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Forest Fire Prediction System

Under the guidance of Dr. Mohammad Arif

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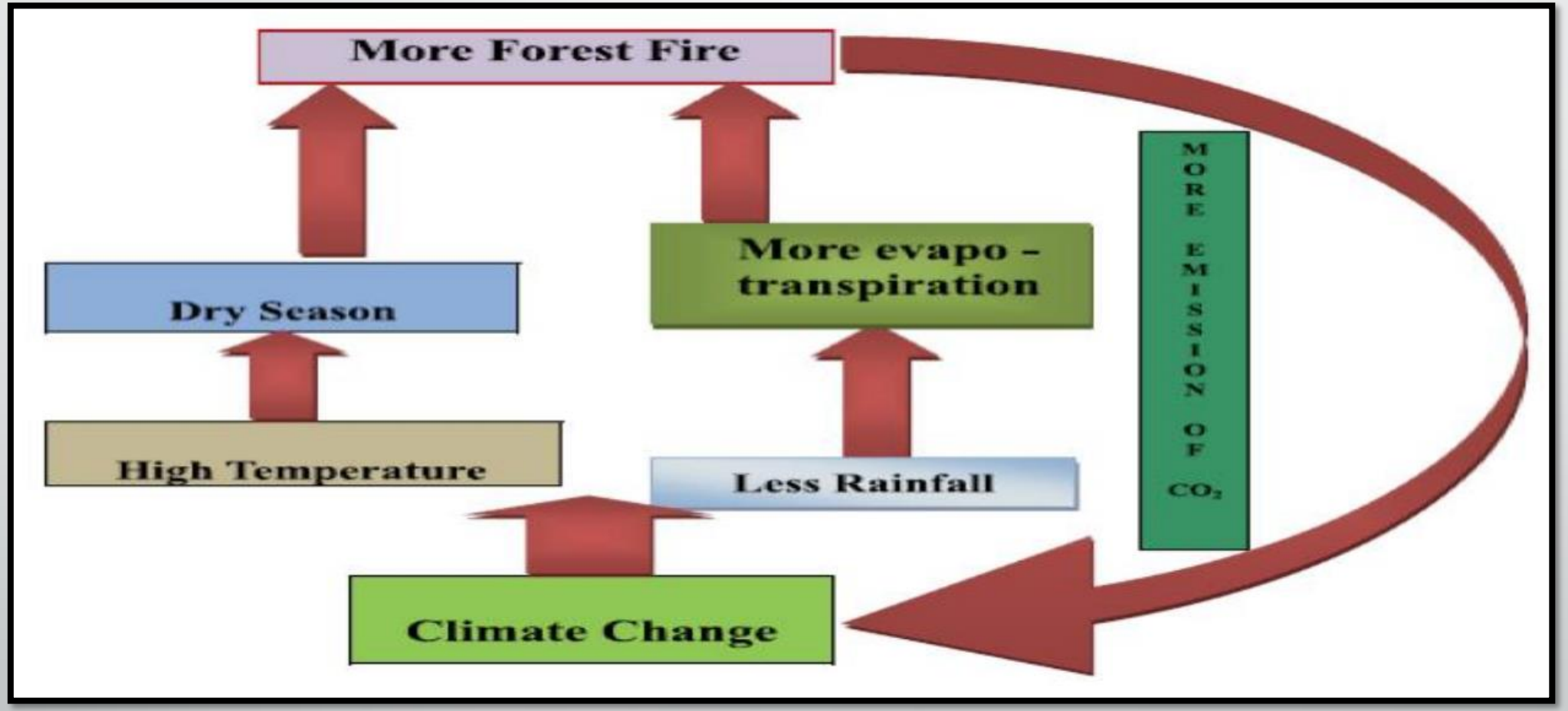
Contents

Domain

The most common hazard in forest is forest fire. They pose a threat not only to forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region.

During summer, when there is no rain for months, the forest become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark.


