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Detection of Forest Fire Areas using Machine Learning

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Abstract: *Forest fire is the major environmental issue. It causes the economical and ecological damages and also it can affect the human's life. In today's technology man-made major disasters are multiplying exponentially. One of the major dangers is the wildfire. In this work, detecting the forest fire area by comparing various machine learning techniques such as Support Vector Machine, Regression, Decision Trees, K-Nearest Neighbour etc. has been done is accomplished. In the proposed modules, dividing the data set to achieve a high accuracy is important. It represents how regression works best for detection the forest fires. Here Detecting in order to take quick action before the fire damages and spreads over a vast region.*

Keywords: SVM, regression, decision trees, KNN, Random Forest etc.

I. INTRODUCTION

Although the forest fires are natural accurance with in the forest echo system. Most commonly the forest fires can be caused by climate changes and poor land management. Forest fire can mainly cause by the naturally, anthropogenic (man-made), accentual fires, intentional fires etc. The natural causes may be rubbing of dry bamboos each other, high temperature etc. The accentual fires caused by the accentually and carelessness. The 95% of fires are caused by the man, sometimes it is caused unintentionally and sometimes it can be caused by intentionally. This fire is also called as deliberate or intentional fires. These above causes damages to forest areas.

Machine learning is a part of artificial intelligence where we are training the machine by giving training dataset or by making the system analyse the situation and produce the result on the basis of this. This technique has reduced human effort and made life easier. There are different methods to train the machine. In the proposed work, the machine is trained using SVM, KNN, Decision Tree, Random Forest, Decision Tree and Extra Tree Regression algorithms to predict the forest fire.

II. LITERATURE SURVEY

Pradeep kumar G et. al [1] detection of forest fires using machine learning methods has used random forest and knn to detect the forest fire. Users discuss an innovative fire detection policy that makes use all technological tools. And also propose a platform artificial intelligence – based. The use of computer vision for smoke and fire recognition and detection based on still imagery or streaming information in the pictures taken. For determining the result, using machine learning. These algorithms have implemented sets of data, and split into test set and a train set will all affect dependability.

Ahmed M. Elshewey et. al [2] linear regression, ridge regression, and lasso regression to detect the forest fire. With a data set size of 517 entries and 13 features for each row, this study shows three machine learning approach: linear regression, ridge regression, and lasso regression. This work has two versions; the first version contains all features, although the second version includes only 70% of the features. The training set, which consists 70% of the data set, and the test set, which composes 30% of the data set, are also both used in the work. Compare to ridge regression and lasso regression algorithms, the linear regression approach is more accurate.

David a. Wood [3] has published the paper called Forest fire prediction and data mining: A highly effective data matching and mining system offers insightful information Regression-based machine learning algorithms to detect the forest fire. The multiple forecasting approach offers a feature selection that is instructive and determines the relative

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impacts of the crucial parameters on forecast burned-area numbers. Data analysis each total fired incident requires complementary information, which would be supplied through maximizing with MAE and RMSE as different goal activities. By increasing comprehension of the key factors that affect each burn occurrence, such insight offers people will receive for farming, biodiversity, the environment, and forestry. Each maximized solution's suitability for correctly guessing burned-areas events from a certain type may very well be evaluated with using specific insight obtained dataset mining the contrasting squared and cumulative total error trends. Such effectiveness and understanding help build a strong in the methodology used to make each prediction. It gives knowledge to behave quickly and minimize individual burn situations as they happen. By attempting to stop specific sorts of burn accidents from occurring once again or spreading, such educated interventions should both have short- and long-term, multifaceted benefits.

Pragati et. al [4] Wireless Sensor Networks (WSN) are becoming more important in current research fields as technology progresses due to their effectiveness in preventing accidents and helping people. An incident is recognised using the sensor devices positioned at various places once an uncommon occurrence in the networks is discovered. The base station receives this event detection information and makes a decision. Such sensor data in WSN typically generate false alarms because of their static design. Due to their efficient dynamic configuration and autonomous operation, machine learning algorithms can be used in this situation to prevent false alarms.

Adithi M. Shrouthy et. al [5] The approach for predicting the danger of forest fires using SVM, Decision trees, Random Forest, KNN, and Logistic Regression are discussed. The results demonstrate that the threat of forest fires can be predicted with some degree of precision. So, based on various characteristics like data input on oxygen, temperature, and humidity by the un the front end, designers suggested a system to forecast the percentage of fire occurrence using the machine learning methods and algorithms such Decision Tree, Random Forest, KNN, SVC, and Logistic Regression.

