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Forest Fire Prediction Using Machine Learning

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Abstract: ***Forest fire vaticination refers to the process of using colorful ways and tools to read the liability and implicit inflexibility of a fire outbreak in a forested area. Forest fires are caused by a combination of factors similar as dry rainfall conditions, high temperatures, and mortal conditioning similar as conflagrations, cigarettes, and fireworks. There are several styles used in forest fire vaticination, including statistical analysis, machine literacy algorithms, and remote seeing ways. These styles help to gather and dissect data on rainfall conditions, energy humidity content, geomorphology, and other factors that contribute to the liability of a fire outbreak. Forest fire vaticination models can be used to give early warning systems to warn authorities and residers of implicit fire peril. These models also help to identify areas that are at high threat of backfires and enable authorities to take necessary preventives, similar as enforcing fire bans and evacuation orders, to help or minimize the impact of forest fires. Overall, forest fire vaticination plays a critical part in precluding and mollifying the damage caused by backfires. By furnishing accurate and timely information, it allows authorities to take visionary measures to reduce the threat of fire outbreaks and cover both mortal and natural coffers. In future predicting forest fire is expected to reduce the impact of fire. In this paper we are implementing the forest fire prediction system which predicts the probability of catching fire using meteorological parameters like position (latitude and longitude), temperature and more. we used Random Forest regression algorithm to implement this module.***

Keywords: Machine learning, meteorological parameters, Random Forest regression algorithm, precautions.

I. INTRODUCTION

Forest fires are a significant environmental and societal issue, causing expansive damage to natural coffers, wildlife, and mortal lives. Beforehand discovery and prediction of Forest fires are pivotal in mollifying their impact and reducing their spread. timber fire prediction involves assaying colorful factors similar as rainfall patterns, foliage humidity content, and literal fire data to read the liability of a fire outbreak in a particular area.

Prophetic models help firefighters and authorities make informed opinions and take visionary measures to help or contain timber fires. Over the times, several ways and approaches have been developed for timber fire prediction, ranging from statistical models to machine literacy algorithms.

These models use data from colorful sources, including satellite imagery, rainfall detectors, and ground- grounded compliances, to identify patterns and trends that can gesture an impending timber fire. Despite the progress made in timber fire prediction, the delicacy and effectiveness of the models can still be bettered. also, the increased circumstance of climate change- convinced extreme rainfall events has brought new challenges to timber fire prediction. In this environment, ongoing exploration in Forest fire prediction seeks to enhance the delicacy and trust ability of prediction models, and address the challenges posed by changing climate patterns.

This includes the development of new data sources and integration of arising technologies similar as artificial intelligence and remote seeing. Overall, forest fire prediction remains a critical area of exploration and development, with the eventuality to save lives, reduce profitable losses, and cover the terrain.

Forest fire prediction model uses Random Forest regression algorithm. Random forest regression algorithm is bagging technique. Random forest regressor algorithm is the supervised learning algorithm it uses labelled dataset to train algorithm. Random forest makes use of Decision Tree Algorithm.

Forest fire prediction system operates by taking the meteorological parameters like daytime/nighttime, FRP, type of forest fire, year of first fire/previous fire occurrence in the format YYYY, month of first forest fire/ previous fire occurrence in the format month(value), date of first forest fire/ previous fire occurrence in the format DD, Latitude of the Place, Longitude of the Place, Brightness or intensity. This system can be further enhanced to include the real time notifications for the people with registered mobile numbers staying in the area within certain circumference.

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II. LITERATURE REVIEW

A. *Preeti T, Dr. Suvarna Kanakaraddi, Aishwarya Beelagi, Sumalata Malagi, Aishwarya Sudi "Forest Fire Prediction Using Machine Learning Technique",2021*

The main aim of Prediction of forest fire id expected to reduce the collision of forest fire in the future. There are so many fire detection algorithms are available with many different approaches towards the detection of fire in the forest. In the existing work processes the fire affected part is predicted and analyzed based on the satellite images. The meteorological parameters such as rain, temperature, wind and humidity were used To predict the occurrences of a forest fire in the proposed system.

