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Approved by AICTE, Govt. of Maharashtra

&

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T.E. MINI PROJECT REPORT CSM601 - Mini Project 2B

On

"Flood Location, Management and Solution System"

Department of Computer Engineering

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CERTIFICATE

Project Title : Flood Location Management and Solution System (FLMS)

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INTERNAL EXAMINER (s) **EXTERNAL EXAMINER (s)**

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HEAD, COMPUTER ENGINEERING

ABSTRACT

The prediction of precipitation is crucial for various applications such as agriculture, hydrology, and disaster management. In this project, we aim to predict the precipitation in Kurla using XGBoost, a popular machine learning algorithm to predict floods in that area. The dataset was obtained from Visual Crossing, which contains various meteorological parameters like temperature, humidity, and precipitation.

Exploratory data analysis on the dataset was performed and interesting patterns such as the seasonal variation of temperature and humidity was found. We also created correlation matrices and probability plots to understand the relationships between different variables.

Then preprocessed the data by removing missing values and outliers and splitting it into training and testing sets. We trained an XGBoost classifier on the training set and achieved a high accuracy of 81% on the test set.

Our results demonstrate that XGBoost is an effective tool for predicting precipitation, and it can be used for real-world applications such as flood forecasting and water management. This project also highlights the importance of exploratory data analysis and data preprocessing in machine learning projects.

Overall, this project provides insights into the prediction of precipitation using machine learning techniques and demonstrates the potential for using these methods for practical applications.

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ABBREVIATIONS

FLMS	Flood Location Management and Solution System
XGBoost	Extreme Gradient Boost

CHAPTER 1: INTRODUCTION

India, being a country vulnerable to various natural disasters, has been facing numerous challenges in disaster management. With climate change leading to an increase in the frequency and intensity of natural disasters, it has become crucial to develop effective and efficient disaster management systems.

In this paper, we present the development of a Flood Prediction and Alert System using machine learning techniques. The system utilizes historical rainfall data of Mumbai city to predict the possibility of a flood in the city. The developed system can provide a warning to the residents and authorities in advance, which will help them to take necessary precautions and measures to prevent or minimize the loss of life and property.

The proposed system utilizes various machine learning algorithm, XGBoost to predict the precipitation levels. The system also includes an alert system that sends out warnings to the authorities and the public through various communication channels.

This paper presents a detailed description of the problem formulation, methodology, implementation, and evaluation of the proposed system. The results obtained from the system show promising results in predicting the precipitation levels and providing early warnings to the public and authorities.

The proposed system has the potential to revolutionize the way we approach disaster management in India and can provide valuable insights to policymakers and disaster management authorities in developing effective strategies for disaster management.

CHAPTER 2: LITERATURE SURVEY

Sr	Author(s) Name	Article	Main Points	Relevance
1	Kourgialas, Nektarios N., and George P. Karatzas	Flood management and a GIS modelling method to assess flood-hazard areas—a case study. (2011)	This paper presents a viable approach for flood management strategy in a river basin based on the European Floods Directive. A reliable flood management plan has two components: (a) a proper flood management strategy, and (b) the determination of the flood-hazard areas.	The various flood management steps and strategies are stated with the help of GIS
2	HU Zhuowei, LI Xiaojuan, SUN Yonghua,	Flood Distance Algorithms and Fault Hidden Danger Recognition for Transmission Line Towers Based on SAR Images. Remote Sensing. 2019	Chinese government put great emphasis on the disaster mitigation. To enhance the ability of disaster monitoring, precaution and emergency response decision-making support is the important task and requirement of disaster administration	The precautionary measures to be take before a flood are stated
3	Tran, Phong	Tran, Phong, et al. "GIS and local knowledge in disaster management: a case study of flood risk mapping in Viet Nam." *Disasters* 33.1 (2009): 152-169.	The paper discusses the use of GIS and local knowledge in flood risk mapping in Vietnam. The authors describe the collaborative process between local communities and government agencies in	Involves the use of GIS technology and data analysis in disaster management

			identifying flood-prone areas and designing strategies for flood risk management.	
4	Liu, Lianguang, Rujun Du, and Wenlin Liu	Liu, Lianguang, Rujun Du, and Wenlin Liu. "Flood distance algorithms and fault hidden danger recognition for transmission line towers based on SAR images." *Remote Sensing* 11.14 (2019): 1642.	The paper discusses flood distance algorithms and fault recognition for transmission line towers using SAR images.	Flood Identification Algorithms

2.1 Similarities between authors

The papers 'Flood management and a GIS modelling method to assess flood-hazard areas—a case study. (2011)' and 'Flood Distance Algorithms and Fault Hidden Danger Recognition for Transmission Line Towers Based on SAR Images. Remote Sensing. 2019' have some similarities between them as authors in both the papers have taken in consideration of the various phases of the disaster management from pre-disaster measures to post-disaster.

