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Forest Fire Prediction Using Machine Learning

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Abstract: Forest fires pose a significant threat to ecosystems and human safety, necessitating effective predictive models for early intervention. This research explores the application of machine learning techniques to enhance forest fire prediction accuracy. Leveraging a comprehensive dataset encompassing environmental variables, historical fire incidents, and meteorological data, we employ state-of-the-art machine learning algorithms. Our study evaluates the performance of these models through rigorous testing, considering metrics such as accuracy, precision, and recall. Comparative analysis with traditional methods underscores the efficacy of machine learning in predicting and mitigating forest fires. The findings contribute to the advancement of proactive strategies for forest fire management and underscore the potential of machine learning in addressing complex environmental challenges.

Keywords: Forest fires, Machine learning, Predictive models, Metrological data, proactive strategies

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.

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 likedaytime/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

II. LITERATURE REVIEW

Forest fires, characterized by their swift and destructive nature, have prompted extensive research into predictive modeling, aiming to minimize their impact on ecosystems and human lives. Previous studies have predominantly explored traditional methods, such as statistical models and rule-based systems, relying on historical fire data and meteorological variables. While informative, these approaches often face challenges in capturing the complexity of wildfire dynamics, especially in the context of changing environmental conditions and climate patterns.

In recent years, a paradigm shift has occurred with the increasing integration of machine learning techniques into forest fire prediction. Machine learning offers a data-driven approach, capable of discerning intricate patterns and relationships within diverse datasets. Various algorithms, including Random Forest, Support Vector Machines, and Neural Networks, have demonstrated promise in enhancing the accuracy and efficiency of forest fire prediction models.

III. RELATED WORKS

1) "Forest Fire Prediction Using Machine Learning "

-International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 11 Issue V May 2023- Available at www.ijraset.com

Authors: Virupaksha Gouda R1 , Anoop R2 , Joshi Sameerna3 , Arif Basha4 , Sahana Gali5

2) " Predicting Forest Fires in Madagascar "

- Authors: Jessica Edwards , Manana Hakobyan , Alexander Lin and Christopher Golden
- School of Engineering and Applied Sciences, Harvard University, Cambridge, MA, USA 2T. H. Chan School of Public Health, Harvard University, Boston, MA, USA
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3) "Early wildfire detection using machine learning model deployed in the fog/edge layers of IoT"

- Authors: Mounir Grari, Idriss Idrissi, Mohammed Boukabous, Omar Moussaoui, Mostafa Azizi,

Published in: Indonesian Journal of Electrical Engineering and Computer Science

- This paper discusses the use of machine learning algorithms, including RandomForest, for predicting the spread of wildfires based on meteorological data collected by the use of Iot

4) "Next Day Wildfire Spread: A Machine Learning Data Set to Predict Wildfire Spreading from Remote-Sensing Data"

- Authors: Fantine Huot1 , R. Lily Hu2 , Nita Goyal, Tharun Sankar, Matthias Ihme, and Yi-Fan Chen

IV. PROPOSED METHOD

1) Data Collection

- Gather a comprehensive dataset containing historical forest fire incidents, meteorological data, and relevant environmental variables. Datasets from sources like weather stations, satellite imagery, and fire incident reports can be valuable.

2) Data Preprocessing

- Clean the dataset by handling missing values, outliers, and inconsistencies.
- Convert categorical variables into numerical representations.
- Explore and understand the distribution of features through exploratory data analysis (EDA).

3) Feature Engineering

- Create new features or transform existing ones to capture meaningful patterns in the data.
- Consider factors such as seasonality, time of day, and historical fire occurrences.

4) Data Splitting

- Divide the dataset into training and testing sets. This is crucial for evaluating the model's performance on unseen data.

5) Model Selection

- Choose machine learning algorithms suitable for the task. Random Forest, Support Vector Machines, and Neural Networks are common choices for forest fire prediction.

6) Hyperparameter Tuning

- Fine-tune the hyperparameters of your selected models to optimize their performance. This may involve techniques like grid search or randomized search.

7) Training the Models

- Train the machine learning models using the training dataset.
- Experiment with different algorithms to compare their performance.

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8) Model Evaluation
- Assess the performance of the trained models using the testing dataset.
- Evaluate metrics such as accuracy, precision, recall, F1 score, and area under the ROC curve.