More Forest Fire
Dry Season
More evapo – transpiration
MORE EMISSION OF CO_2
High Temperature
Less Rainfall
Climate Change

Introduction

Forest fires are a significant threat to the environment and human settlements worldwide, causing massive damages to biodiversity, wildlife, human lives, and the economy. Therefore, there is a pressing need for accurate and timely forest fire prediction models to prevent or mitigate the damages caused by these disasters. This project proposes a forest fire prediction system that utilizes machine learning algorithms to provide accurate predictions and early warning of forest fire incidents. The system will consider several environmental factors, such as weather conditions, vegetation types, topography, and human activities, to predict forest fire occurrences and severity accurately. The system will be trained on a large dataset of historical forest fire incidents. The proposed solution will address the issues of inadequate prediction accuracy, limited resources for monitoring, and human factors, providing forest authorities with a comprehensive system to prevent and mitigate forest fires' damages. The forest fire prediction system will have a user-friendly interface that can be used by forest authorities and other stakeholders to monitor and predict forest fire incidents, providing visualizations and alerts to help forest authorities make informed decisions on forest fire prevention and mitigation measures.

Problem Statement

Forest fires have become a significant threat to the natural environment and human settlements worldwide. The frequency, intensity, and extent of forest fires have been increasing in recent years, causing massive damage to biodiversity, wildlife, human lives, and the economy. Therefore, there is a pressing need for accurate and timely forest fire prediction models to prevent or mitigate the damages caused by these disasters.

List of Issues

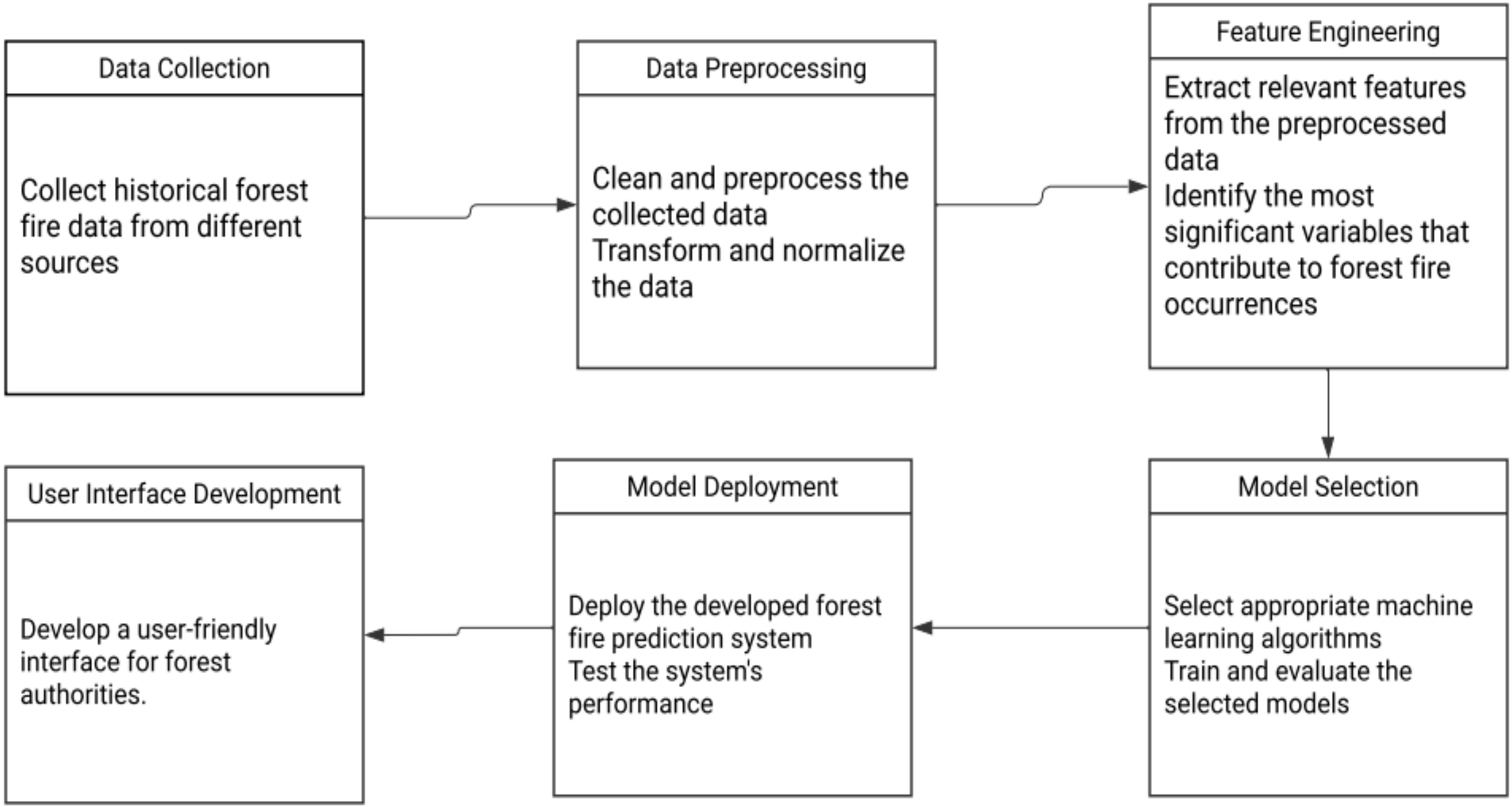
- Lack of reliable data: One of the primary challenges in developing a forest fire prediction model is the availability of reliable and up-to-date data.
- Complexity of the forest ecosystem: The forest ecosystem is complex, and several factors can contribute to the occurrence and spread of forest fires, such as weather conditions, vegetation types, topography, and human activities.
- Limited resources for monitoring: Monitoring forest fires requires a significant amount of resources, such as manpower, equipment, and technology.
- Human factors: Human activities such as camping, smoking, and burning trash are some of the leading causes of forest fires.

