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PREDICTION OF MAJOR EARTH QUAKE EVENTS USING DIFFERENT MACHINE LEARNING ALGORITHMS

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ABSTRACT_ At least two basic categories of earthquake prediction exist: short-term predictions and forecast ones. Short term earthquake predictions are made hours or days in advance, while forecasts are predicted months to years in advance. The majority of studies are done on forecast, taking into consideration the history of earthquakes in specific countries and areas. In this context, the core idea of this work is to predict whereas an event is classified as negative or positive major earthquake by applying different machine learning algorithms. Eight different algorithms have been applied on a real earthquake dataset, namely: Random Forest, Naive Bayes, Logistic Regression, Multi Layer Perceptron, AdaBoost, K-nearest neighbours, Support Vector Machine, and Classification and Regression Trees. For each selected model, various hyperparameters have been selected, and obtained prediction results have been fairly compared using various metrics, leading to a reliable prediction of major events for 3 of them.

Keywords: Random Forest, Naïve Bayes, Logistic Regression, AdaBoost, KNN, Support Vector Machine and Multi-Layer Perceptron Classifier

1.INTRODUCTION

Rapid global urbanization leads to an increase in earthquakes, a major catastrophe which has occupied 60% of deaths overall natural disasters [8]. Obviously, human cannot stop natural disasters, while the application of machine learning is a powerful and invaluable method and technique, used by researchers as new area of study in geology, in order to reduce, as much as they can, the loss of life and billions of dollars in infrastructure and housing costs. Traditional classification methods rely on statistical assumptions for earthquakes that turn out to be unsatisfactory in danger state prediction. Therefore, the use of machine learning algorithms is becoming more widespread, that adapt and learn a problem by simulating a biological or natural system. Introducing the machine learning techniques in the field of geology and earthquake beats the traditional and standard methods used in earlier years and provides the scientists a new fresh method for assessing seismic risk and triggering future earthquakes. Data mining applications have achieved great success in geophysics and geology such as ecology, weather prediction, modelling, etc. and finally predicting the earthquakes. Two basic categories of earthquake prediction exist: short-term predictions and forecast ones. Short term earthquake predictions are made hours or days in advance, while forecasts are predicted months to years in advance. Due to the chaotic and complex phenomena of earthquake process, it is considered that short-term predictions are very difficult to address. Thus, the majority of studies are done on forecast, taking into consideration the history of earthquakes in specific countries and areas.

The core idea of this work is to predict whereas an event is classified as negative or positive major earthquake by applying different machine learning algorithms. It is well known that there is no best algorithm or one solution that fits all the problems and datasets for machine learning since the performance of algorithms depends on many factors. Some algorithms are best for small data, while others perform better for a tons of data sample. Some algorithms require categorical inputs, while others need quantitative. Another important criterion while choosing the algorithm is the complexity of the dataset and how many features the model needs to learn and predict. This is why, in this work, eight different algorithms have been applied on an earthquake dataset, namely: Random Forest, Naive Bayes, Logistic Regression, Mult iLayer Perceptron, AdaBoost, K-nearest neighbours, Support Vector Machine, and Classification and Regression Trees. For each selected model, various hyperparameters have been tested, and obtained prediction results have been fairly compared using various metrics, leading to a reliable prediction of major events for 3 of them.

2.LITERATURE SURVEY

[1] KM Asim, F Mart ınez-Alvarez, A Basit, and T Iqbal. Earthquake ´ magnitude prediction in hindukush region using machine learning techniques. Natural Hazards, 85(1):471–486, 2017.

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Earthquake magnitude prediction for Hindukush region has been carried out in this research using the temporal sequence of historic seismic activities in combination with the machine learning classifiers. Prediction has been made on the basis of mathematically calculated eight seismic indicators using the earthquake cata-log of the region. These parameters are based on the well-known geophysical facts of Gutenberg–Richter's inverse law, distribution of characteristic earthquake magnitudes and seismic quiescence. In this research, four machine learning techniques including pattern recognition neural network, recurrent neural network, random forest and linear programming boost ensemble classifier are separately applied to model relationships between calculated seismic parameters and future earthquake occurrences. The problem is formulated as a binary classification task and predictions are made for earthquakes of magnitude greater than or equal to 5.5 ,for the duration of 1 month. Furthermore, the analysis of earthquake prediction results is carried out for every machine learning classifier in terms of sensitivity, specificity, true and false predictive values. Accuracy is another performance measure considered for analyzing the results. Earthquake magnitude prediction for the Hindukush using these aforementioned techniques show significant and encouraging results, thus constituting a step forward toward the final robust prediction mechanism which is not available so far.