9) Model Deployment
- Model deployment using Flask involves integrating your trained machine learning model into a Flask web application to make real-time predictions accessible via API endpoints

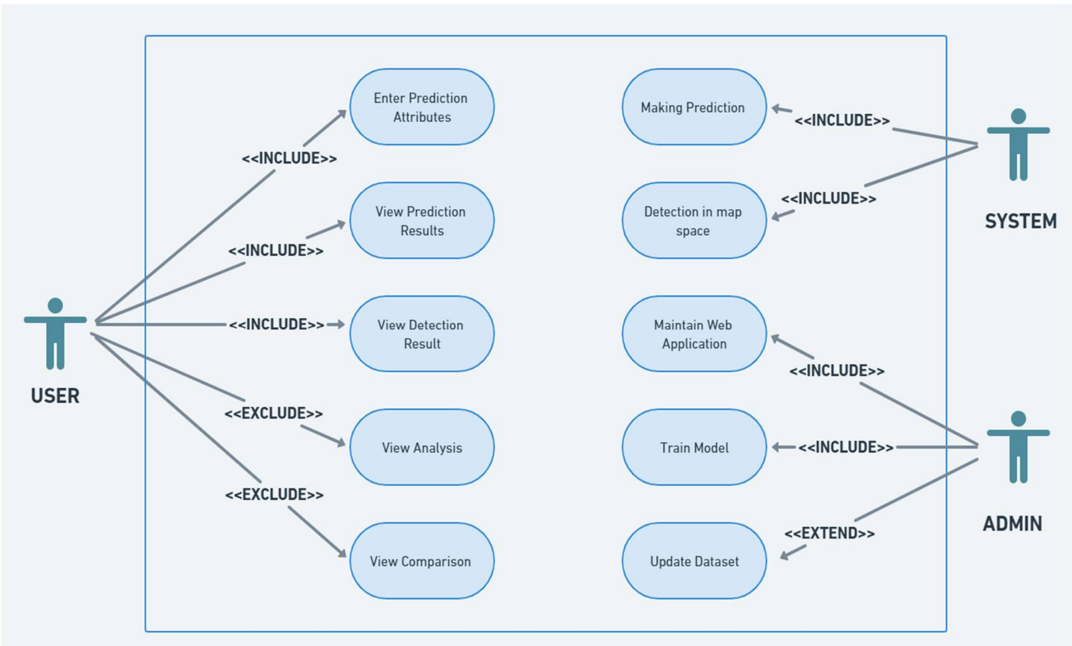
V. DATASET DESCRIPTION

It comprises a data matrix in which columns represent variables, and rows represent instances.
The data set comprise of the nine months data of Algerian Forest.

