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WILDFIRE PREDICTION TECHNIQUE USING MACHINE LEARNING

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Abstract: *Forest fires have become one of the most serious issues. Forest fires have a significant influence on ecosystems and have a significant impact on greenhouse gas and aerosol levels in the atmosphere. Wildfires have devastated a large quantity of forest and wildlife as a result of these fires. Forest fires are caused by two major factors: global warming caused by an increase in the average temperature of the earth, and human irresponsibility. Predictions must be made to discover sections of land that have the potential to burn and lead to a large forest fire based on meteorological conditions in order to prevent forest fires. Our suggested system will focus on parameters such as temperature, humidity, and other variables that contribute to wildfires. There are a variety of fire detection algorithms available, each with its own approach to the problem.*

Keywords - *Convolution Neural Network, forest wildfires, forest fire detection, forest fire prediction, satellite pictures*

I. INTRODUCTION

Forest fires are a matter of concern because they cause extensive damage to environment, property and human life. Hence, it is crucial to detect the forest fire at an earlier stage. This can help in saving flora and fauna of the region along with the resources. Also, it may help to control the spread of fire at initial phase. The task of monitoring the forests is difficult because of the vast territory and dense forest. The forest fire has become a threat to not only to the forest wealth but also flora and fauna and ecology of the environment of the region. The main cause of forest fires can be categorized under natural and man-made classes. High atmospheric temperature, lightening and dryness (low humidity) offer positive environment for a fire to start which are the natural causes for forest fire. The fire is also caused by Manmade sources like naked flame, cigarette, electric spark, etc. A Wildfire predicting technique generally consists of Convolution Neural Network (CNN) model and image classifier. Which consists of datasets more than 600. In this paper we propose a machine learning approach for event detection. Various models have been generated. The performance of the proposed approach is determined in terms of complexity and accuracy.

II. RELATED WORK

George E. Sakr et al. [1] has proposed an approach to the study of forest fire prediction methods based on artificial intelligence has been suggested. Forest fire risk forecast algorithm is built on help vector machines. Lebanon data were used for the application of the algorithm and has proven the ability to correctly estimate the risk of fire. A novel forest fire risk prediction algorithm, based on support vector machine, is presented. The algorithm depends on previous weather conditions in order to predict the fire hazard level of a day. The implementation of the algorithm using data from Lebanon demonstrated its ability to accurately predict the hazard of fire occurrence.

Vijayalakshmi M.N, Divya T.L [2] has proposed, . There are many fire detection algorithms available, each one of it has its own approach of predicting fire. The proposed work processes the satellite images based on its intensity levels to find out the fire affected region (hot spots). In order to detect hot spots agglomerative hierarchical clustering algorithm is used and the direction of the fire spread regions are plotted based on the clusters obtained by the algorithm for the given input image. The implementation is based on RGB values of pixels of an image. The algorithm's efficiency is relatively high when it is applied on forest fire images.

Dr.Rajni Jindal, Aditya Kulraj Kunwar, Anupreet Kaur, Bramhdeep Singh Jakhar [3] has proposed, This paper is an attempt to simulate the spread of forest fires and to help the necessary authorities identify the best cut off points to obliterate the fire. We developed a dynamic model by modelling the problem as Markov Decision Process, treating wildfire as an agent advancing over the effective region in response to surrounding parameters. At any point of time, the fire can choose to move in either of the 4 cardinal or the 4 ordinal directions or not spread at all. Analyzing satellite images in sequence, we use LRCNN (Long-Term Recurrent Convolutional Neural Networks) to build a generative model for input to the Markov Reinforcement Learning Model.

Richa Sharma, Shalli Rani & Imran Memon [4] The proposed framework aims to analyze the images of the forest area and detect different parameters like temperature, relative humidity, and Carbon Mono-oxide (CO) level concurrently and persistently throughout the day. The two outputs will at that point be combined to acquire the condition of the forest area further ordering it into the instance of Fire and No Fire utilizing the Boosted Decision Tree characterization model.