B. *Pratima Chaubey, Nidhi J. Yadav, Abhishek Chaurasiya "Forest Fire Prediction System using Machine Learning ",2020*

The forest fires that are occurring in the forest region or wild land and are uncontrolled fires and cause significant and more damage to human and natural resources, which are one of the most dangerous disaster to the ecological environment .The existing systems use various technology like Machine learning techniques and Artificial Intelligence and Wireless network utilized for collecting 24-hour weather data continuously, which provides a higher chance to reflect perfectness of the status of forest environment. Depending on those system, we can decide which days have the highest possibility of catching a forest fires and danger and paid special attention to prevent forest fire for forest guards.

C. *Amira. A. Elsonbaty, Ahmed M. Elshewey "Forest fire Detection Using Machine Learning Technique",2020*

Stated that Nowadays, Forest fires became one of the major important problems that cause huge damages to several areas around the globe. This paper displays predicting forest fire-prone areas using machine learning regression techniques. The data set used in this paper is presented within the UCI machine learning repository that consists of climate and physical factors of the Montesinos park which is present in Portugal. The research also proposes many machine learning approaches, linear regression, ridge regression and lasso regression algorithm with data set size of 13 features and 517 entries for each row. The accuracy of the linear regression algorithm gives higher accuracy than ridge regression and lasso regression algorithms.

D. *Pranjali Bora, Sandeep Sharma, Sandeep Banerjee, K. Sudha, M. Sravanisai, "prevention part I: Prediction and web-based analysis",2022*

Stated that this particular paper elaborates an approach to develop a system which predicts the catching of forest fires with accuracy. The paper introduces a new approach for predicting forest fires that includes a user-friendly web application for easy access. A FWI system is developed with the help of IBM Python Flask service to help in the predicting of forest fires. IBM Auto-AI service has also been used in predicting the onset of forest fires and present very useful information. The prediction results are displayed in a web application deployed on the IBM cloud. The system is expected in helping with the growing concerns over forest fires and reduce the impact of the disasters as much as possible around the globe.

E. *Ayu Shabrina, Intan N. Wahyuni, Rifika Sadikin, Arninda L. Latifah "Evaluation of Random Forest model for forest fire prediction based on climatology over Borneo" 2019*

States that Indonesia has entered an alarming condition related to catching of the forest fires. It has become a seasonal hazardous phenomenon in tropics in the Indonesia. As it is the largest tropical forest in Indonesia, Borneo is the most susceptible area to catch fire especially in dry condition. Forest fires are threatened by human activities, ecosystem and climate processes, but in Borneo only variable of climate can be quantified the research objective is to assess the effectiveness of the random forest model in predicting forest fires using satellite data of burned areas and climate variables as input. Prediction of forest fires is expected to reduce the influence of forest fires in the future Through an analysis of annual and spatial variability, it was found that the random forest model, incorporating all selected climate variables, effectively represents forest fire events across the Borneo region of Indonesia.

F. *Salma A Sahel, Samar O Alosaimi, Muhammad Arif, Khloud K Alghamdi Mashael E Alsahafi, Maram A Alharthi and Maryam Arif "Role of Machine Learning in Forest Fire Management" 2021.*

Across the globe Forest fire disasters are recently getting lots of attention due to the climate change. Globally, changes in the climates are also affects rapidly changing of the fire patterns on Globe. Accurate information on the occurrence of fires, their impact on the environment, and their spread is essential for effective fire management. Predicting of fire activities in the forest is beneficial to the authorities to make efficient, optimal and sound decisions in fire management system. The objective of the paper is to provide a summary of the latest advancements in predicting forest fires, estimating their spread rate, detecting them, and mapping the areas that have been burned.

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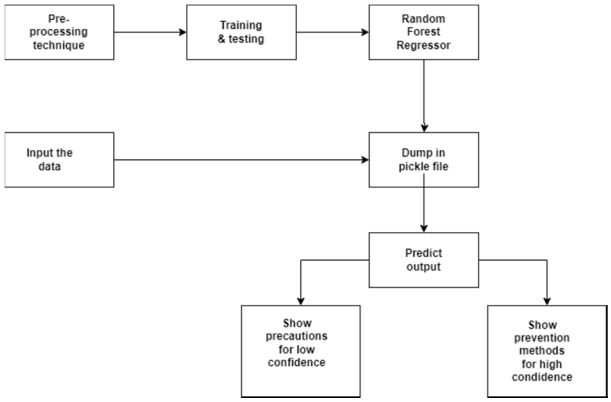
G. Muhammad Arif, Khloud K Alghamdi , Salma A Sahel1 , Samar O Alosaimi1 , Mashael E Alsahafi1 , Maram A Alharthi1 and Maryam Arif

In this research work they principally introduced effective fire management. Accurate information is necessary for managing effectively. The focus of this paper is to provide an overview of the latest developments in predicting, detecting, estimating the spread rate, and mapping the burned areas of forest fires.

