KIET Group of Institutions, Ghaziabad
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FOREWARNING SYSTEM ABOUT NATURAL CALAMITIES

PCS25-44, Guide: Prof. Sreesh Gaur

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Introduction and Background

Forewarning systems are early warning tools that detect and alert about upcoming natural disasters like floods or cyclones. They analyze environmental data in real-time to enable timely action and reduce loss of life and damage.

Our project enhances this concept by combining a Threshold-Based Alert Algorithm (TBA) with a Random Forest Classifier (RFC). This hybrid model ensures fast alerts and accurate flood severity prediction.

Key Examples:

- IMD (India Meteorological Department): Issues weather alerts for floods and cyclones using satellite data and weather models.
- CWC (Central Water Commission): Monitors river levels and provides flood forecasts across India.
- GFMS (Global Flood Monitoring System): Uses satellite data to offer near real-time global flood alerts.

These systems highlight the value of early warnings in disaster management. Our model adds to this by improving speed, precision, and adaptability.

*For our current study, the scope of natural calamities is focused on floods

Problem Statement

- **Natural disasters**, including earthquakes, hurricanes, ***floods***, and wildfires, pose a continual **threat** to humanity, infrastructure, and ecosystems worldwide.
- Despite advancements in understanding their mechanisms, **accurately predicting** their occurrence and issuing **timely warnings** remain ***challenging***.
- The purpose of **AWARN(Forewarning System)** is to enhance ***flood* preparedness and response*** through a comprehensive approach involving data acquisition, processing, and analysis.

*For our current study, the scope of natural calamities is focused on floods

Objectives

Data Analysis and Prediction

To utilize various data sources and analytical techniques to predict and provide early warnings for potential natural disasters.

Risk Assessment and Alerting

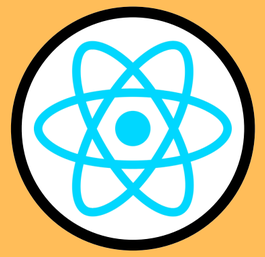
Assess the risk of future calamities by analyzing historical data. Provide real time notifications and mailing alerts for potential threats.

Forewarning

Forewarning natural calamities aims to predict the occurrence, intensity, and potential impact of these disasters based on various factors and data sources.

Tech Stack

FrontEnd



BackEnd

Priority SDGs

There are 17 SDGs and 169 targets in total. Here we specify the SDGs alignment with our project.

SDG 13

Climate Action

"Take urgent action to combat climate change and its impacts"

Targets:

- **Target 13.1**: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
- **Target 13.2**: Integrate climate change measures into national policies, strategies and planning
- **Target 13.3**: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

Note: (Our project specifically aligns with Target 13.3 of SDG 13)