2.2 Current Limitations

The existing systems present in India are on a larger scale so accurate prediction of a flood occurring in a particular area is not possible.

2.3 Summary of Literature Survey

A reliable flood management plan has two components: (a) a proper flood management strategy, and (b) the determination of the flood-hazard areas. The Chinese government put great emphasis on the disaster mitigation. To enhance the ability of disaster monitoring, precaution and emergency response decision-making support is the important task and requirement of disaster administration. Both the components of carried out seamlessly will lead to less casualties and overall less damage.

CHAPTER 3: PROPOSED SYSTEM

The Flood Location Management Solution system (FLMS) proposes a solution to improve flood management and prevention in the Kurla area. The technique entails creating a forecast model using data from previous floods. This model will employ statistical analysis to find patterns and trends that can improve flood prediction in the future and using GIS based maps to show the latest updates.

In order to make flood risk information more accessible to citizens, the FLMS system will also have a user-friendly web interface. To convey flood risk information in a simple and understandable manner, the website will feature interactive maps and visualisations. Residents will be better able to make decisions about their safety and wellbeing during potential flooding occurrences thanks to this.

The FLMS system will not only inform locals about their risk of flooding, but it will also advise the municipality and emergency services on the best ways to prevent and mitigate flooding. Based on the examination of the flood data, these suggestions will be updated when new information becomes available.

The suggested approach will assist government agencies and emergency services in improving their readiness for prospective flood occurrences and in taking proactive steps to lessen the effects of floods. The FLMS system seeks to provide a complete and efficient instrument for flood management and prevention in Kurla by utilising statistical analysis and historical flood data.

3.1 Use Case

To provide a flood alert and management system to help local public, municipal corporation, local authority, and nearby educational institutes prepare for and respond to flooding in the Kurla area.

Actors

- *Local public:*
  Individuals who live or work in the Kurla area and may be affected by flooding.
- *Municipal corporation:*
  Government agency responsible for managing public services in the Kurla area.
- *Local authority:*
  Local government agency responsible for managing emergency response services in the Kurla area.
- *Nearby educational institutes:*
  Schools, colleges, and other educational institutes located in the Kurla area.

Steps:

- Local public, municipal corporation, local authority, and nearby educational institutes register with the Flood Location, Management and Solution (FLMS) system.
- FLMS system gathers data from various sources, including historical flooding data and weather reports
- FLMS analyses the data to determine the likelihood of flooding in the Kurla area from historic and forecasted weather data.
- If a flood is imminent, FLMS sends alerts to all registered users, including local public, municipal corporation, local authority, and nearby educational institutes.
- Municipal corporation broadcasts warnings to the public via loudspeakers, social media, and other channels.
- Local authority sets up management teams to coordinate emergency response efforts.
- Nearby educational institutes receive alerts and use the information to decide whether to

