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Prediction of Occurrence of Fires in Forest

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Abstract:
A crucial part of controlling forest fires is the prediction of a forest fire. This is a significant environmental issue that leads to ecological degradation in the form of an endangered landscape of natural resources, which affects the ecosystem's stability, raises the risk of subsequent natural disasters, and depletes resources like water. Which contributes to water pollution and global warming. Fire detection is a critical component for dealing with such incidents.

It is anticipated that forest fire prediction would lessen the effects of a forest fire in the future. An important aspect of managing forest fires is forest fire prediction. It is crucial to efforts for allocate resources, mitigate risks, and recover. In this essay, based on artificial intelligence strategies for predicting forest fires are described and analyzed, provided based on random forest and decision trees. The system uses historical weather data to determine whether or not a fire will break out. Utilizing data from Lebanon, the algorithm's implementation showed how well it could forecast the risk of a fire occurring. Several forest fire prediction models, including Decision Tree and Random Forest, are compared and contrasted in this study.

Keywords
Decision Tree, Random Forest, and Forest Fire Prediction

Introduction:
Forest fires are a huge problem because they seriously destroy the environment, property, and people. The fire at Associate in Nursing must therefore be extinguished as soon as possible. The warmth brought on by the rise in the global average temperature is one of the primary causes of forest fires. The opposing causes are brought on by lightning, thunderstorms, and carelessness on the part of people. The average number of acres of American forest lost to wildfires each year is one and a half million. The number of forest fires in the Asian country increased by 125 percent between 2016 and 2018. Presently, a variety of tools, including physical models and mathematical models, can be used to anticipate how fires will develop. These models use a variety of information from laboratory experiments and simulations of forest fires to specify and forecast the spread of fire in various places. Simulation tools have recently become popular for predicting forest fires, but these technologies had to overcome challenges including the computer file's precision and the speed of the execution of the simulation tool. The branch of computing that deals with machine learning may be called artificial intelligence in computers. There are two categories of machine learning: supervised, unattended, and reinforcement learning. Regression, support vector machines (SVM), artificial neural networks (ANN), and decision trees are examples of machine learning techniques[3]. Unsupervised learning does not appear to label information qualities. This suggests that the labels should be defined in the formula. The

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formula will learn the link between the alternatives as well as the structure of the data collection. The major goal of forest fire forecasting is to properly allocate resources and to assist the fire management team's firefighters as much as possible[1].

Weather conditions are the primary causes of fire. The closest meteorological stations are utilized to combine sensors in the area to get the climatic data. Millions of hectares of land are destroyed by fire every year. These fires have consumed a significant area and produce more carbon monoxide than all the traffic put together. Monitoring possible danger zones and early fire detection can significantly minimize reaction times, the risk of damage, and the expense of combating fires.

Literature Survey:

Prediction of Forest Fires using Artificial Intelligence

A methodology for studying artificial intelligence-based forest fire prediction approaches has been proposed. Vector assistance machines are the foundation of forecasted forest fire risk method. The system was implemented using Lebanon information, and it has demonstrated the capacity to accurately assess the danger of fire[2].

Image Mining Technique for Predicting Forest Fires

By analyzing a series of pixel values can be used to anticipate the spread of a forest fire using an image mining technique. To forecast forest fires, the suggested approach makes use of satellite photos[4].

Artificial neural network for the prediction of forest fires

Lebanon was taken into consideration while predicting the likelihood of a forest fire. Temperature, relative humidity, and wind speed are among the parameters. Artificial Neural Networks must adapt in response to these[6].

Prediction of Forest Fires Using Linear Regression

The use of multivariate linear regression has been suggested for predicting forest fires. A few of the variables are temperature, humidity, wind, and precipitation. Different linear regression coefficients are computed using different methods such gauss-Jordan, Gausseidel, and least-squares. The findings of a comparative comparison of the methodologies are discussed[2].

Methodology

The user will be given input and the input is pre- processed to remove the noisy data. The models must be followed during the data's pre-processing. This improves the precision of the model and the information of the data. The data must be obtained from public sources because it will be utilised to train the models. The data is divided into Training and Testing data. ML models are trained and then testing will be done for evaluation[3]. The evaluation and prediction processes heavily rely on machine learning models. Predictions are frequently made using the data collection's factors. Machine learning models and the elements of the data set can be used to generate long-term forecasts. Prediction is the main application of the random forest and decision tree algorithms. As a result the system takes the input data from the users and produces the output.