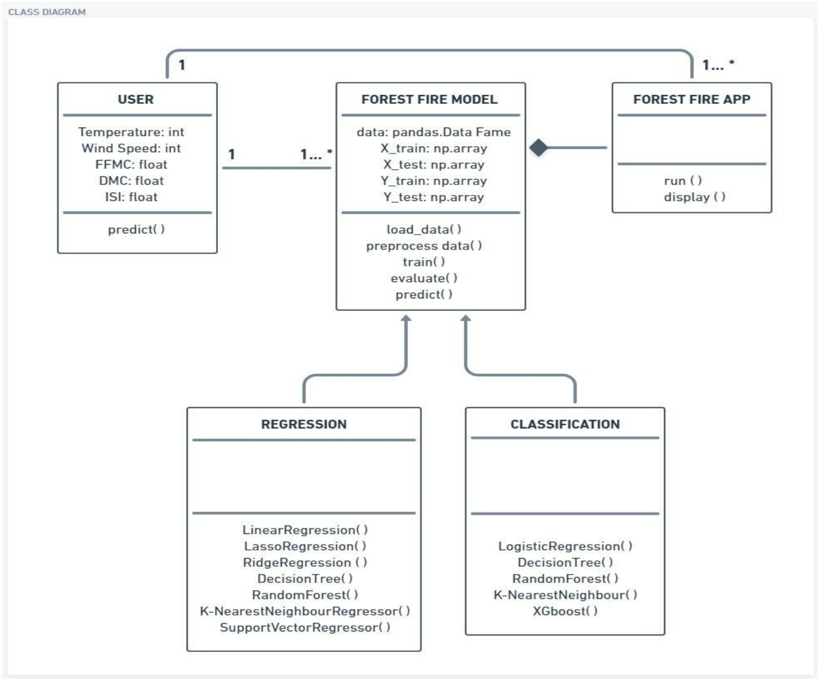
A. Attribute Information

1) Date : (DD/MM/YYYY) Day, month ('june' to 'september'), year (2012)
2) Temp : temperature noon (temperature max) in Celsius degrees: 22 to 42
3) RH : Relative Humidity in %: 21 to 90
4) Ws : Wind speed in km/h: 6 to 29
5) Rain: total day in mm: 0 to 16.8FWI Components
6) Fine Fuel Moisture Code (FFMC) index from the FWI system: 28.6 to 92.5
7) Duff Moisture Code (DMC) index from the FWI system: 1.1 to 65.9
8) Drought Code (DC) index from the FWI system: 7 to 220.4
9) Initial Spread Index (ISI) index from the FWI system: 0 to 18.5
10) Buildup Index (BUI) index from the FWI system: 1.1 to 68
11) Fire Weather Index (FWI) Index: 0 to 31.1
12) Classes: two classes, namely Fire and not Fire