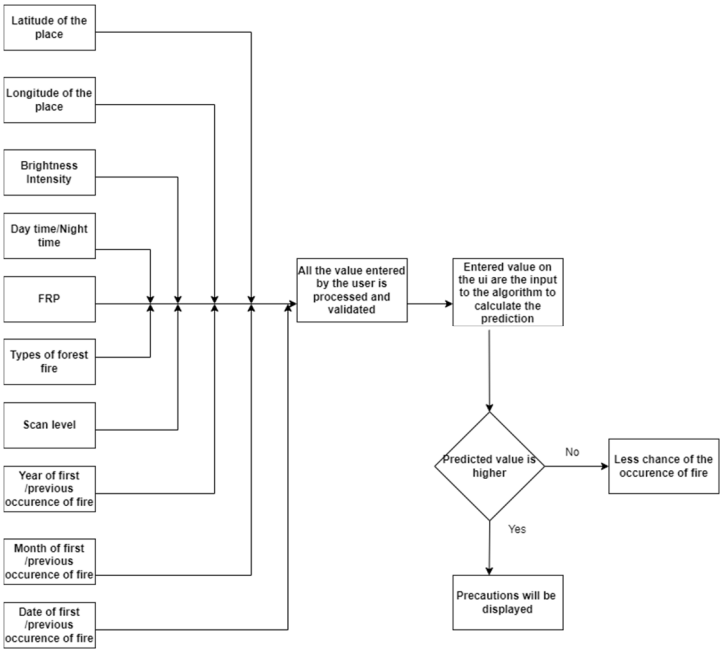
H. MENG ZHANG, HAO LIANG, AND HAILAN WANG "A Neural Network Model for Wildfire Scale Prediction Using Meteorological Factor

In the early stages of a wildfire, the predictive model allows fire rescuers to take necessary actions to reduce the extent of damage based on the predicted severity of the fire. Prediction models were developed using a back propagation neural network (BPNN), a long short-term memory (LSTM) network, and a recurrent neural network (RNN), taking meteorological factors as input values. Of these classification methods, LSTM exhibited the greater accuracy of 90.9%.

III. METHODOLOGY



IV. SYSTEM ARCHITECTURE



The architecture of the proposed system is shown below the UI of the system includes following fields to be manually entered by the user the fields are:

1) Latitude of the Place
2) Longitude of the Place
3) Brightness intensity
4) Day time/Night time
5) FRP
6) Types of forest fire
7) Scan level
8) Year of first fire/previous fire occurrence in the format YYYY
9) Month of first fire/ previous fire occurrence in the format month(value)
10) Date of first fire/ previous fire occurrence in the format DD

a) The user is supposed to enter the values manually the fields are as mentioned above.
b) The predict button is provided at the bottom of the web page so that the user can click on the button to predict the Forest fire occurrence.
c) There is an algorithm that is invoked on click of the Predict button.
d) The algorithm is designed in such a way to give the best outcome with the less time consumption, refer to the [5] in the introduction to find the time complexity of the algorithm.
e) The logic makes use of the value 1 to predict the occurrence of the fire in a particular geological location.
f) If the outcome of the algorithm [2] is greater than the threshold value which is 1, it is predicted by the system that probability of the occurrence of the forest fire is high.
g) If the outcome of the algorithm is greater than probability of the occurrence of the forest fire is high.
h) If the outcome of the algorithm is less than probability of the occurrence of the forest fire is low.
i) The predicted outcome of the algorithm is displayed on the webpage along with precautions.

V. EXISTING SYSTEM

They used different approaches for detection of fire many of them use support vector machine (SVM), and satellite image processing so these are all different approaches used to predict the forest fire. The main disadvantage of their project is they not provided precautions/solutions for preventing recatching or spread of fire. The existing system also lacks in security as they dint provided authentication option.

A. Disadvantages Of Existing System

1) Lack of Security
2) They dint provide precautionary measures to reduce the spread of fire.

B. Problem Statement

To design and develop a user-friendly web-based forest fire prediction system using Machine Learning.