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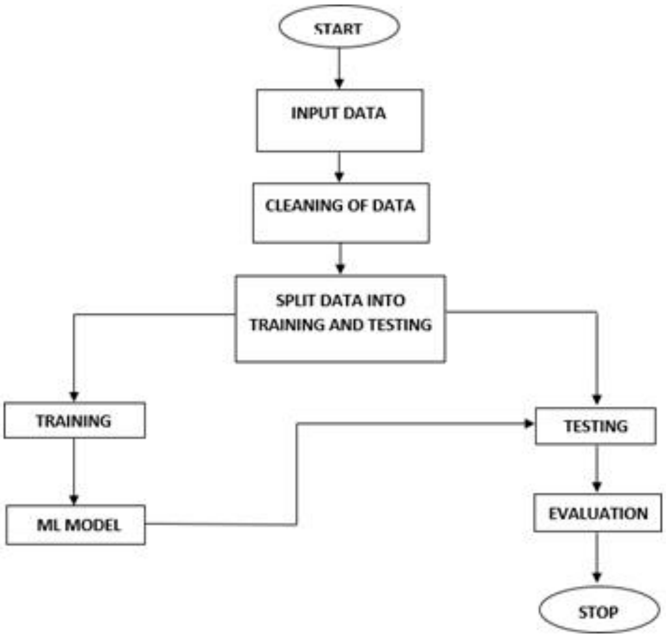

4. Algorithms:

4.1 Decision Tree

By continually dividing data based on a certain parameter, Decision Tree is an example of Supervised Machine Learning approach to handle problems with classification and regression. Decisions are made in the leaves, and the data is divided by the nodes. While a regression tree's decision variable is continuous, whereas a classification tree's decision variable is categorical (the outcome is a Yes/No). The following benefits of the decision tree include: suitability for classification and regression problems, simplicity of interpretation, handling of quantitative and categorical values, ability to fill in missing values in attributes with the most probable value, and high performance as a result of effectiveness the algorithm for tree traversal. Decision Tree may experience the over-fitting issue, which Random Forest, based on ensemble modelling approach, is the answer. Decision trees have drawbacks, including the potential for instability, difficulty in controlling tree size, potential for sampling error, and tendency to produce locally rather than globally optimal solutions. Decision trees can be applied to issues like estimating future book usage at the library.

4.1.1 Random Forest

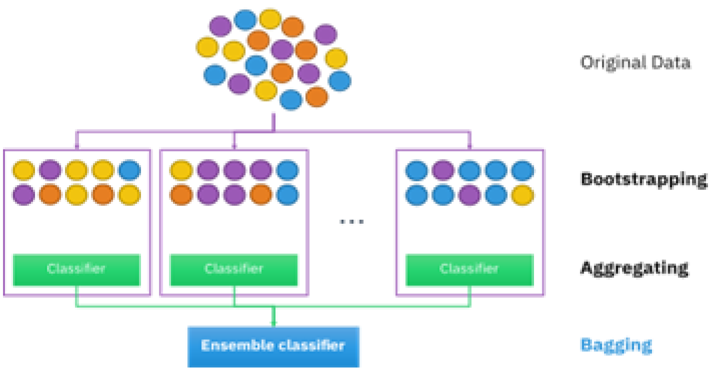

Figure 2: Over view of random forest algorithm

Random forest and other supervised machine learning algorithms are frequently used in classification and regression problems. Different samples are used to form decision trees, with the majority vote being used for regression and the average of those samples being

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used for categorization. The Random Forest Algorithm's ability to handle data sets comprising both continuous variables, as in regression, and categorical variables, as in classification, is one of its most crucial features. It produces better results when it comes to classification problems. To better comprehend this idea, let's use a real-world analogy. After finishing his 10+2, student X wants to enroll in a course but is unsure which one to take given his skill set. So he makes the decision to talk to a variety of people, including his cousins, teachers, parents, degree students, and workers. He asks them a range of queries, such as why he ought to select, employment prospects with that course, tuition, etc. He ultimately chooses to take the course that the majority of people recommended after conversing with a variety of people about it.

Figure 3: Example of random forest algorithm

Working of Random Forest Algorithm: We must first examine the ensemble technique in order to comprehend how the random forest functions. Ensemble simply refers to the process of blending of various models. As a result, a group of models rather than a single model is employed to create predictions.

Bagging: The outcome is determined by majority voting, and a new training subset is created using replacement from a sample of the training data. Consider Random Forest.

Bagging:

Bagging, also known as Bootstrap Aggregation, is the ensemble method used by random forest. Bagging is used to select a random sample from the data set.