Proposed solution

The proposed solution for the forest fire prediction system is to develop a machine learning model that considers several environmental factors to predict forest fires occurrence and severity accurately. The model will be trained on a dataset of historical forest fire incident, including weather conditions, vegetation types, topography, and among other variables. The model will use supervised learning algorithms such as Random Forest, Linear Regression and Artificial Neural Networks (ANN) to identify patterns and correlations between these variables and forest fire incidents.

Methodology

1. **Data Collection**
    a) Collect historical forest fire data from different sources
2. **Data Preprocessing**
    a) Clean and preprocess the collected data
    b) Transform and normalize the data
3. **Feature Engineering**
    a) Extract relevant features from the preprocessed data
    b) Identify the most significant variables that contribute to forest fire occurrences
4. **Model Selection**
    a) Select appropriate machine learning algorithms
    b) Train and evaluate the selected models
5. **Model Deployment**
    a) Deploy the developed forest fire prediction system
    b) Test the system's performance
6. **User Interface Development**
    a) Develop a user-friendly interface for forest authorities


Data Collection
Collect historical forest fire data from different sources
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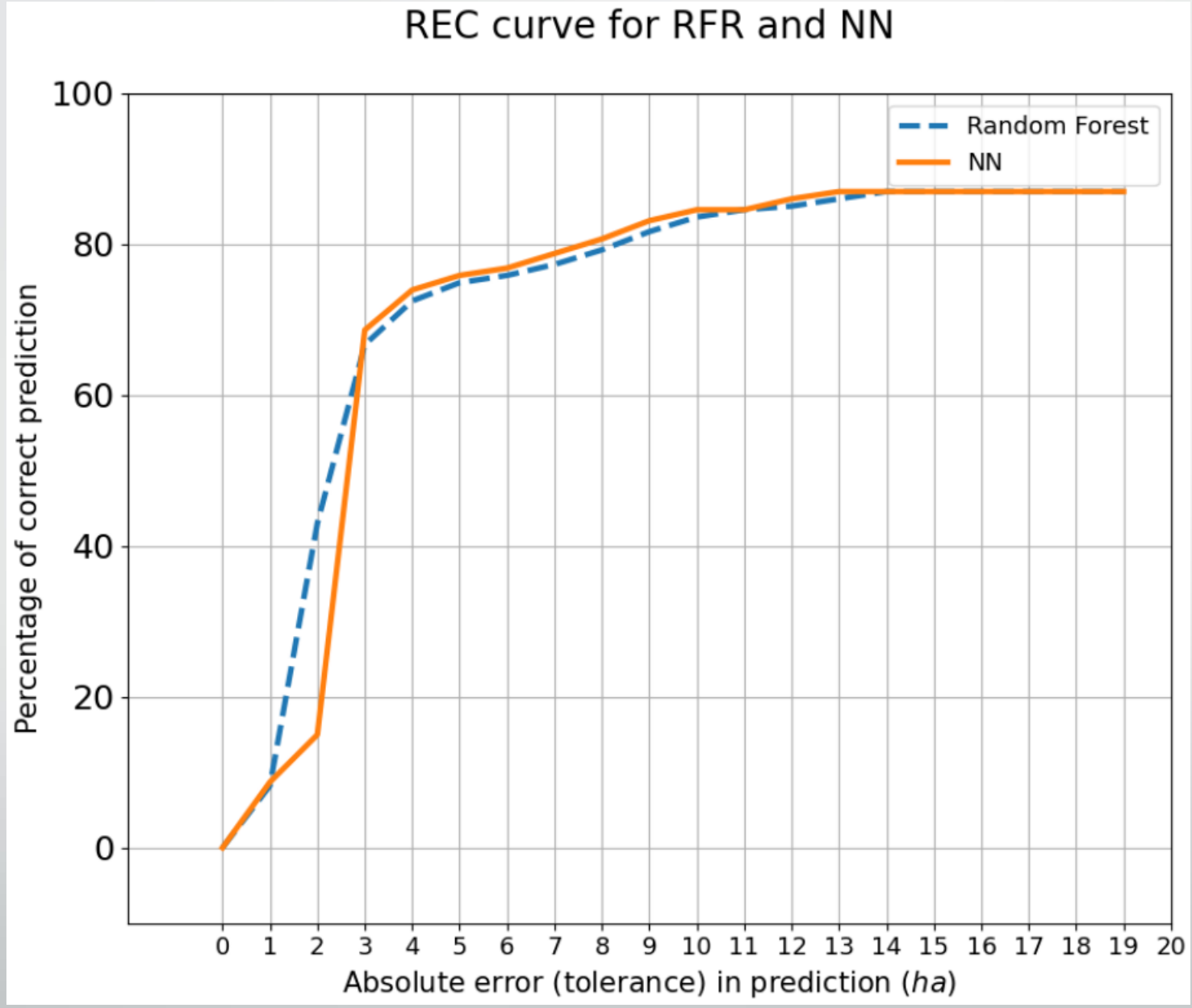
Develop a user-friendly interface for forest authorities.