[2] Louise K Comfort. Self Organization in disaster response: The great hanshin, japan earthquake of january17, 1995. In Self organization in disaster response: The Great Hanshin, Japan earthquake of January 17, 1995. US University of Colorado. Natural Hazards center, 1995.

This report presents findings from a quick response study of the response system that evolved following the Great Hanshin, Japan, Earthquake on January 17, 1995. The study was initially designed to examine the processes of self organization specifically in the medical response to this earthquake. However, in making plans for the study, it became clear that the medical response was inseparable from the larger disaster response system, given the interdependent characteristics of local and intergovernmental disaster management in Japan. Consequently, this study addresses the process of self organization in the broader disaster response system for this earthquake, with particular attention to emergency medical services. Building a

community capacity for rapid transition in event of disaster is fundamental to effective disaster response. In every disaster environment, evidence exists of spontaneous reallocation of resources and reorganization of action to meet urgent human needs. However, such systems vary significantly in timing, efficiency, effectiveness, and reliability in practice, with associated costs in lives and property. This study explores the characteristics of self organization in order to characterize more accurately the dynamics of this process in a complex, interdependent, densely populated, metropolitan environment

[3] M. Gomes, R. Martins, J. J. Almeida, P. Henriques and P. Novais, "Hate Speech Classification in Social edia Using Emotional Analysis," 2018 7th Brazilian Conference on Intelligent Systems (BRACIS), 2018, pp. 61-66, doi: 10.1109/BRACIS.2018.00019.

Remote sensing continues to be an invaluable tool in earthquake damage assessments and emergency response. This study evaluates the effectiveness of multilayer feedforward neural networks, radial basis neural networks, and Random Forests in detecting earthquake damage caused by the 2010 Port-au-Prince, Haiti 7.0 moment magnitude (M_w) event. Additionally, textural and structural features including entropy, dissimilarity, Laplacian of Gaussian, and rectangular fit are investigated as key variables for high spatial resolution imagery classification. Our findings show that each of the algorithms achieved nearly a 90% kernel density match using the United Nations Operational Satellite Applications Programme (UNITAR/UNOSAT) dataset as validation. The multilayer feedforward network was able to achieve an error rate below 40% in detecting damaged buildings. Spatial features of texture and structure were far more important in algorithmic classification than spectral information, highlighting the potential for future implementation of machine learning algorithms which use panchromatic or pansharpened imagery alone.

3.PROPOSED SYSTEM

Proposed several machine learning models to classify whether there is a chance of occurring earthquake or not, but none have adequately addressed this misdiagnosis problem. Also, similar studies that have proposed models for evaluation of such performance classification mostly do not consider the heterogeneity and the size of the data Therefore, we propose a Random Forest, Naïve Bayes, Logistic Regression,

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AdaBoost, KNN, Support Vector Machine and Multi-Layer Perceptron Classifier to predict.

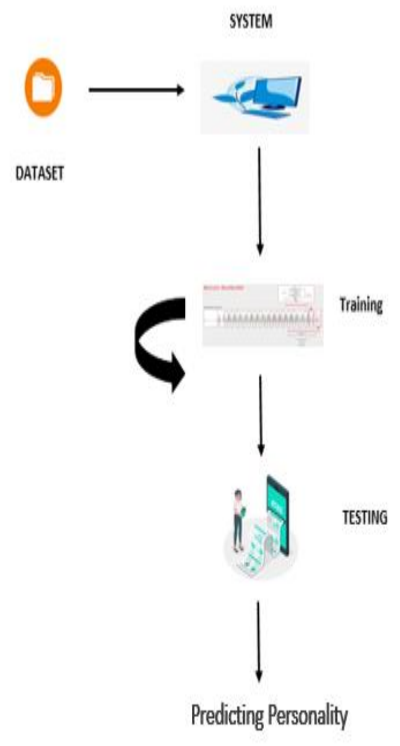

Fig 1:Architecture

3.1 IMPLEMENTATION

User:

View Home page:

Here user view the home page of the Hate Speech Classification web application.

View Upload page:

In the about page, users can learn more about the hate speech prediction.

Input Model:

The user must provide input values for the certain fields in order to get results.

View Results:

User view's the generated results from the model.

View score:

Here user have ability to view the score in %

System

Working on dataset:

System checks for data whether it is available or not and load the data in csv files.