Work Flow Diagram

Risk Assessment

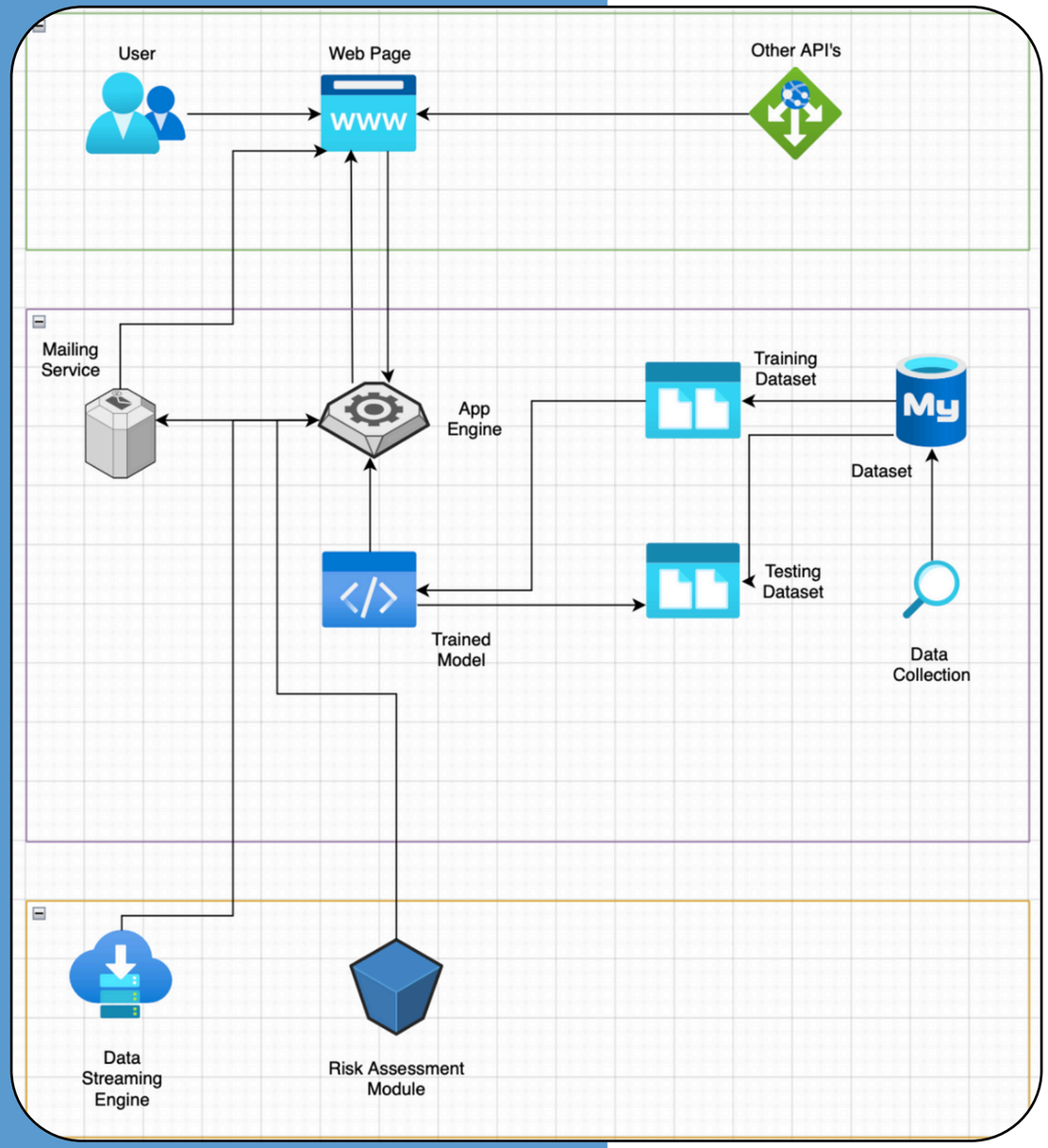
Ensemble learning models that allow variance in predicting flood runoff parameters.

Legend mapping to potential threats that arise in real-time.

Alert Generation

Mailing services are integrated to send notifications to users, if there are risks of potential threats.

When visiting website, realtime alerts are generated.



Enhancing Flood Severity Prediction through a Combined Threshold-Based Alert Algorithm and Random Forest Classifier

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***Abstract*—Flooding is a significant and recurrent is- sue that poses severe risks to communities, economies, and environments. Traditional flood prediction methods, which often rely on fixed thresholds, may lack adaptability to changing conditions. Meanwhile, machine learning (ML) models like Random Forest Classifiers (RFCs) offer advanced predictive capabilities, but may not provide straightforward alert mechanisms. This research proposes a novel approach that integrates a Threshold-Based Alert Algorithm (TBA) with an RFC to enhance flood severity prediction. The combined model leverages the strengths of both methodologies: immediate, interpretable alerts from the TBA and adaptive, data-driven insights from the RFC. Using historical and real-time data from river basins in Wisconsin and New York, the hybrid model demonstrates improved accuracy and reliability over traditional methods and standalone RFCs. The results indicate that this integrated approach offers a more effective tool for flood management and disaster mitigation.**