C. Advantages Of Proposed System

1) Provide security.
2) Detailed processing of provided values.
3) Provides proper precautions to prevent the recatching of forest fire.

D. Objective

1) To design the user-friendly website, helps in predicting the occurrence of forest fire using Django Framework.
2) To design the login and signup page using Django framework
3) To make the prediction of occurring the fire by using some of the parameters like Latitude of the place, Longitude of the place, Brightness Intensity, Scan level etc.
4) To provide the precautionary measures that helps to prevent fire spread ness throughout the forest

VI. RESULTS

Image 1

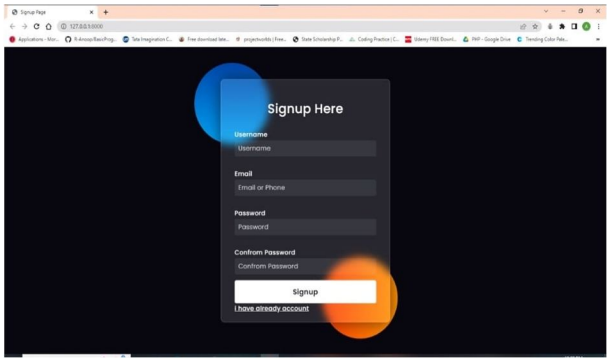


Image 2

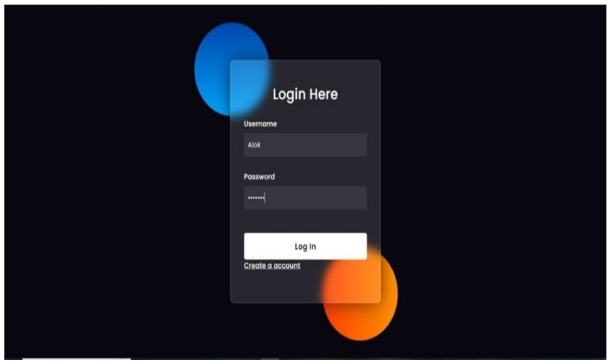


Image 3:

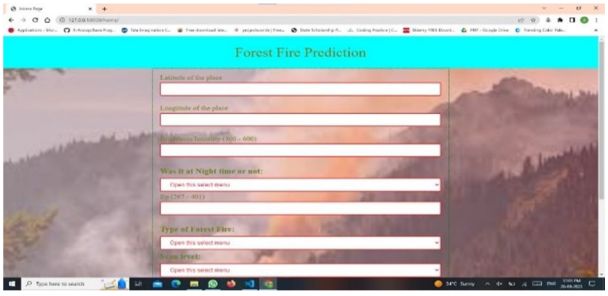


Image 4

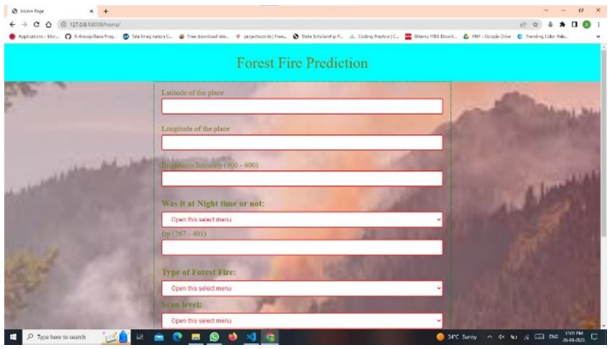
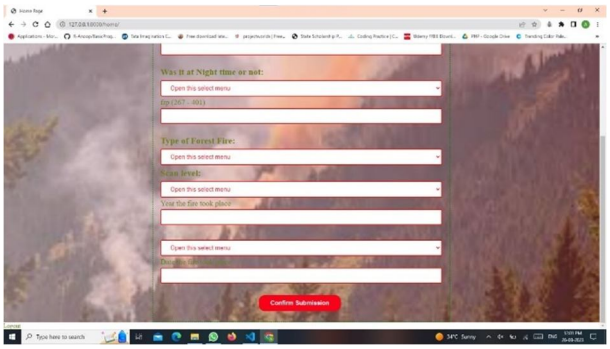