Pre-processing:

Data need to be pre-processed according the models it helps to increase the accuracy of the model and better information about the data.

Training the data:

After pre-processing the data will split into two parts as train and test data before training with the given algorithms.

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Model Building

To create a model that predicts the personality with better accuracy, this module will help user.

Generated Score:

Here user view the score in %

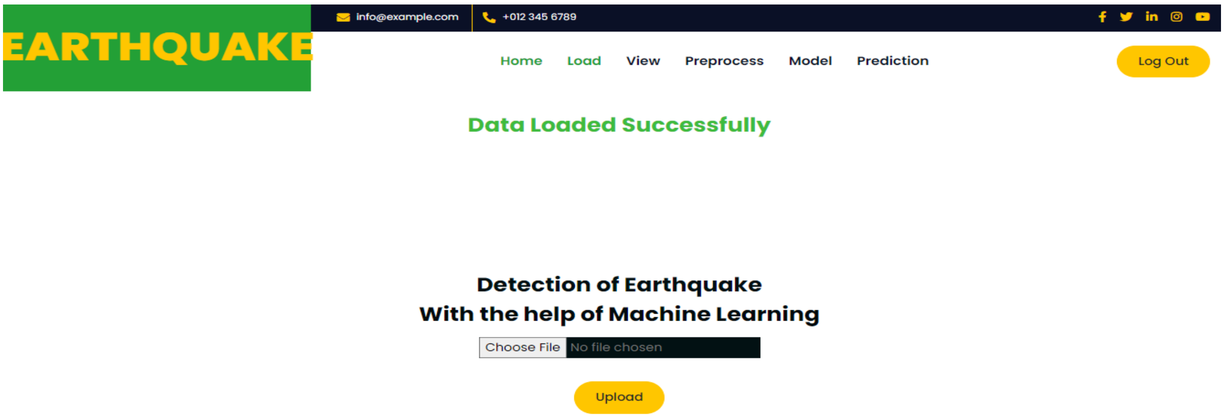
Generate Results:

We train the machine learning algorithm and predict the hate speech.

4.RESULTS AND DISCUSSION

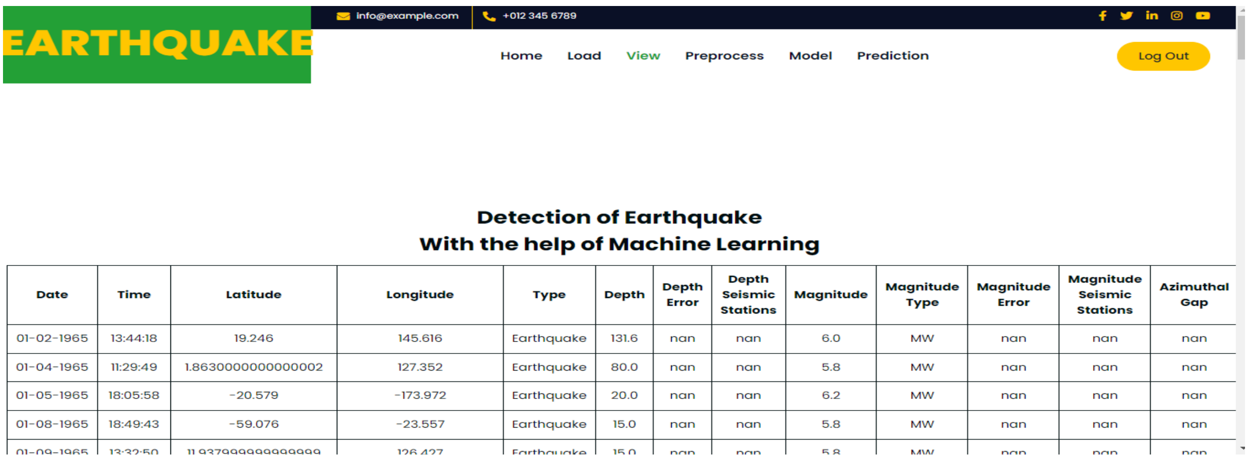
Load:

In the load page, users can load the earthquake dataset.



View:

Here we can see the uploaded data set.



