Forest Fire Prediction

A Project Report

Submitted in the partial fulfillment of the

requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

DEPARTMENT OF COMPUTER SCIENCE ENGINNERING

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Declaration

The Project Report entitled “Forest Fire Prediction” is a record of Bonafide work of Siripuri Divya- 457788, Team leader K Sahitya-2320030301, Team members K.Srirjth-2320030296, Jatin-2320090006 submitted in partial fulfillment for the award of B.Tech in Computer Engineering to the K L University. The results embodied in this report have not been copied from any other departments/University/Institute.

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Certificate

This is certify that the project based report entitled "Forest Fire Prediction" is a bonafide work done and submitted by **S.Divya (458999,** Team leader K Sahitya-2320030301, Team members K.Srirjth-2320030296, Jatin-2320090006 for the award of the degree of **BACHELOR OF TECHNOLOGY** in Department of Computer Science Engineering, K L (Deemed to be University), during the academic year **2024-2025.**

Signature of the Supervisor

Signature of the HOD

Signature of the External Examiner

ACKNOWLEDGEMENT

The success in this project would not have been possible but for the timely help and guidance rendered by many people. Our wish to express my sincere thanks to all those who has assisted us in one way or the other for the completion of my project.

Our greatest appreciation to my guide, Siripuri Divya, Department of Computer Science which cannot be expressed in words for his tremendous support, encouragement and guidance for this project.

We express our gratitude to **Dr.Ramesh**, Head of the Department for Computer Science Engineering for providing us with adequate facilities, ways and means by which we are able to complete this project based Lab.

We thank all the members of teaching and non-teaching staff members, and also who have assisted me directly or indirectly for successful completion of this project. Finally, I sincerely thank my parents, friends and classmates for their kind help and cooperation during my work.

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ABSTRACT

The Forest Fire Prediction Website combines machine learning techniques with web development to provide an accessible platform for predicting fire risks based on environmental conditions. By using real-time climate data, the platform utilizes the Random Forest algorithm to forecast the likelihood of forest fires occurring. The project aims to provide a preventative tool for emergency services and individuals by displaying easy-to-interpret predictions through a simple, user-friendly web interface. This tool empowers users to make informed decisions about fire safety and mitigation.

INTRODUCTION

Background and Motivation: Forest fires continue to pose serious challenges across the globe, causing destruction of property, loss of biodiversity, and environmental damage. Traditional methods for detecting forest fires depend on surveillance systems that often fail to predict fires in advance. With climate change, the frequency and intensity of these fires are expected to increase. This project was conceived as a

response to these challenges, aiming to provide a real-time, predictive solution based on environmental data.

Problem Statement: Reactive fire management is costly and often too late to prevent widespread damage. The lack of affordable predictive tools hampers efforts to intervene early. This project addresses the issue by offering a proactive solution through machine learning predictions based on real-time environmental inputs.

Objectives: Develop a machine learning model capable of predicting forest fire occurrences based on environmental data. Create a user-friendly web interface for accessing predictions and visualizing results. Make the platform accessible to the public, enhancing awareness of fire risks.

Scope: This system focuses on the early detection of potential forest fire conditions based on environmental factors such as temperature, wind speed, and rainfall. The platform will cater to individuals and organizations working in fire-prone areas, assisting in decision-making processes for fire prevention.

Constraints: The system's reliance on accurate and up-to-date environmental data can be a limitation. In areas where data is sparse or unreliable, the predictions may lose accuracy. Additionally, while the machine learning model performs well in training, real-world scenarios may vary significantly from historical data, affecting prediction reliability.

Literature survey

Historical Approaches: Historically, fire detection relied on satellite imagery, manual surveillance, and fire lookout towers. While these methods offered some success, their limitations include the inability to predict fire risks before they happen, which can delay critical interventions. The need for a more accurate predictive system has been a topic of increasing research.

Machine Learning in Fire Prediction: Recent studies indicate that machine learning, specifically Random Forests and Neural Networks, can significantly improve fire prediction. These algorithms allow for the analysis of large datasets, identifying patterns that are too complex for manual analysis. Research has also demonstrated that integrating environmental factors with historical fire data yields more accurate predictions.

Current Technologies: Today, IoT sensors, satellite data, and weather prediction systems are used to monitor fire risk factors. However, most of these systems are not available to the general public and are often costly to implement. There is a gap in the market for accessible, affordable fire risk prediction tools that can be used on-demand.