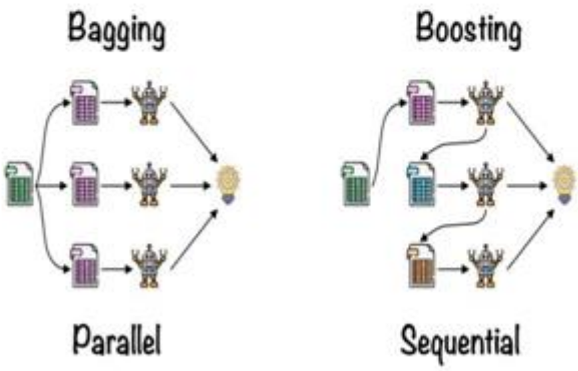

Figure 4: working of random forest algorithm

Architecture:

The "system architecture" computer paradigm describes the organisational structure of a system. First, we must provide the dataset. Kaggle was used to gather the information. The data set must be obtained from public sources because it will be utilised to train the models. Additionally, the dataset is pre- processed, providing Pre - processing data, followed by model training, prediction, and display of the outcomes like as shown in figure 5. In this application we are using Random forest, decision tree algorithms [6] are used for predicting the data accuracy of each model.

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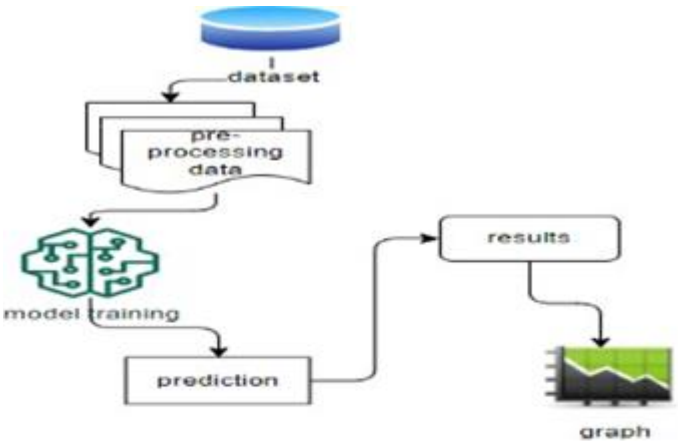

Figure 5: Architecture

6. Results:

Home Page: This is our application's home page. It mostly has buttons for home, upload Data, viewData, Train Model, and prediction.

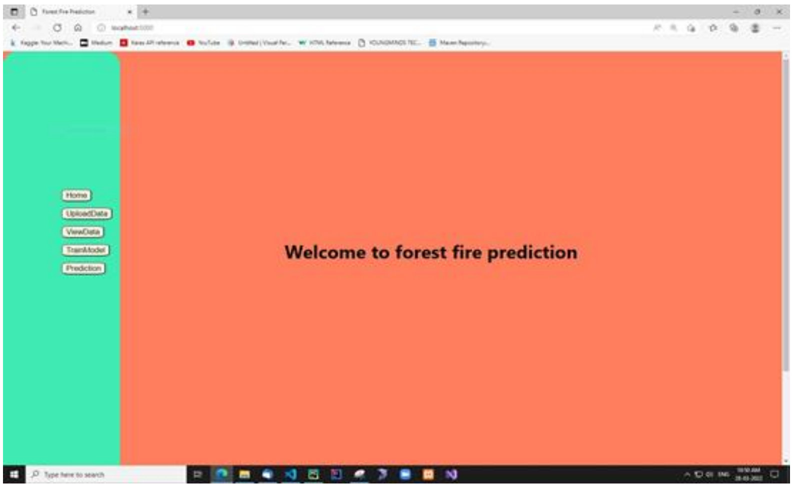

Figure 6: Home page

Upload Data Page: A page is opened when the UploadData button is clicked. We can upload the dataset file on that page.

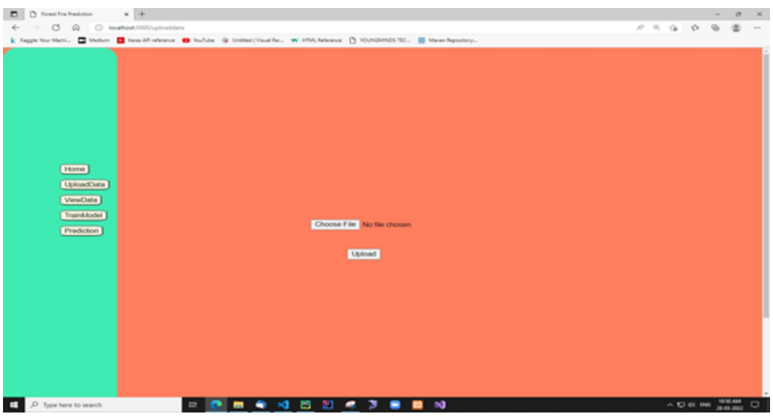

Figure 7: Upload Data Page

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View Data Page: A page where we can see the dataset file that we uploaded will be launched when we click see data page.