Diyana Kinaneva, Georgi Hristov, Jordan Raychev and Plamen Zahariev [6] have proposed, a platform that uses Unmanned Aerial Vehicles (UAVs), which constantly patrol over potentially threatened by fire areas. The UAVs also utilize the benefits from Artificial Intelligence (AI) and are equipped with on- board processing capabilities. This allows them to use computer vision methods for recognition and detection of smoke or fire, based on the still images or the video input from the drone cameras. Several different scenarios for the possible use of the UAVs for forest fire detection are presented and analyze in the paper, including a solution with the use of a combination between a fixed and rotary-wing drones

Dieu Tien Buia,b , Nhat-Duc Hoangc , Pijush Samui [7], have proposed a new hybrid computational approach based on MARS and DFP, named as MARS-DFP, has proposed for predicting tropical forest fire danger. Both MARS and DFP are state-of-the art computational method with the first one is used to generalize a classification model to predict fire susceptibility; whereas second one helps to optimize the MARS model by determining the best set of model parameters. To the best of our knowledge, they have never been explored for forest fire danger modeling; therefore, the current study is an attempt to fill this gap in the literature. The high-performance result of the MARS-DFP model with the case study in the tropical forest at the northwest region of Vietnam indicates that the proposed model is capable to tackle the complexity of forest fire danger modeling. Compared to those deriving from benchmarks (BPANN, ANFIS, RBFANN, and RF), the proposed model has achieved better performance significantly. This fact demonstrates that the proposed MARS-DFP is a very promising alternative to help local authorities in hazard mitigation and land use planning tasks.

Sukuan Jin, Xioabo Lu [8] has proposed how to solve the problem of forest fire detection based on video sequences by combining image processing with machine learning. The algorithm consists of three parts: moving object detection, image feature extraction and classifier recognition. Through a large number of comparative experiments, the optimal algorithm combinations of the above three parts are founded. In this paper, the moving object detection algorithm is modified by adding the image segmentation step before it to reduce the false alarm rate.

B S Negara, R Kurniawan, M Z A Nazri , S N H S Abdullah , R W Saputra and A Ismanto [9]] have proposed forest fires in Riau Indonesia using Decision Tree and Bayesian Network algorithms. The algorithms provide good accuracy and have a low error rate. In accordance with the 'No Free Lunch Theorem,' this study has shown that each algorithm has its own advantages. The Decision Tree algorithm has a lower accuracy than the BN algorithm. However, it has advantages in explaining the relationship of each attribute of weather data that affects the hotspot level using the tree diagram. Whereas the Bayesian Network has advantages in terms of accuracy. Thus, it can be concluded that the prediction model using Bayesian Network has the potential to be used effectively but still has plenty of room for improvement.

Sofiane Ouni, Zayneb Trabelsi, Ayoub Farouk Kamoun [9] have proposed a new approach Autoorganization, Adaptive rame Periods for forest Fire detection for multi-level optimization based on the network topology reorganization, and the frame activity period optimization according to the energy preservation and also the fire detection timing constraints. The reorganization is made locally according to the node states with regard to the fire detection events. It is made by a new association/re-association procedure that creates links and paths between nodes with respect to the two constraints. According to the network topology, an adaptive frame periods adjustment procedure is executed to select the suitable timing periods that reduce the sensor node activities without exceeding the timing constraints.

Shixiao Wu, Libing Zhang [10] have focused on three problems that surrounded forest fire detection, real-time, early fire detection, and false detection. For the first time, we use classical objective detection methods to detect forest fire: Faster R-CNN, YOLO (tiny-yolo-voc, tiny-yolo-voc1, yolo-voc.2.0, and yolov3), and SSD, among them SSD has better real-time property, higher detection accuracy and early fire detection ability. We make the fire and smoke benchmark, utilize the new added smoke class and fire area changes to minimize the wrong detection. Meanwhile, we adjust YOLO's tiny-yolo-voc structure and propose a new structure tiny-yolo-voc1, the experiments proves that this improves the fire detection accuracy rate.