Date	Time	Latitude	Longitude	Type	Depth	Depth Error	Depth Seismic Stations	Magnitude	Magnitude Type	Magnitude Error	Magnitude Seismic Stations	Azimuthal Gap
01-02-1965	13:44:18	19.246	145.616	Earthquake	131.6	nan	nan	6.0	MW	nan	nan	nan
01-04-1965	11:29:49	1.8630000000000002	127.352	Earthquake	80.0	nan	nan	5.8	MW	nan	nan	nan
01-05-1965	18:05:58	-20.579	-173.972	Earthquake	20.0	nan	nan	6.2	MW	nan	nan	nan
01-08-1965	18:49:43	-59.076	-23.557	Earthquake	15.0	nan	nan	5.8	MW	nan	nan	nan

Pre-process:

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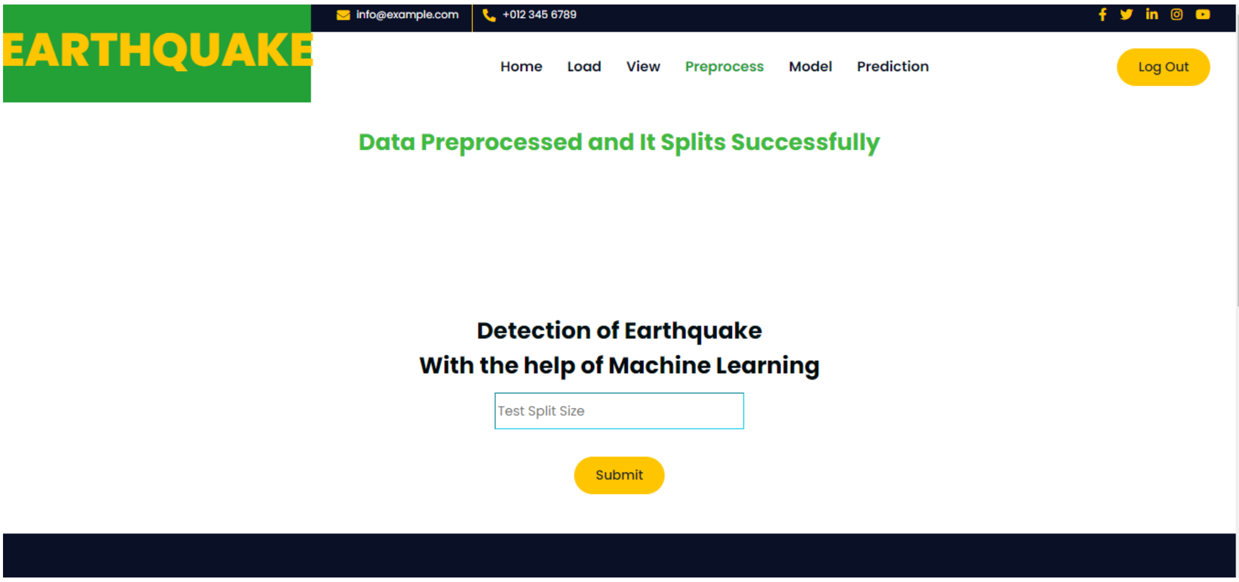
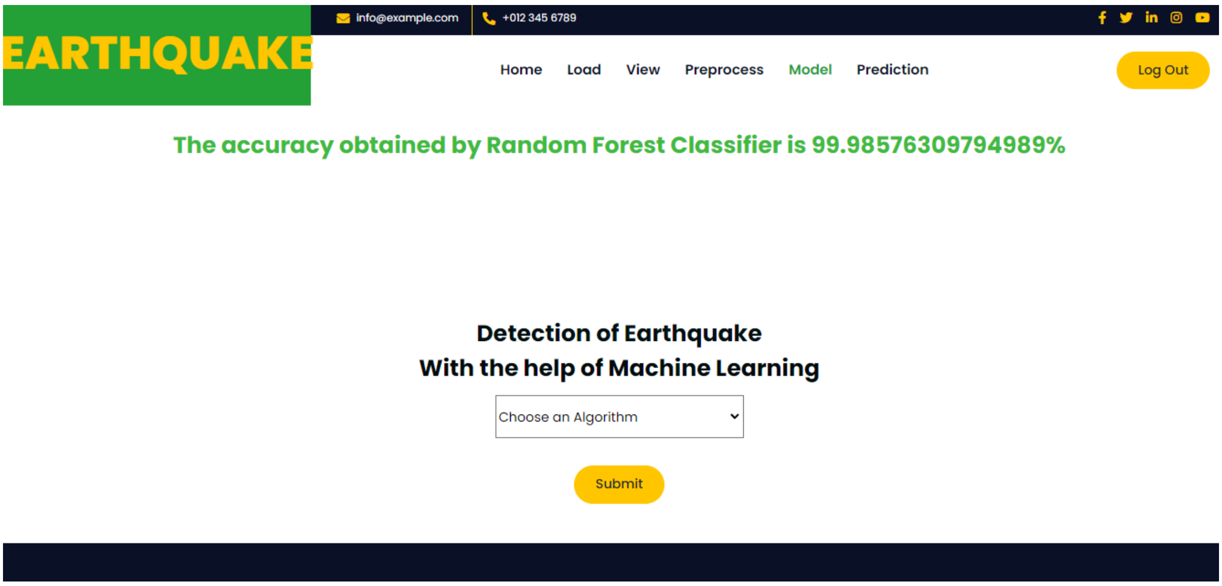
Here we can prepare our data in such a way that our system should understand i.e , we will make our data noise free.