Image 5

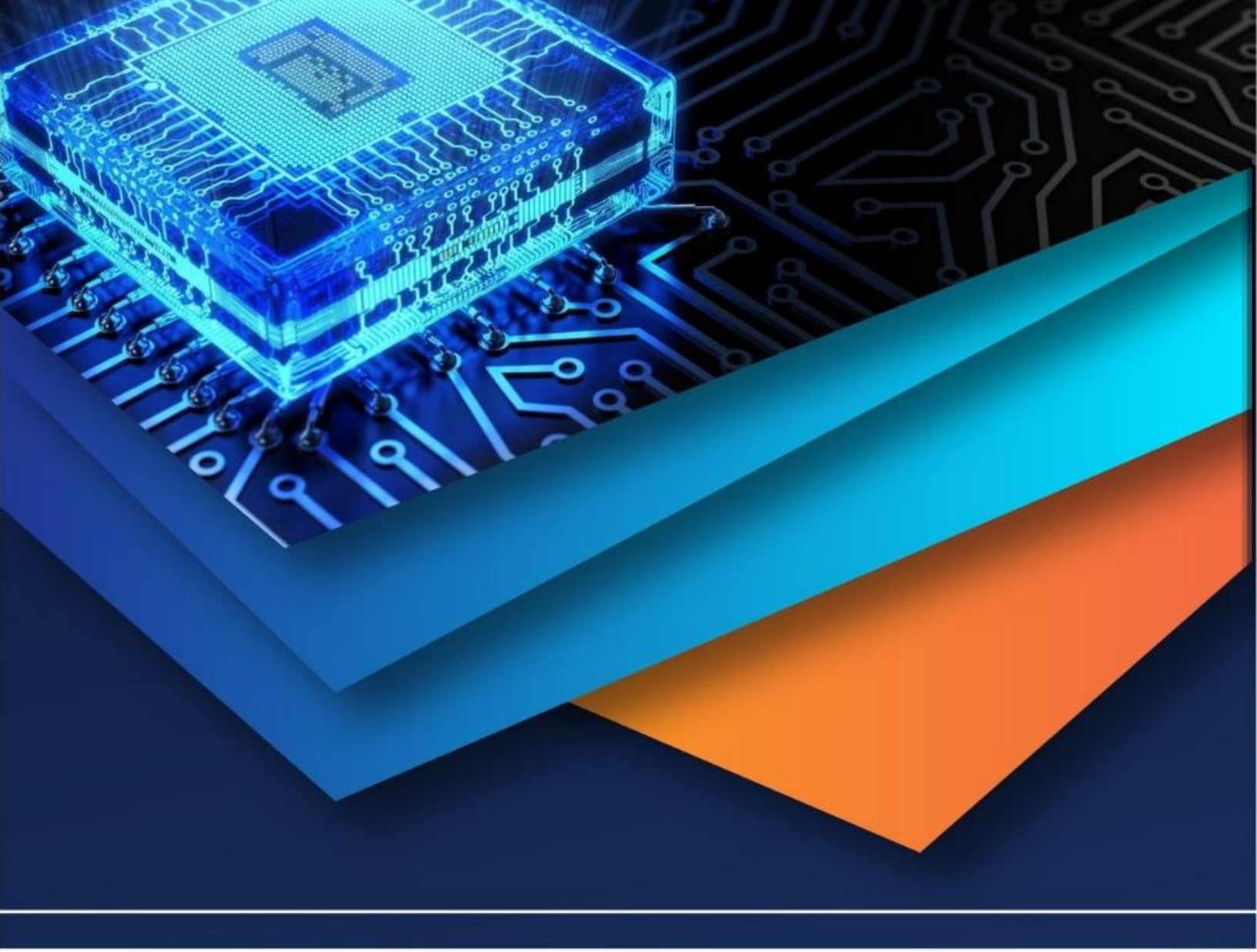


VII. CONCLUSION

The objective of machine learning is to develop a model that can correctly forecast results from input data. The model would be trained using a dataset containing geographical factors (such as Latitude, levels, etc.) This is the case for predicting the forest fire using random forest regression. Once trained, the model can be used to make predictions on previously unexplored data. Metrics like MSE, RMSE and accuracy can be used to assess the model's accuracy. The efficiency of the Random-forest regression model for predicting forest fire can be inferred from the prediction accuracy, Training time and feature importance. The model can be regarded as a successful tool if it has great precision and accuracy. The model can be regarded as a successful tool if it has great precision and accuracy

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[8] MENG ZHANG, HAO LIANG, AND HAILAN WANG “A Neural Network Model for Wildfire Scale Prediction Using Meteorological Factor
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