Zhentian Jiao, Youmin Zhang, Jing Xin, Lingxia Mu, Yingmin Yi, Han Liu, Ding Liu [11] have proposed a forest fire detection algorithm by exploiting YOLOv3 to UAV-based aerial images. Firstly, a UAV platform for the purpose of forest fire detection is developed. Then according to the available computation power of the onboard hardware, a small-scale of convolution neural network (CNN) is implemented with the help of YOLOv3. The testing results show that the recognition rate of this algorithm is about 83%, and the frame rate of detection can reach more than 3.2 fps. This method has great advantages for real-time forest fire detection application using UAVs.

Aadira Pillai, Aishwarya Gaikwad, Dipali Dande, Prof. Deepali Dhadwad [12] have studied the effects of climatology data: temperature, relative humidity, wind speed and daily precipitation on the risk of forests fire occurrence. These impacts urge the modification of certain techniques that could help to predict fires and thus avoid their happening. Artificial Neural Networks have been utilized for the purpose. We have studied the effects of both the number of neurons in the hidden layer and the training technique on the network's performance and the mean squared error. This is an demonstration of the good acquisition of such network in adopting its predicting decision. In this paper comprehensive survey on various machine learning techniques used for fire prediction is presented.

III. METHODOLOGY

To develop a system that predicts wildfires using Machine Learning and detect intensity of fire in the corresponding region using image classifier. Therefore, the proposed solution is designed to, train a prediction model using forest Algorithm and weather datasets. Predict the possibility of wildfire of the given set of attributes. Detect fire intensity in the region. We have analyzed a dataset collected from forest's weather with the utilization of FWI system. Firstly, we established relationships between the meteorological factors (e.g., temperature, relative humidity, wind) as well as model features (e.g., FFMC, DMC) correlated to forest fires. Having acquired the weights and influence of different factors on forest fires, we then applied the relationship to building a prediction system for forest fires. The system will calculate the parameters input and give feedback on the probability of potential forest fires using Multilayer perceptron (MLP) and linear regression. Machine learning models play a major role in the process of evaluation and prediction. Prediction is often done by using the available variables within the data set. Through the available variables within the data set, machine learning models can make predictions for the long term.

Machine learning models play a significant role within the method of analysis and prediction. Prediction is usually done by victimization the out their variables among the info set. Throughout their variables among the info set, machine learning models will build predictions for the long run.

Multi-layer perceptron (MLP) approach supported back propagation rule was applied in reference to physical, climate and fireplace incidence datasets.

CNN was used to detect wildland forest fire smoke to avoid the complex manually feature extraction process in traditional video smoke detection methods

