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Identification of Flood Prone Areas in Urban Settlements using AI and ML

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Abstract: Floods are natural disasters characterized by the overflow of water onto normally dry land. They are among the most common and widespread of all natural hazards, causing extensive damage to infrastructure, homes, and agricultural land, as well as posing significant risks to human lives. This study proposes an innovative approach leveraging Artificial Intelligence (AI) and Machine Learning (ML) techniques to identify flood-prone areas within urban environments. Monsoons are becoming more erratic because of climate change and global warming. Floods can occur due to various factors such as changes in landscape, rainfall conditions, humidity and temperature. One of the challenges of Urban areas is to prepare for eventuality such as floods in new areas and having safety measures in place to protect human lives and at the same time restrict damages.

Keywords: Machine Learning algorithms, Flood Prediction, SAR images, Image Processing.

I. INTRODUCTION

Flooding is a serious risk that affects both rural and urban places globally and recently. Specifically, heavy rains led to widespread floods that resulted in nearly £3 billion in damages and several fatalities. The likelihood that such intense rainfall events may occur in the future is growing due to the effects of global warming. Our system offers accurate and dynamic assessments of flood susceptibility by combining real-time data streams from river levels, urban growth trends, and weather forecasts. Stakeholders can quickly evaluate and rank sites for urban planning interventions and mitigation efforts by using interactive visualization tools.

This strategy protects lives, property, and the socioeconomic stability of metropolitan areas by improving early warning systems and enabling proactive measures to reduce flood risks. Our approach provides a sustainable framework for resilient urban development in the face of growing climate-related concerns because of its scalability and adaptability.

The Commission made numerous recommendations, one of which was the availability of real-time or almost real-time flood visualization tools to help emergency responders handle rapidly evolving situations and concentrate their limited resources on the regions that are most important. It was thought that a straightforward GIS would be a helpful tool to alert the emergency services during a flood event, one that could be efficiently updated with the timing, level, and extent of flooding. For operational flood relief management, a near real-time flood detection algorithm that provides a synopsis of the amount of flooding in both urban and rural areas and can function both during the day and at night even in the presence of clouds could be helpful.

Such technology is now available because to the most recent generation of very high-resolution Synthetic Aperture Radar (SAR) satellites. A few hours after the overpass, an almost real-time technique might enable the emergency services to examine, at very high resolution, the geo-registered flood extent across the entire area superimposed on a base map. It can be challenging to accomplish this in another way. Even though a flooded area may consist primarily of rural rather than urban areas, it is nevertheless crucial to identify urban flooding due to the higher hazards and expenses involved.

In an offline scenario, the algorithm seeks to identify flood extents in order to calibrate and validate an urban flood inundation model. It necessitates user input at several points, such as selecting training regions for pixels with and without water, which inevitably adds a delay to the final product's manufacturing. The goal of this paper is to develop a near real-time algorithm that is almost entirely automatic for the near real-time processing steps by building on several aspects of the existing algorithms, automating the steps that require human interaction, and utilizing the availability of LiDAR data in the urban area.

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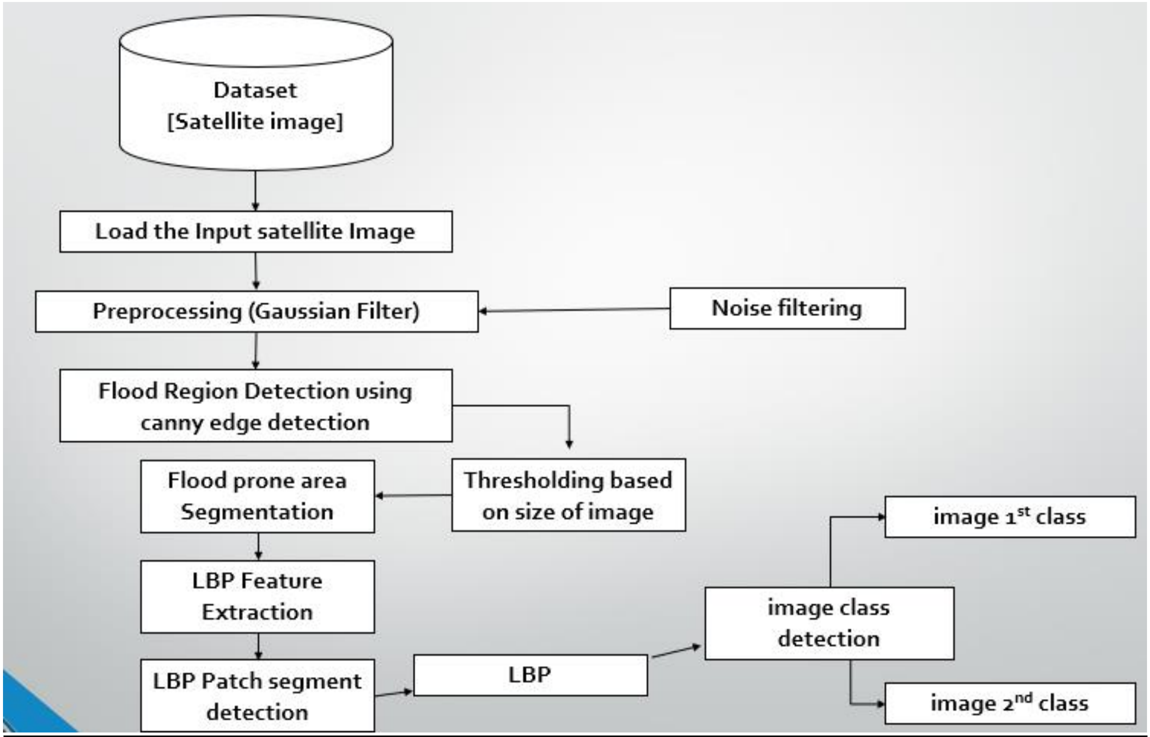
II. PROPOSED SYSTEM