K.G. Shangavi et. al [6] In this study, researchers used sensors to examine forest fires that happened in various locations and at various times. By examining the time, it takes to produce the output, the error rate, and a variety of other factors, we can determine whether rattling is an effective instrument. According to the findings, decision tree is more effective than random forest in terms of both time and mistake rate.

Mohana Kumar S et. al [7] Due to a number of factors, including the rapid advancement of digital camera technology, image processing has been used in this study. The camera has outstanding results when covering large areas, and its response time for handling pictures is faster than that of current sensor architectures. and the general expense of the picture preparing frameworks is lower than sensor frameworks. Final findings reveal that the suggested strategy for detecting forest fires has a high detection rate (92 percent) and a low percentage of false alarms (8 percent).

Dr. C K gomathy et. al [8] In this article, various machine learning techniques including SVM, regression, decision trees, and neural networks are compared. The time it takes to immediately detect forest fires in this document is lower than in other machine learning approaches. This study proposes a fire detection method that divides datasets into months and makes use of regression. The algorithm can achieve high R-squared and low root mean square error.

Srinivas ramasubramanian [9] For forecasting the quantity of forest land burned, this research suggests several machine learning techniques, including linear regression, logistic regression, SVR, random forest, gradient boosting, and bagging. Consequently, the fire breakouts that occurred in Portugal northeast are used to develop the predictive model. In this research, researchers create a model for predicting the area burned during forest fires using Big Data and machine learning approaches.

Suhas G et. al [10] With this work, researchers want to advance deep learning's ability to detect fire in videos. Artificial neural networks-based deep learning is a new idea that has produced outstanding results in several domains, including computer vision.

III. PROPOSED METHODOLOGY

Forest fire is caused sometimes intentionally or sometimes unintentionally. By using the best machine learning algorithm to predict the forest fire and stop the fire before occurring huge destruction with low error rate and high accuracy.

3.1 Dataset

The collecting of the project's dataset is the initial step. The Dataset in this case was obtained from the Kaggle. 13 attributes and 517 rows help compensate the dataset. X, Y, month, weekday, FFMC, DMC, DC, ISI, temperature, RH, wind, rain, and area are the properties. The map's x-axis geographical value ranges from 1 to 9. The map's y-axis

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geographical value ranges from 1 to 9. Year: from January to December. Day of the year is: Monday through Sunday. 18.7 to 96.20 for the FFMC Score from of the Fire weather index method. DMC Score 1.1 to 291.3 as from Fire weather index method. DC Score 7.9 to 860.6 from either the Fire Weather index method. ISI score 0.0 to 56.10 from the Fire Weather Index method. temperature ranges between 2.2 to 33.30 degrees Celsius. percentage humidity levels range from 15.0 to 100. 0.40 to 9.40 km/h of wind direction. 0.0 to 6.4 mm/m2 of rain fell outdoors.

3.2 Pre-Processing

Pre-processing data is the second phase. If any missing or null values are found throughout this operation, the entire row has been erased. Gathering original data to be used with a machine learning algorithm is known as data pre-processing. It is a method for transforming impure data into pristine sets of data. The adjustments made to our data ingesting it to the program are referred to as pre-processing. Every time data is obtained from various sources, it is done so in a raw manner that makes analysis impossible.

3.3 Splitting of Dataset

Following pre-processing, the data is divided into training and testing sets according to the specifications. The information has indeed been divided into two sections in this stage. such as a data collection for training and validation. where test data is used to evaluate the model's efficacy and accuracy and train data is used to validate the algorithm. Data is separated into two parts: training set (20%) and testing set (80%).

3.4 Performance of the Algorithms

Calculates each effectiveness of the algorithm here. Using the error, efficiency, and accuracy numbers that these models have produced. Depending on Rating, RMSE, MSE, MAE, and R2 SCORE values, calculations are performed. Decision tree and Extratree Regressor have provided the higher accuracy and lower errors rates based on the methods

IV. RESULT ANALYSIS

In result analysis it is mainly focussing on the result it obtained through various algorithms. It is also comparing different algorithms to predict the high accuracy with low error rate. In the GUI of this work, provide the access to the user to enter the Index, Temperature, Relative Humidity, Wind, Rain to predict the burnt areas. x axis and y axis attributes, month, day, Fine Fuel Moisture Code (FFMC), Duff Moisture Code (DMC), Initial Spread.

