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Forest fire prediction using ML and AI

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ABSTRACT

Forest fire forecasting is crucial for resource allocation, mitigation, and recovery. The risk of forest wildfires is rising all around the planet. Large wildfire frequency and area damaged have increased by more than four and six times in the last five decades, respectively. Oxygen, humidity, and temperature are all essential factors in wildfire risk evaluations. A new forest fire risk prediction method is described, which is based on Support Vector Machines, Logistic Regression, KNN, decision trees, and Random Forest. The findings show that forest fire danger can be predicted with reasonable accuracy. So, using machine learning techniques and algorithms such as Logistic Regression, KNN, SVC, Random Forest, and Decision Tree, we proposed a system to predict the percentage of fire occurrence based on various parameters such as temperature, humidity, and oxygen data entered by the user in the front end

Keywords: *Forest Fire, Machine Learning, Oxygen, Humidity Temperature, KNN, Random Forest, SVM, Decision Tree, Logistic Regression*

1. INTRODUCTION

Forest fires are a typical occurrence in the natural world. Forest fire is the most common threat in forests. Forest fires are a major environmental hazard that threatens forest preservation, causing economic and ecological harm as well as human suffering. They endanger not only the forest's wealth, but also the entire ecosystem's animals and vegetation, causing major disruption of a region's biodiversity, ecology, and environment. During the previous few summers, the Himalayan forests, particularly the Garhwal Himalayas, have been burning on a regular basis, resulting in a massive loss of vegetative cover in that region. Forest fire forecasting is an important aspect of forest fire control. It has a significant impact on resource allocation, mitigation, and recovery.

Support vector machines, decision trees, KNN, logistic regression, and Random Forest are used to create a novel forest fire risk prediction method. In order to anticipate the amount of fire threat on a given day, the algorithm relies on weather factors. The algorithm is implemented utilizing data from a dataset to painstaking estimate the menace of a holocaust incident.

2. LITERATURE SURVEY

[1]George E. Sakr, Imad H. Elhajj, George Mitri and Uchechukwu C. Wejinya "**Artificial Intelligence for Forest Fire Prediction**" 2010 IEEE/ASME International Conference on Advanced Intelligent Mechatronics Montréal, Canada, July 6-9, 2010: This paper presented a forest fire risk prediction method. The findings show that a small quantity of data can be used to estimate forest fire risk.

[2]Mauro Castelli, Leonardo Vanneschi, and Ales Popovic **"Predicting burned areas of forest fires: an artificial intelligence approach**" Fire Ecology 2015: They demonstrated a novel intelligent GP-based approach for examining burned areas in this demonstration. The major goal was to create a system that could forecast how much land will be destroyed in the event of a forest fire. The experimental findings revealed that geometric semantic genetic programming outperforms due to the small MAE.

[3]A. Kansal, Y. Singh, N. Kumar and V. Mohindru, "**Detection of forest fires using machine learning technique: A perspective**" 2015 Third International Conference on Image Information Processing (ICIIP), Waknaghat, 2015: The use of regression and the division of datasets has been proposed in this paper as a method for detecting fire. The algorithm achieves a low R-squared and a low root mean square error. This method could be used for other calamities in the future. The use of specific transformations may also help to increase the model's efficiency.

[4]L. Yu, N. Wang, and X. Meng "**Real-time forest fire detection with Wireless Sensor Networks**" in Wireless Communications, Networking and Mobile Computing, 2005. Proceedings. 2005 International Conference on, vol. 2. IEEE,

2005: Ensemble learning is used at all cluster heads in this case. At the base station, SVM, a supervised machine learning technique, is used with a polynomial kernel function. Carbon dioxide, temperature, humidity, and carbon monoxide can all be detected using the sensors that have been installed. Clustered stream generates data in tabular or clustered form. After that, the SVM is used to detect fire.

[5]Guruh Fajar Shidik and Khabib Mustofa "**Predicting Size of Forest Fire Using Hybrid Model** "ICT-Eurasia 2014: An alternative hybrid model capable of predicting the extent of forest fire has been developed in this study. The algorithm, which includes meteorological and forest weather index variables, has successfully classified the level of burning into three categories: No Burn Area, Light Burn, and Heavy Burn. The proposed model's examination revealed encouraging results in terms of accuracy. of confusion matrix around 97.50% and Kappa 0.961.

[6]Paulo Cortez and Anibal Morais "**A Data Mining Approach to Predict Forest Fires using Meteorological Data**": They investigate a Data Mining approach for predicting the burned area of forest fires in this paper. The optimal configuration combines an SVM with four meteorological inputs to forecast the burned area of minor fires. Such information is especially valuable for bettering the administration of firefighting resources.