IV. FIGURES AND TABLES

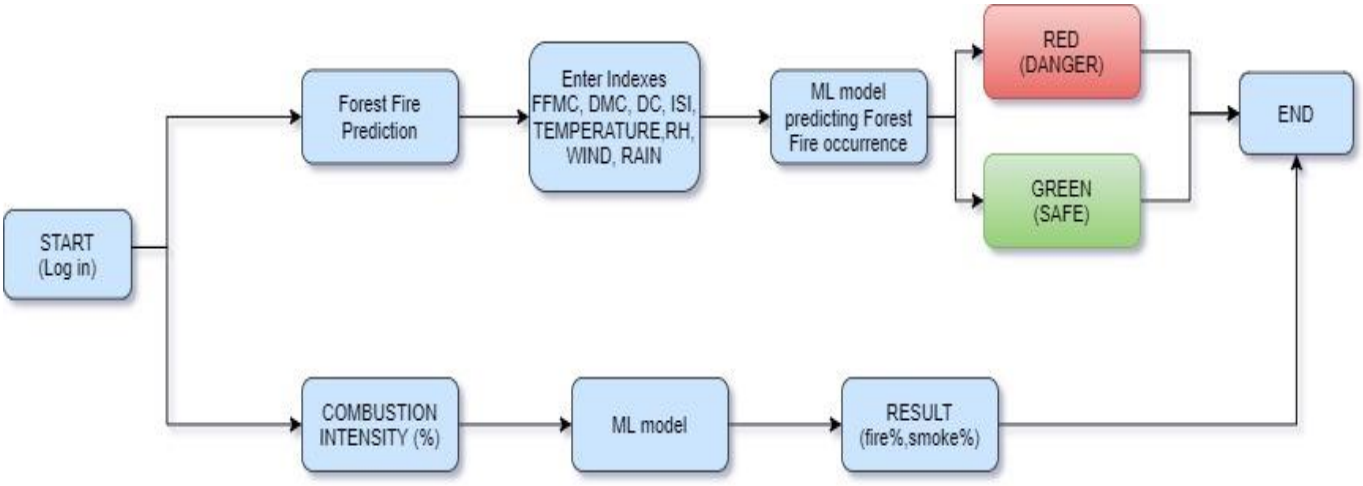

Fig 1: System Flow Diagram

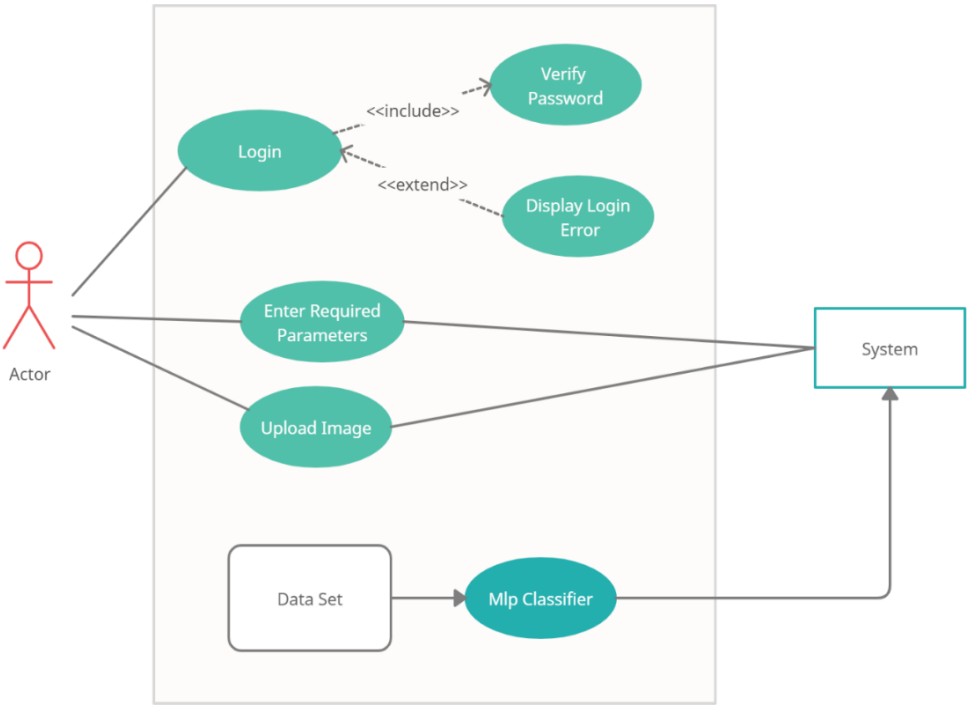

Fig 2: Use Case Diagram

Fig.1 depicts the system flow diagram of the system. The system starts with a registration page, followed by a log in page where an official logs in. The next page is a forest fire prediction page where the system will take input indexes viz. FFMC, DMC, DC, ISI, RH, Temperature values. After values are insert the MLP model, and data cleaning works on weather dataset after which it will predict whether the forest is in danger or not. If the forest is in danger it will predict in red with probability %, if the forest is safe it will predict in green with the probability %. The next page which is an extension to the first page which is a fire smoke intensity. With the use of image classifier, it takes image as an input, CNN model, logistic regression and various packages will work on it and will detect the intensity of fire and smoke.
Use case diagrams are behavior diagrams. They are used to describe the action sets that a system can perform in team with more than one external users. The Use case diagram is shown in Fig 2.

V. CONCLUSION

In the proposed system, we have presented a new algorithm: combination of Convolution Neural Network (CNN) and a class of feedforward artificial neural network Multilayer Perceptron (MLP). This project can be used by The Forestry Department to predict whether the forest is prone to catching fire or not. However, they can also use this proposed system to take precautions to prevent wildfire. We demonstrated agent-based model of wildfire which can fortell obtain the possible fire spread using value iteration. The accuracy of the model can still be further improved with more data set.

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