MODEL	SCORE	MAE	MSE	RMSE	R2 SCORE
Linear Regression	0.0273216	26.8757	11855.2	108.882	0.0191977
Random Forest	0.815088	12.5828	2238.78	47.3158	0.814781
KNN	0.369025	21.9707	7730.69	87.9244	0.360425
ExtraTreesRegressor	0.99996	0.124135	0.49283	0.702019	0.999959
DECISION TREE	0.99996	0.124135	0.49283	0.702019	0.999959
(Service Vector Machine)SVM	0.000432932	22.6218	12570.1	112.117	-0.0399505

Table 1: Final Result

In the Table 1 score and r2 score range from 0 to 1. where 1 denotes a perfect fit of the model to the dataset provided, 0 denotes that the model does not fit the given data, The error rates are MAE, MSE, and RMSE. A regression model's accuracy will be higher if its MAE, MSE, and RMSE values are lower. We can conclude from Table 1 that ExtraTree Regressor and Decision Tree providing the highest score and r2 score values.

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Figure 2: R2 Score Bar chart

Figure 2 represents the bar chart for variance score for different algorithms, ExtraTree Regression and Decision Tree has same score of 0.99 and Linear Regression has the least score of 0.0190.

Figure 3: Score Bar chart

Figure 3 represents the bar chart for score for different algorithms, ExtraTree Regression and Decision Tree has same score of 0.99 and Linear Regression has the least score of 0.027.

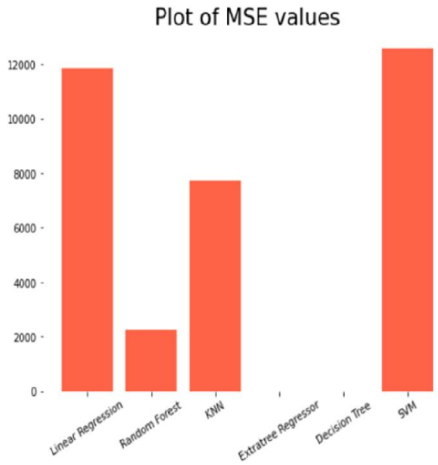

Figure 4: MSE value bar chart

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Figure 4 represents the bar chart for mean square error for different algorithms, support vector machine has maximum value of 12570.1 and extratree regression and decision tree has lest value of 0.49283.

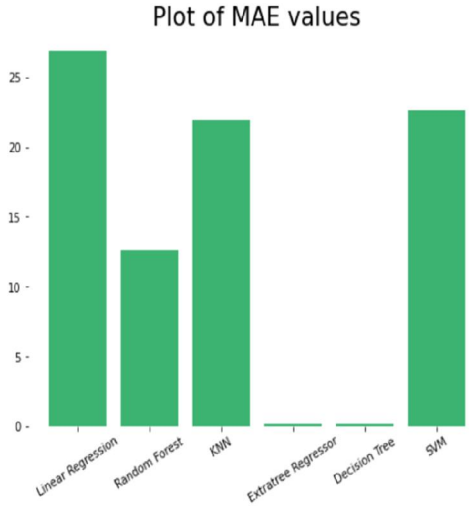

Figure 5: MAE Value Bar Chart

Figure 5 represents the bar chart for Mean Absolute Error for different algorithms, Linear Regression has maximum value of 26.8757 and Extratree Regression and Decision tree has the least Score of 0.124135.

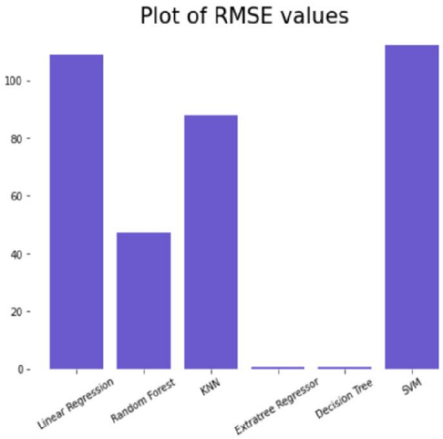

Figure 6: RMSE value Bar Chart

Figure 6 represents the bar chart for Root Mean Square Error for different algorithms, Support Vector Machine has maximum value of 112.117. and Extratree Regression and Decision tree has the least Score of 0.702019.

V. CONCLUSION

Once the most appropriate regression has been found, the goal values are converted to binary classes, and the accuracy of those classes is then determined, designers get to the conclusion that the decision tree method is the best one for predicting the burn area of forest fires. Designers have trained and tested on Decision tree, Service Vector Machines, K-Nearest Neighbor, Extra tree Regressor, Linear Regression, Random Forest algorithms. Decision tree and Extra tree Regressor gave more accurate results with less error rates.

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