Model:

Here we can train our data using different algorithm.



Prediction:

This page show the detection result of the earthquake prediction data.

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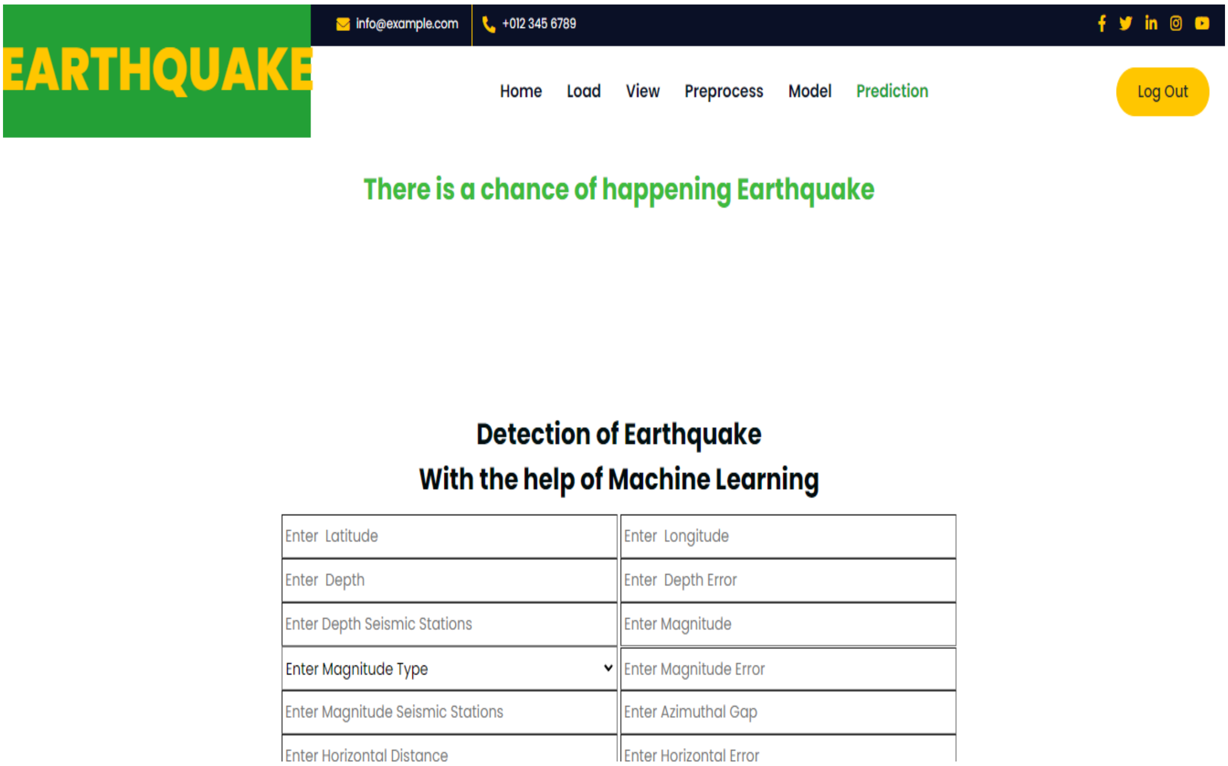

5.CONCLUSION

Seven machines learning algorithms have been tested for our work to classify the major earthquake events between negative and positive. The study has been applied to a dataset collected from a center in California, which was recording inputs for 36 years. Every machine learning technique shows different results from each other. KNN, Random Forest and MLP are the best by producing the least false output (FP) while SVM, KNN, MLP and Random Forest classify the higher number of output correctly. Future work involves working on case studies based on real intervention data and add consideration to features selection methods.

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