VI. IMPLEMENTATION DIAGRAM

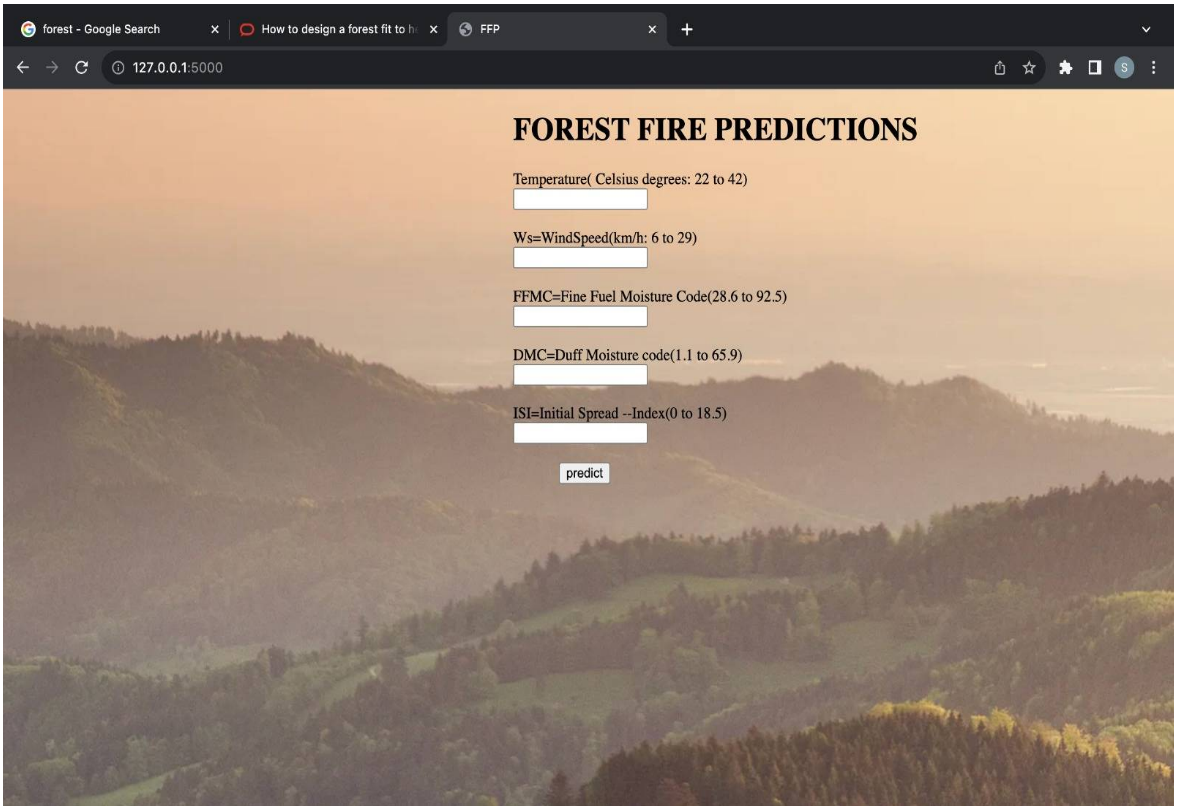


Use Case Diagram



Class Diagram

A. Output



Sample GUI

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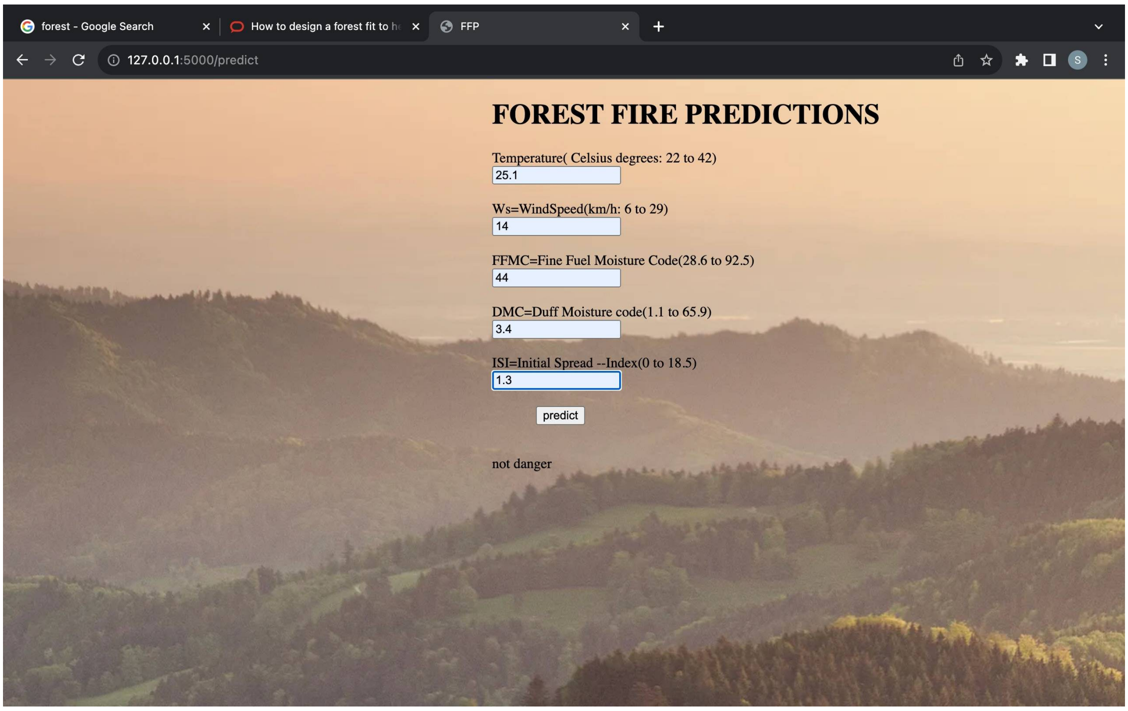

GUI with output

VII. FUTURE WORK

A. Integration of Real-time Satellite Data

Explore methods to incorporate real-time satellite data, leveraging advancements in satellite technology, to enhance the accuracy and timeliness of predictions.

B. Dynamic Model Updates with Continuous Learning

Implement mechanisms for continuous learning, allowing the model to adapt and improve over time as it receives new data, ensuring robustness in the face of changing environmental conditions

C. Collaboration with Environmental Sensors and IoT Devices

Collaborate with environmental monitoring initiatives and deploy IoT devices equipped with sensors to capture localized data, fostering a more detailed and fine-grained understanding of the forest ecosystem.

D. Ensemble of Multiple Models for Enhanced Accuracy

Investigate the effectiveness of combining predictions from multiple models, potentially including diverse machine learning algorithms, to create an ensemble system that captures a broader range of patterns and nuances in forest fire dynamics.

E. User-Friendly Visualization and Communication Tools

Develop user-friendly visualization tools and communication interfaces to empower stakeholders, such as firefighting agencies and local communities, with easily interpretable insights and actionable information.

VIII. CONCLUSION

In conclusion, the development and implementation of a Forest Fire Prediction System represent a critical step towards proactive forest conservation, community safety, and environmental management. This comprehensive system integrates cutting-edge technology, machine learning, and real-time data analysis to provide early warning and decision support for forest fires.

Ultimately, the Forest Fire Prediction System serves as a vital tool in safeguarding our forests, ecosystems, and communities from the devastating impact of forest fires. By combining technology, data science, and environmental awareness, we can work towards a sustainable future where the threat of forest fires is mitigated, and our natural resources are conserved for generations to come.

REFERENCES

[1] "Forest Fire Prediction Using Machine Learning "-International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 11 Issue V May 2023- Available at www.ijraset.com Authors: Virupaksha Gouda R1 , Anoop R2 , Joshi Sameerna3 , Arif Basha4 , Sahana Gali5

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