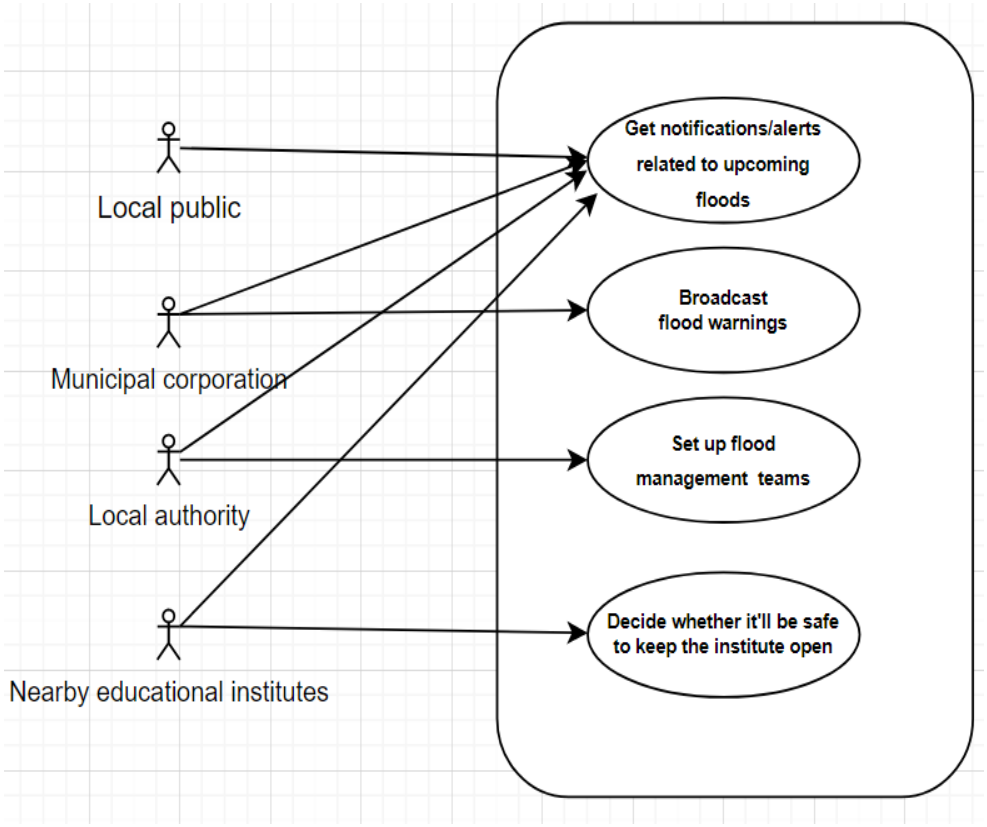

Figure 1 - use case diagram

CHAPTER 4: IMPLEMENTATION DETAILS

4.1 Web Development Technologies and Frameworks Used

A web-based platform is used to implement the FLMS system, which stands for Flood Location, Management, and Solution. HTML, CSS, and Bootstrap are used to create the system's front end, which gives it a responsive interface. The Django web framework, which enables scalable and efficient development of complex online applications, is used to build the system's back end. The FLMS system is able to deliver an appealing and seamless user experience while also offering the essential capability to precisely predict and moderate floods in the Kurla region by utilising these technologies.

4.2 Precipitation Prediction using XGBoost Classifier

XGBoost is an open-source implementation of gradient boosting decision trees, which has great performance on structured data. In order to avoid overfitting, it can handle missing data and regularisation approaches. In this study, we used XGBoost as a classifier to accurately and efficiently predict precipitation from the dataset which was collected from Visual Crossing and pre-processed. On the dataset, the XGBoost model was trained and validated to produce precipitation level forecasts.

The training and testing sets were separated using the train_test_split function from the sklearn.model_selection module, and the performance of the XGBoost model was assessed on the testing set using evaluation measures like accuracy. The figure 16 depicts the process of developing a Machine learning model .

4.3 User Experience

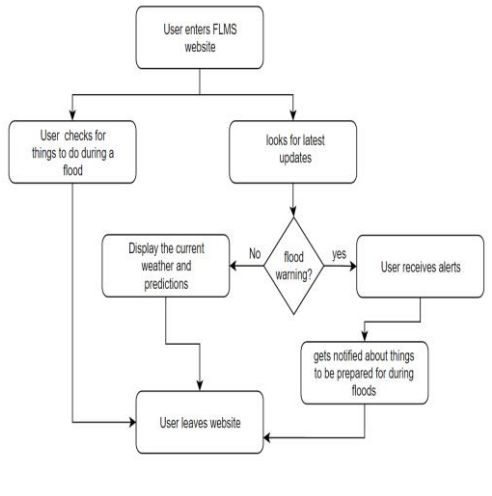

Figure 2 - User Interaction

- On Upon visiting the website, users are presented with a landing page that provides an overview of the system and its capabilities. From there, they can navigate to different sections of the site,

including the flood monitoring dashboard, the flood management section, and the flood solutions section.

- The flood monitoring dashboard provides real-time information about current flood conditions, including water levels, rainfall, and other relevant data. Users can also view historical data and trends to help them better understand the nature of flooding in their area.
- In the flood management section, users can access tools and resources to help them prepare for and respond to floods. This includes information on evacuation routes, flood shelters, and emergency contacts. Users can also report flooding in their area and receive alerts and notifications about flood risks and other relevant information.
- The flood solutions section provides information on different solutions and strategies for managing and mitigating flood risks. This includes information on flood-resistant building design, flood barriers and levees, and other approaches to flood management.
- Throughout the website, the user experience is designed to be intuitive and user-friendly, with clear and concise information presented in a way that is easy to understand. The goal is to empower users with the information and tools they need to better manage and respond to floods in their area.