Proposed method:

- This proposed method's main advantage is that it builds on several aspects of the existing algorithms, automates the steps that require human interaction, and makes use of the LiDAR data that is available in the urban area. This allows for the development of a near real-time algorithm that is almost entirely automatic for the near real-time processing steps.
- The objective of our approach is to identify flood extents in order to validate and calibrate an urban flood inundation model in an offline setting. It necessitates user input at several points, such as selecting training regions for pixels with and without water, which inevitably adds a delay to the final product's manufacturing.
- Here first we consider to find the following things:
- Greater resolution in preprocessing
- Greater resolution in near real-time processing
- Lower resolution in near real-time processing
- Lastly, the validation data processing

III. SYSTEM ARCHITECTURE



MODULES:

- Higher Resolution Preprocessing operations
- Near real-time, higher-resolution processing in urban areas
- Processing the entire image with a lower resolution.
- Terrasa -X flood Extent T validation; processing of validation data

MODULE DESCRIPTION:

1. High Resolution Pre-processing Operations:

- Urban area demarcation
- Computation radar shadow and overlay
- Building of compound DEM
- Determining the high-height threshold
- Dividing the shadows
- Dividing the possible water and elevated terrain

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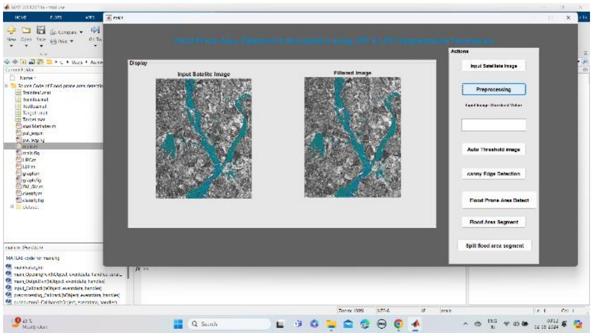
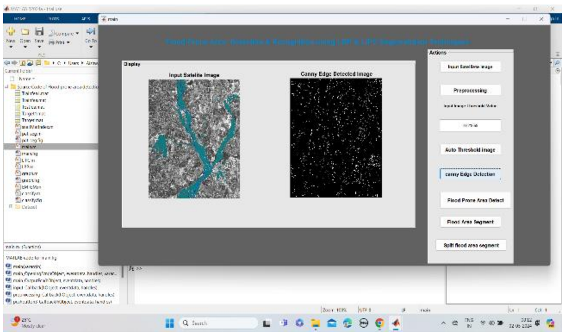
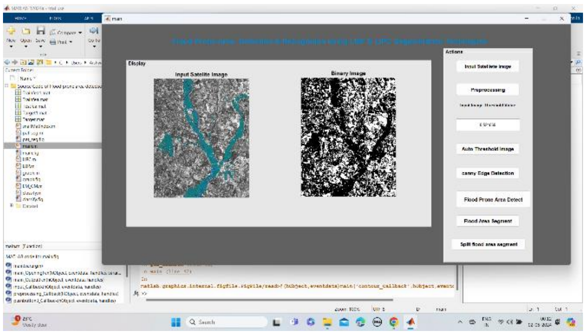
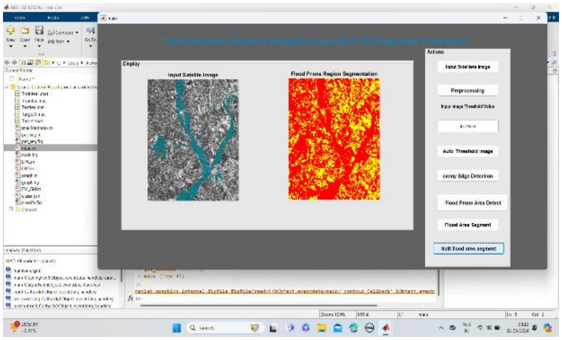
RESULTS









PROPOSED SYSTEM ADVANTAGES:

- This proposed method's main advantage is that it builds on several aspects of the existing algorithms, automates the steps that require human interaction, and makes use of the LiDAR data that is available in the urban area. This allows for the development of a near real-time algorithm that is almost entirely automatic for the near real-time processing steps.
- In an offline setting, our system seeks to identify flood extents in order to calibrate and validate an urban flood inundation model. It necessitates user input at several points, such as selecting training regions for pixels with and without water, which inevitably adds a delay to the final product's manufacturing.

IV. CONCLUSION

In conclusion, the identification of flood-prone areas in urban settlements is essential for effective disaster preparedness and mitigation strategies. Moreover, the identification of flood-prone areas facilitates proactive urban planning, encouraging sustainable development practices that minimize exposure to flood hazards. By incorporating flood risk assessments into land-use zoning and building codes, cities can reduce the potential for property damage, economic losses, and loss of life during flood events.

In addition, cultivating a culture of readiness and resilience requires educating locals about the dangers of residing in flood-prone locations. Communities can be better equipped to handle disasters if they are informed about flood-resistant building methods, emergency shelter locations, and evacuation routes.

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