3. PROPOSED SYETEM AND METHEDOLOGY

Based on temperature, humidity, and oxygen data given by the user on the front end, we designed a system that

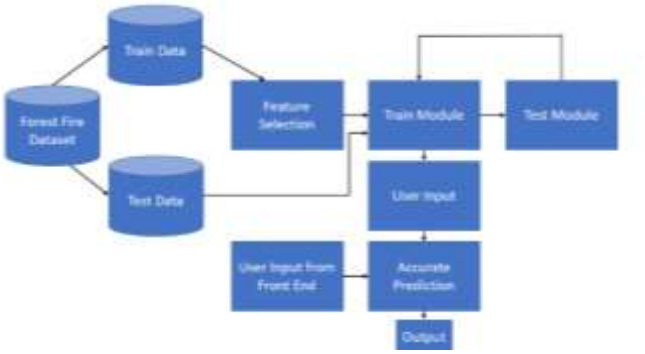

Fig 1: Proposed System

Training and Testing of Data

Training data and test data are two broad concepts in machine learning. The data set is divided into two parts: a training set and a testing data set, with the training and testing data sets divided in an 80:20 ratio.

4. ALGORITHMS

A .Logistic Regression

Algorithm: Logistic Regression

Input: Forest Fire Dataset

Steps:

- Take the user's input and convert it into arrays.
- Preprocess the data used as input
- Train the model
- Finally, use the learned model to produce a prediction

B. Random Forest Classifier

Algorithm: Random Forest Classifier

Input: Forest Fire Dataset

Steps:

combines machine learning techniques and algorithms such as Logistic Regression, KNN, SVC, Random Forest, and Decision Tree to forecast the fraction of fires that will occur.

Data Set and Preprocessing

Data Set was collected from Kaggle and applied with all the preprocessor techniques to make the data set proper input for the machine learning model

Preprocessing is the process of modifying data to make it appropriate for use as an algorithm input. Cleansing data is the process of transforming raw data into clean data. Because the data collected using the characteristics temperature, humidity, and oxygen level contains a lot of impurities, it can't be directly entered into the algorithms. As a result, preprocessing is employed to clear the data.

With the help of Machine Learning, the data is cleaned. The input data is first checked for missing or unknown values, which are subsequently corrected or removed to make the data appear clean. Furthermore, null values are evaluated; null values are disregarded because they provide no information. As a result, we have data that is suitable for machine learning techniques.

Software Specifications

Operating system used is Windows XP / 7/ 10.Coding Language used is Python, Integrated Development Environment used is Python version 3.6.8 HTML is used for frontend development. ML Packages used are NumPy, Pandas, Sklearn, Flask, PymySql. Other Requirements needed include Notepad, XAMPP Control Panel for backend, Flask framework .

- Take samples from the forest fire dataset at random.
- For each of the data considered, create a decision tree and acquire a forecast result from each decision tree.
- Make a vote for each expected result.
- Choose the prediction with the most votes as the final forecast.

C. Decision Tree Classifier

Algorithm: Decision Tree Classifier

Input: Forest Fire Dataset

Steps:

- Using the Attribute Selection techniques , the data is separated.
- Here , A property is considered as a decision node, which further divides the dataset into smaller parts.
- The tree is constructed based on recursively repeating the above two steps, for each part , until the required condition is met.
- All of the tuples are associated with the same attribute value.

D. Support Vector Machine

Algorithm: Support Vector Machine

Input: Forest Fire Dataset

Steps:

- Fill in the diabetes information to be classified.
- Expel lost information by pre-processing data.
- It will check the condition and, if the data is categorized, it will display the projected outcome.
- If data isn't categorized at that moment, it will be divided into two categories: preparation data and testing data.
- It will then use the SVM classifier to make a prediction.
- It will then pre-process the data in order to recover the missing data. It will then display the expected result and check for accuracy.

E. K- Nearest Neighbors
Algorithm: K-Nearest Neighbors(KNN)
Input: Forest Fire Dataset
Steps:

- Choose the Kth neighbor's number.
- Distance between K neighbors is found out by Euclidean method .
- Consider the k's closest neighbors totally based on the closest distance.
- The number of data points in each group among the k neighbors are counted.

The new data point is assigned to the group with a greater number of neighbors.

5. RESULTS

In the below table , the accuracy of algorithms is listed. For the implementation of the project, Support Vector Machine algorithm is implemented. Even though Logistic Regression and Support Vector Machine has the same accuracy, SVM is implemented it has more pros rather than cons.

Table 1: Results

Sl. No	Algorithm	Accuracy
1	Logistic Regression	89.47%
2	Random Forest Classifier	84.21%
3	K-Nearest Neighbors	73.68%
4	Support Vector Machine	89.47%
5	Decision Tree Classifier	73.68%

Graph 1 : Accuracy of Algorithms

6. CONCLUSION

Forest fires are a typical occurrence within the flora and fauna. Every year, legion hectares of forest are destroyed round the world. This resulted in significant environmental harm in addition because the loss of irreplaceable human lives. Forest fires are a serious environmental hazard that threatens forest preservation, causing economic and ecological harm likewise as human suffering. Quick fire detection and reaction are efficient methods for decreasing fire damage. Various studies are conducted in try to improve early fire prediction and detection systems, which aid within the development of fireside response methods. It signifies that early caution detection is provided. The accurate prediction of results supported defined parameters is expounded to early caution detection.

We completed our research and constructed a system that forecasts the proportions of fires that may occur are supported by the weather data provided by the user, like temperature, oxygen, and humidity. The strategy accurately predicts the proportion of fires that may occur.

7. ACKNOWLEDGEMENT

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8. REFERENCES

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