4.4 System Implementation

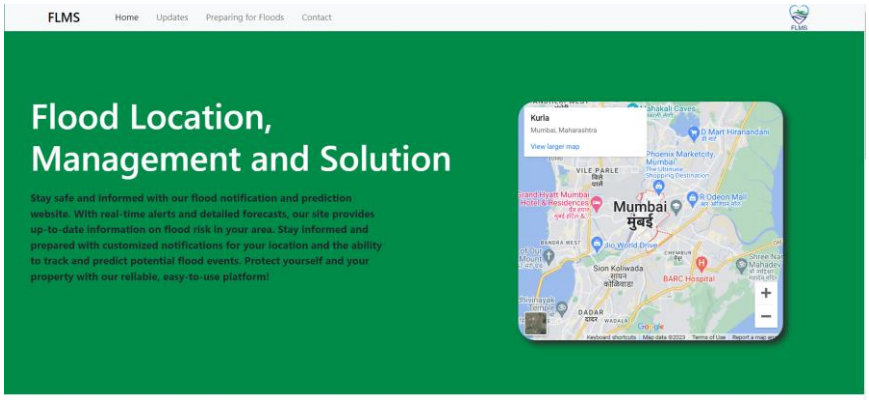

Figure 3 - Home page

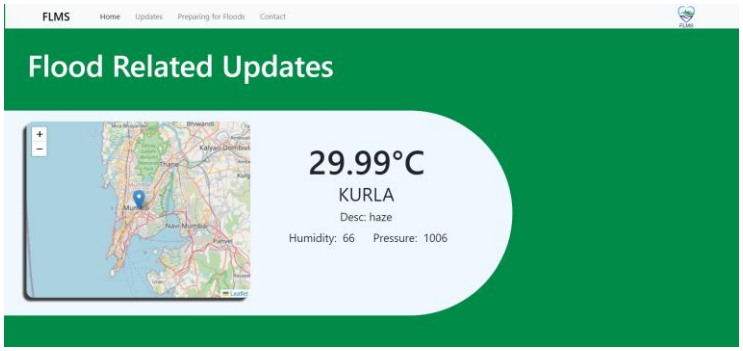

Figure 4 - updates page

Error! Reference source not found. is a page from the FLMS website which aims at providing latest u pdates about floods to the people in Kurla.

In order to develop the Flood Location, Management and Solution (FLMS) system, a combination of HTML, CSS, Bootstrap, and the Django web framework was used. The website may be accessed from both desktop and mobile devices because it was made to be user-friendly and responsive. To store and handle data connected to floods, the system also makes use of a SQlite database.

A wide range of features and capabilities, such as flood alert, flood zone mapping, emergency preparedness planning, awareness related to flood, and others, are available to users through the FLMS system. This platform was also made to be modular, making it simple to integrate with other technologies and systems.

The website also provides links to various important contacts like the disaster management department and also a way for the people to directly send their issues from the website for being addressed by the concerned authorities.

There were a number of difficulties were faced during the design and implementation process of FLMS system , including problems with managing data and design of user interfaces. Yet, all these difficulties were overcome thanks to proper preparation and cooperation.

The goal is the improve to system’s performance by taking more surveys form general population and making the interface as user friendly as possible.

CHAPTER 5: RESULT AND DISCUSSIONS

The possibility of flood-related damage and fatalities in the Kurla area could be significantly decreased because of the FLMS system. Local government officials and citizens can take the required actions to protect them and their property by receiving real-time flood warnings and flood danger assessments.

Flood forecasting and hazard mapping are made possible by the FLMS system's utilisation of GIS and historical flood data. Local government agencies and emergency personnel can use this information to better prepare for flood occurrences and respond to them when they happen.

The FLMS system can assist in lowering the financial expenditures related to floods. Local businesses can better anticipate for floods and perhaps reduce damages by offering more precise flood predictions and hazard mapping.

5.1 Limitations

It is important to recognise the limitations of any study or endeavour. We also need to take into account some restrictions on our FLMS system. The fact that it depends on the accessibility and veracity of data sources like flood maps and weather reports is one of its key drawbacks. Inaccurate data can result in inaccurate evaluations and projections, which can have major ramifications for the management of floods.

Our platform's requirement for a particular degree of technical proficiency to manage and run is yet another drawback. For certain local governments or educational institutions, who might not have the means or expertise to operate the system successfully, this could be a problem.

Internet access may not be available in times of flood, hence the system also depends on its availability. This may reduce the system's usability and efficacy in those places.

It's also crucial to remember that while the system can help with flood control and offer useful information, it cannot totally remove the risk of flood or ensure the security of the impacted communities. It ought to be viewed as a planning and decision-making tool rather than as a conclusive answer to the flooding issue.

To ensure the FLMS system is implemented and used in an effective manner, these limitations must be taken into account and addressed.

CONCLUSION

The development and implementation of a Flood Location, Management, and Solution (FLMS) are presented in this paper. The system enables various actors, such as the local public, municipal corporations, local authorities, and nearby educational institutions, to receive notifications and alerts. regarding impending floods, broadcast alerts, set up management teams, and make choices about whether to keep institutions open or not.

Technologies like HTML, CSS, Bootstrap, and Django have been used to implement the FLMS system. It is anticipated that the suggested approach will enhance the overall flood management procedure and lessen the damaging impacts of floods in sensitive locations.

There were several drawbacks discovered during system installation, nevertheless, such as the necessity for more precise and dependable flood detection algorithms and thorough flood management plans. Future work might include using more sophisticated flood detection algorithms and creating more potent flood management plans.

One of the additional areas where the FLMS system has to be improved in the future is user input. Overall, the FLMS system is a huge improvement in flood management and has the potential to be a significant help to places that are prone to flooding.

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