Dataset Description

1. X - x-axis spatial coordinate: This attribute represents the x-coordinate of the location where the forest fire occurred. It ranges from 1 to 9.
2. Y - y-axis spatial coordinate: This attribute represents the y-coordinate of the location where the forest fire occurred. It ranges from 2 to 9.
3. month - month of the year: This attribute represents the month in which the forest fire occurred. It ranges from 'jan' to 'dec'.
4. day - day of the week: This attribute represents the day of the week on which the forest fire occurred. It ranges from 'mon' to 'sun'.
5. FFMC - Fine Fuel Moisture Code: This attribute represents the moisture content of litter and other cured fine fuels. It ranges from 18.7 to 96.20.
6. DMC - Duff Moisture Code: This attribute represents the moisture content of decomposed organic material underneath the litter. It ranges from 1.1 to 291.3.
7. DC - Drought Code: This attribute represents the drought level of the forest. It ranges from 7.9 to 860.6.
8. ISI - Initial Spread Index: This attribute represents the expected rate of fire spread. It ranges from 0.0 to 56.10.
9. temp - temperature in Celsius degrees: This attribute represents the temperature at the time of the forest fire. It ranges from 2.2 to 33.30.
10. RH - relative humidity: This attribute represents the relative humidity at the time of the forest fire. It ranges from 15 to 100.
11. wind - wind speed in km/h: This attribute represents the wind speed at the time of the forest fire. It ranges from 0.40 to 9.40.
12. rain - outside rain in mm/m2: This attribute represents the amount of rainfall at the time of the forest fire. It ranges from 0.0 to 6.4.
13. area - the burned area of the forest: This attribute represents the burned area in hectares. It ranges from 0.00 to 1090.84.



Comparative Analysis for Random Forest Regressor and Neural Network

Forest Fire Prediction System

Predict the probability of Forest-Fire Occurence

FFMC
FFMC Index 18.7-96.20 in FWI system

DMC
DMC Index 1.1-291.3 in FWI system

DC
DC Index 7.9-860.6 in FWI system

ISI
ISI Index 0.0-56.10 in FWI system

Temperature
2.2-33.30 degrees Celcius

RH
RH% 15.0-100.0

Wind
Wind km/hr 0.49-9.40

Rain
Rain mm/m2 0.0-6.4

PREDICT PROBABILITY

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Result and Analysis

Forest fires are socially and economically unwelcome as they cause deforestation and land burning, taking time to recover. Preventing forest fires is important. The model used in the study has an accuracy of 0.90, but can be improved by adding live data processing, on-site predictions, or making it sensor-based. Future improvements aim to increase the speed and accuracy of the working model.

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Thank You