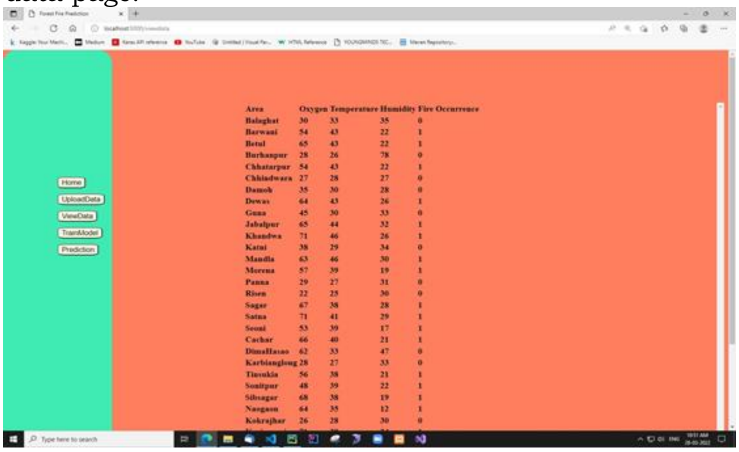

Figure 8: View Data Page

Select Model: We can choose which model needs to be applied to the dataset we've supplied by selecting select model.

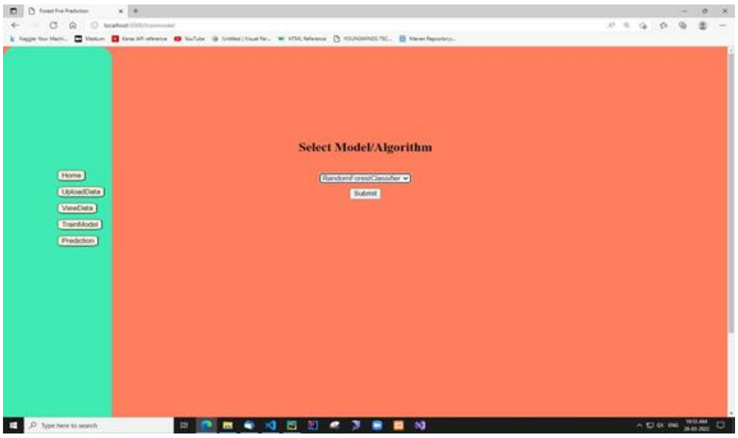

Figure 9: Select Model

View Result: We must enter the input values prior to hitting the prediction button. The submit button must be clicked after entering all the input values to view the results.

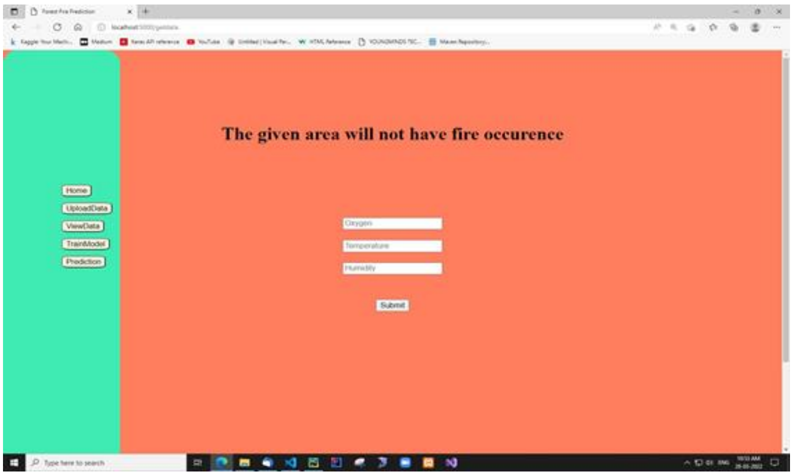

Figure 10: View Result

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Conclusion

For the purpose of predicting forest fires, the experiment findings are utilized to select a variable number of training sessions and instances of evaluation. In this study, the factors that influence the frequency of fires are investigated. It takes into account the three meteorological factors of temperature, relative humidity, and wind speed. High wind speeds, low humidity, and extreme temperatures all dramatically increase the risk of burning. Additionally, it has been discovered that there are more forest fires than in other types of surface areas. Due to the heightened risk of forest fires, data mining techniques should be employed to forecast fires. This project can be improved by being enlarged in order to improve the models' capabilities and the results. For the application's UI, we might have built some real-time performance. The user can enter the city and zip code in accordance with the UI model's process. We'll use the zip code to obtain using any latitude and longitude available APIs, then use as well as the coordinates inputs to retrieve meteorological data for a specific day, including the maximum and minimum temperatures, humidity levels, wind speeds, and more.

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