***Keywords*—Flood forecasting, threshold-based alert algorithm (TBA), random forest classification (RFC), machine learning (ML), hybrid models, flood management, data integration, predictive analytics, environmental data, disaster risk reduction.**

I. Introduction

Flooding represents a major threat to infrastructure, agriculture, and human safety, emphasizing the critical need for accurate and timely flood prediction systems to mitigate associated risks [1]. Traditionally, flood prediction relies on predefined thresholds that, while straightforward, can be limited in their ability to adapt to dynamic and evolving conditions. These threshold-based methods, although useful for generating immediate alerts, often lack the flexibility required to handle complex and variable flood scenarios [2].

In contrast, machine learning (ML) models have demonstrated strong predictive power in time-series applications, as evidenced in applications like radon level forecasting [3]. Studies by Gao et al. [4] and Islam et al.

[5] highlight the efficacy of machine learning models in weather forecasting and precipitation prediction. However, while these models excel in refining predictions through sophisticated data analysis, they may fall short in providing immediate, interpretable alerts, which are crucial for real-time decision-making [6].

This paper proposes a hybrid approach that combines the strengths of both traditional and modern methodologies. We integrate a Threshold-Based Alert Algorithm (TBA) to generate initial flood alerts based on predefined conditions, alongside a Random Forest Classifier (RFC) for enhanced flood severity classification. The goal of this integration is to improve prediction accuracy, offer actionable insights, and provide a more comprehensive tool for flood management. By leveraging the immediate, interpretable alerts from the Threshold-Based Alert Algorithm and the advanced analytical capabilities of the Random Forest Classifier, this approach aims to bridge the gap between traditional flood forecasting and modern machine learning techniques. Ultimately, this model enhances flood prediction and response strategies, providing an adaptable and

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Research Paper

Patent Draft

STATUS

DRAFT: COMPLETED
IDF: FILLED

SUBMITTED TO IPR

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Internal Undertaking for Patent/Copyright/Trademark

I/We **SREESH GAUR (CS)**

Main Applicant: **KIET GROUP OF INSTITUTIONS DELHI - NCR**

Co-applicant / INVENTOR: **SREESH GAUR (CS) AISHWARYA GUPTA (2125CS1148) AKSSHAT GOVIND (2125CS1189) AVIRAL KATIYAR (2125CS1067) CHIRAG TYAGI (2125CS1202)**

I/We have in the course of my study/ employment invented titled, **FOREWARNING SYSTEM FOR NATURAL CALAMITIES** by using the facilities of Institute and I/We are the true and first inventor.

I/We hereby abide by the IPR Policy which was approved by the management and now public to all stakeholders. Also, the intent of research policy of KIET is towards promoting and encouraging Students/Faculties for recognition of their work by promoting their invention through filing patent/copyright/trademark.

I/We are opting the **OPTION - 1**

I/We would like to engage with the institute for filing the patent/design/copyright/trademark as per IPR policy. I/We do not have any objection by giving unconditional rights to college (KIET Group of Institutions) to file and register the patent/design/copyright/trademark in their name.

I/We hereby state that we shall be abide by the IPR policy clause no. **8.2, 8.3, 9, 9.1, 9.2, 10, 10.1, a, b, c and 10.2** approved by college management.

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I/We have given this undertaking at my/our own will and without having any kind of compulsion and pressure by and on behalf of the Institute.

Signature of the Co-Applicant/Inventor(s)

Recommendation of HoD

HOD.....

Signature

FORM 2

THE PATENTS ACT, 1970
(39 of 1970)
&
THE PATENT RULES, 2003

COMPLETE SPECIFICATION
(See Section 10 and Rule 13)

Title of invention:
FOREWARNING SYSTEM FOR NATURAL CALAMITIES

APPLICANTS:
AKSSHAT GOVIND
AVIRAL KATIYAR
AISHWARYA GUPTA
CHIRAG TYAGI

The following specification describes the invention and the manner in which it is to be performed.