Research Gaps: While machine learning approaches have shown promise, there is still a need for improved feature engineering, integration of real-time data, and model training to deal with different geographical locations. There is also a lack of easy-to-use systems that can provide fire predictions for users without specialized knowledge.

Software requirements

Frontend:

HTML: Provides the basic structure for the webpage.

CSS: Ensures a responsive, visually appealing design.

JavaScript: Used for dynamic content handling and form validations.

Bootstrap: Enhances design elements for mobile responsiveness.

Backend:

Flask:

A lightweight web framework for Python that connects the user interface with the machine learning model, handles requests, and serves predictions.

Jinja2: Template engine integrated with Flask for rendering HTML content dynamically.

Machine Learning Libraries: Scikit-Learn: For implementing the Random Forest algorithm and evaluating model performance.

Pandas: Used for data manipulation, cleaning, and preprocessing.

Matplotlib: Provides visualizations for model performance and data analysis.

Cloud Deployment:

Heroku: A platform-as-a-service (PaaS) for deploying web applications, chosen for its ease of use and integration with Flask.

AWS: Potential backup for scaling the application as user traffic grows.

Implementation

Backend: The Flask backend handles HTTP requests from the frontend, processes them, calls the machine learning model for predictions, and sends the results back to the frontend.

Frontend: Users interact with an HTML form where they input temperature, humidity, and other variables. JavaScript ensures that the data is validated before being sent to the backend.

Project Objectives

Develop a Machine Learning Model: The model aims to process environmental data to predict forest fire risks. By leveraging the Random Forest algorithm, the goal is to create a high-performing, robust system that can deliver real-time predictions with minimal latency. **Create a User-Friendly Frontend**: The project also focuses on the design of an easy-to-navigate web interface. The system allows users to input various environmental parameters (e.g., temperature, wind speed) and receive a prediction of the fire risk. Implement Real-Time **Data Processing**: A key objective is to incorporate the capability for real-time data processing. This would allow the website to fetch and display updated environmental data to predict fire risks dynamically. Deploy the System for Public Use: To ensure broad accessibility, the platform will be deployed on a reliable web hosting service, such as AWS or Heroku, to provide public access and allow users to predict fire risks easily.

Methodology

Data Collection: Datasets related to climate conditions, weather forecasts, and historical fire occurrences were collected from open-source platforms, including Kaggle and government environmental monitoring agencies. The data includes variables such as temperature, humidity, wind speed, and fire incidents.

Data Preprocessing: This step involved cleaning the data, handling missing values, and normalizing the data to ensure that all features have similar scales, which prevents any one feature from dominating the model training process.

Feature Engineering: Several derived features were considered, such as the interaction between wind speed and humidity, which may influence fire risk. By examining the relationship between different features and fire occurrences, we identified the most relevant predictors for the model.

Model Selection: The Random Forest algorithm was chosen because it is known for its high performance with large, complex datasets, such as those used in environmental predictions. The ensemble nature of Random

Forest reduces the risk of overfitting compared to single models like Decision Trees.

Model Training: The model was trained using 80% of the data, with 20% held out for validation. Hyperparameters such as the number of trees and maximum tree depth were optimized using Grid Search to improve accuracy.

CONCLUSION

The **Forest Fire Prediction Website** project provides a comprehensive solution to one of the most pressing environmental challenges: predicting and mitigating the risks of forest fires. By combining machine learning techniques, specifically the Random Forest algorithm, with a user-friendly web interface, the platform empowers users to make data-driven decisions based on real-time environmental conditions.Through the development of a robust machine learning model trained on historical fire data and environmental factors, the website offers real-time predictions of fire risks. The easy-to-navigate interface ensures that individuals and organizations in fire-prone areas can access these predictions and take proactive measures to reduce fire damage and loss of life.Despite challenges such as data accuracy and real-world variability in environmental factors, the project demonstrates the potential of integrating advanced technologies with practical, real-world applications. The use of publicly accessible environmental data,

combined with scalable cloud deployment, ensures that this tool can reach a broad audience, from local residents to emergency services.This project contributes to the growing field of predictive analytics for disaster management, providing a powerful tool for forest fire prevention and safety. Future improvements could include further optimization of the machine learning model, better integration of real-time data sources, and expanded geographic coverage to increase the platform's overall effectiveness.In conclusion, the **Forest Fire Prediction Website** is a step forward in leveraging technology to address environmental crises, offering a proactive and accessible solution to fire risk prediction. The successful deployment of the platform paves the way for future enhancements, including integration with IoT devices, improved models, and broader geographical applicability.