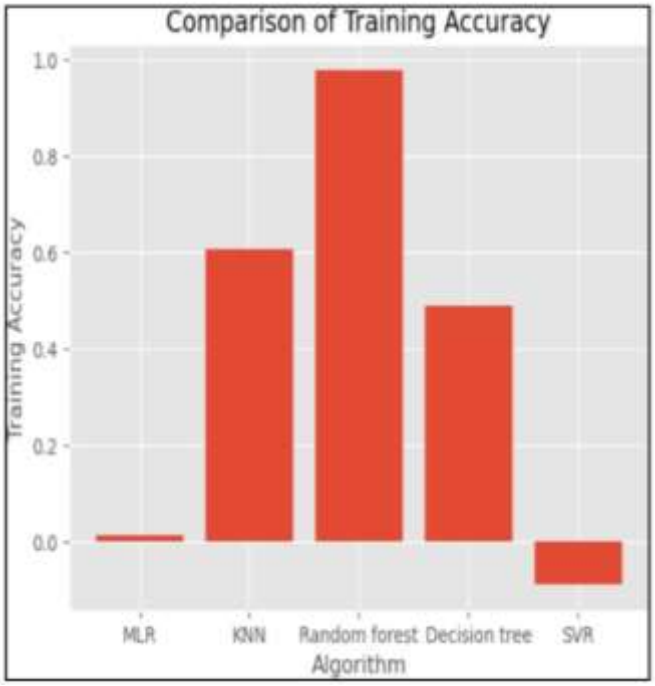

Fig 3. Comparison of training accuracy

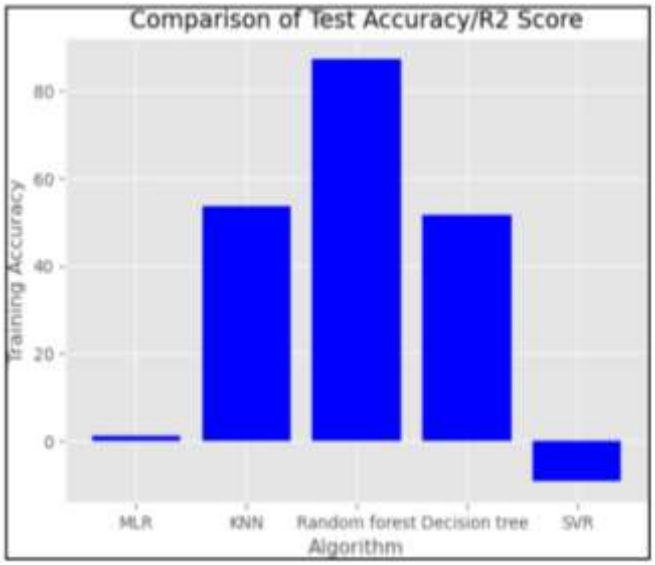

Fig 4. Comparision of testing accuracy

S.No	ALGORITHM USED	TRAINING ACCURACY	R2 SCORE	MEAN SQUARED ERROR
1	Multiple Linear Regression	0.01182	0.011852	126.1790
2	KNN Regression	0.6080	0.538007	86.27675
3	Random Forest Regression	0.979053	0.8744	44.877
4	Decision Tree	0.4896	0.5165	88.259
5	Support Vector Regression	-0.08850	-0.09170	132.6261

Fig 5.Comparison table of various algorithms

Fig 6. Depth predicted at Indonesia

Fig 7. Homepage of the model developed.

5. Conclusion and Future work:

This paper compares several machine learning algorithms for good accuracy in predicting the depth of earthquakes. Random forest regressor has good accuracy compared to other machine learning algorithms in predicting earthquake depth. The proposed model takes into account various geographical factors to predict the depth of earthquakes. The proposed model can be used to identify the areas most vulnerable to earthquakes and take appropriate measures to protect human life and infrastructure. Currently we have used machine learning to predict depth, in the future we may use deep learning techniques to provide more accurate results than this algorithm. And the dataset can also be improved in the future, possibly with more columns of data, providing more data for prediction. It is impossible to develop a model that can satisfy all the necessary needs required by the user. Results can be further improved by including more parameters as prediction inputs.

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