INVENTION DISCLOSURE FORM

INNOTECH PROJECT ID

DEPARTMENT – Computer Science

Ques.1. Title of your invention

FOREWARNING SYSTEM FOR NATURAL CALAMITIES

Ques.2. Type of Invention

This invention falls under **Disaster Management and Early Warning Systems**, with a focus on **Machine Learning** integration for predicting, detecting, and communicating natural calamities like rainfall, floods, etc.

Ques.3. Brief Description of your invention

The **Forewarning System for Natural Calamities** is an advanced predictive and alert mechanism that leverag environmental data to detect, analyze, a is designed to enhance disaster prepar timely alerts to authorities and the gener

Key Features and Functionality:

- **Integration of Real-Time Data S**
  - Continuously monitors env warning signs of potential d
- **Machine Learning and AI-Driv**

ANNEXURE-I

KIET GROUP OF INSTITUTIONS
Affiliated to Dr. A.P.J. Abdul Kalam Technical Univ., Lucknow
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Internal Undertaking for Intellectual Property Right (Patents)

I/We

1	Aksshat Govind	S/o/ D/o	Manish Kumar Saxena
2	Aishwarya Gupta	S/o/ D/o	Kamlesh Gupta
3	Chirag Tyagi	S/o/ D/o	Ashok Kumar
4	Aviral Katiyar	S/o/ D/o	Nishad Katiyar
5	Sreesh Gaur	S/o/ D/o	M D Gaur

Are Bonafide Student/Faculty of KIET Group of Institutions, Ghaziabad and enrolment number/ employee id is **2100290120025, 2100290120021, 2100290120065, 2100290120059, 21327** and Department **Computer Science**

I/We have in the course of my study/ employment invented .....
titled **FOREWARNING SYSTEM FOR NATURAL CALAMITIES** by using the facilities of Institute and I/We are the true and first inventor.

I/We hereby abide by the IPR Policy which was approved by the management and now public to all stakeholders. Also, the intent of research policy of KIET is towards promoting and encouraging Students/Faculties for recognition of their work by promoting their invention through filing patent/copyright/trademark.

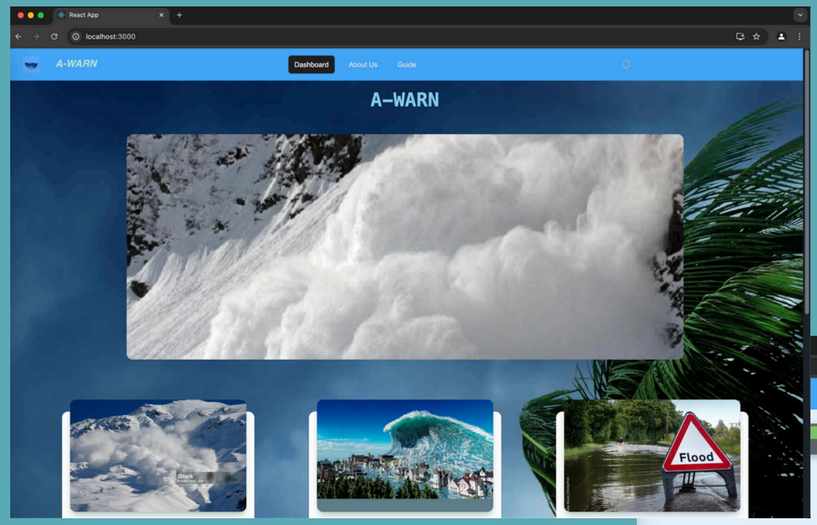
I/We would like to engage with the institute for filing the patent/design/copyright/trademark as per IPR policy. I/We do not have any objection by giving unconditional rights to college (KIET Group of Institutions) to file and register the patent/design/copyright/trademark in their name.

Therefore, the applicant of the patent/design/trademark will be KIET Group of Institutions. The faculty members/ students associated with the IPR will be the Inventors.

Project

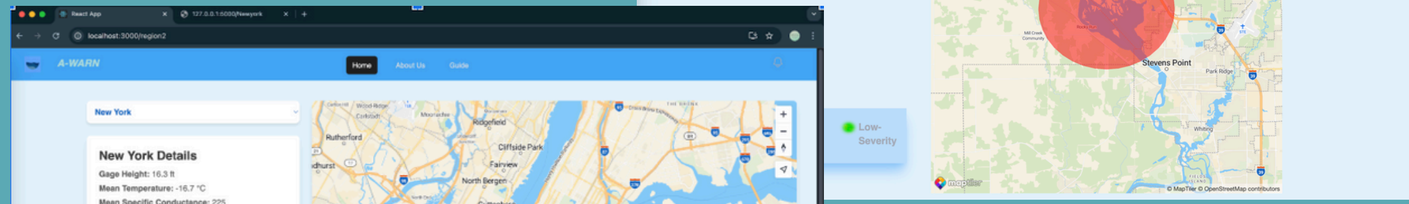
1 Dashboard

Display and info cards about calamities



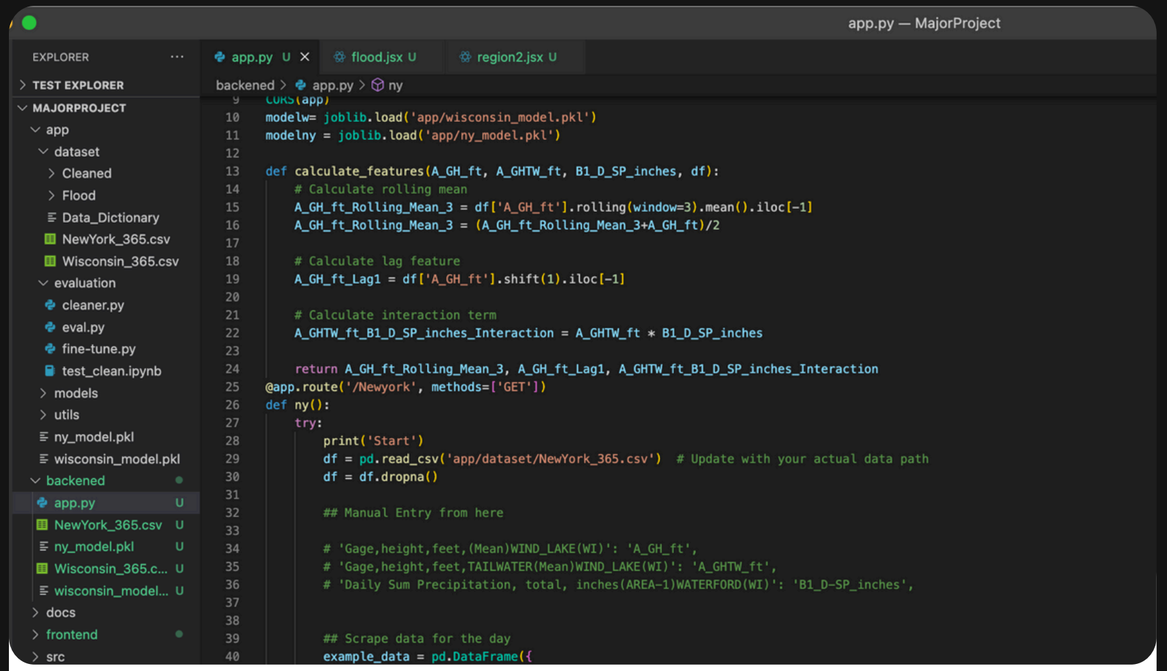
2 Vulnerability Map

Potential threats and warnings are displayed here, using legends as infographics



3 Timely Alerts

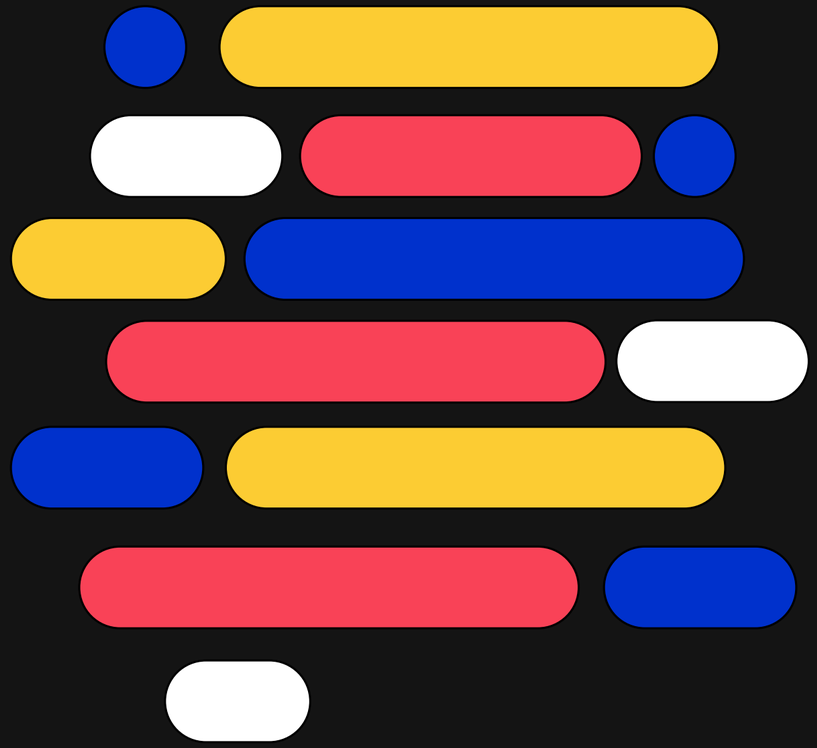
Notification Tab on the side where current warnings are displayed with relation to time



The primary objective of the Forewarning System is to enhance disaster preparedness and response by providing timely alerts and instructions for flood events.

DEPLOYMENT NOT UNDER SCOPE

100% **PROJECT STATUS**



Literature Survey

Link: Reviews

LITERATURE REVIEW REPORT

PAPER 1

Natural Disaster Application on Big Data and Machine Learning: A Review[1]

AUTHOR: Rania Rizki, Andi Wahju

Natural disasters are events that are difficult to avoid. There are several ways of reducing the risks of natural disasters. One of them is implementing disaster reduction programs. There are already several developed countries that apply the concept of disaster reduction. In addition to disaster reduction programs, there are several ways to predict or reduce the risks using artificial intelligence technology. One of them is big data, machine learning, and deep learning.

By utilizing this method at the moment, it facilitates tasks in visualizing, analyzing, and predicting natural disasters. This research will focus on conducting a review process and understanding the purpose of machine learning and big data in the area of disaster management and natural disaster. The result of this paper is providing insight and the use of big data, machine learning, and deep learning in 6 disaster management areas. This 6-disaster management area includes early warning damage, damage assessment, monitoring and detection, forecasting and predicting, and post-disaster coordination, and response, and long-term risk assessment and reduction.

Conclusion

In this study, we present a hybrid model combining a Threshold-Based Alert Algorithm (TBA) with a Random Forest Classifier (RFC) for flood severity forecasting. This approach merges TBA's rapid responsiveness with the analytical capabilities of machine learning. The model demonstrated strong predictive accuracy, achieving up to 98% in New York and reliable performance in more variable conditions in Wisconsin.

Key contributions include:

- **Improved Accuracy**: The model minimizes false alarms and missed events, offering dependable flood severity classification.
- **Adaptability**: Dynamic thresholds and feature engineering help the model adjust to environmental changes.
- **Practical Integration:** Its modular design enables real-time monitoring and scalable deployment across locations.
- **Actionable Insights**: Instant alerts paired with detailed severity analysis empower timely and effective decision-making for disaster response.

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