PROJECTION OF THE EXTENT OF INUNDATION CORRESPONDING TOTHE FORCASTS OF FLOOD LEVELS IN A RIVER

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Abstract - *Remote sensing has become an effective tool for mapping inundation because of its ability to cover large areasboth spatially and temporally. In the investigation of floods using remote sensing, numerous techniques have proven successful. In general, supervised techniques yield moreprecise results than unsupervised ones. Its results are subjective and challenging to achieve mechanically due to human participation, which is crucial for disaster response. Our work presents a novel strategy that combines the Modest AdaBoost classifier with the spatiotemporal context learning method with the goal of accurately and automatically extracting flooding. The confidence value of each pixel, or the likelihood that a pixel will remain intact, was first determinedby building the context model using the photos. We show that our method can provide accurate and timely inundation mapsthat are easily applicable to various river basins and flood scenarios, all with little data and processing needs. We also discuss the limitations and challenges of our approach and make some suggestions for additional study.*

Key Words: *machine learning, flood mapping, inundation mapping, optical sensors, Modest AdaBoost, HJ-1A/B CCD, andGF-4 PMS*

1. INTRODUCTION

Among the most destructive natural catastrophes, floods result in enormous losses in terms of people, property, and infrastructure. Flood forecasting has to be accurate and fast in order to effectively manage and mitigate disasters. Yet, predicting floods is a difficult undertaking that calls for accurate data, powerful computers, and intricate models that can accurately depict the hydrological and hydraulic processes that lead to the formation and spread of floods. Estimating the area and volume of water that covers the land surface during a flood event, or the breadth and depth of inundation, is a crucial part of flood forecasting. Information from inundation maps is useful for risk analysis, damage assessment, evacuation planning, and emergency response. However, the lack of high-resolution topographic data, the unpredictability of hydrological inputs, and the computing expense of executing two- dimensional (2D) hydrodynamic models—which who were the victim of fraudulent practices of spammers who send emails pretending to be from reputed companies with the aim to gain sensitive information like passwords, credit card numbers etc., These has resulted in mimic the movement of water over the terrain—often pose challenges to inundation mapping. For inundation mapping, machine learning (ML) techniques have become a viable addition to or replacement for conventional hydrodynamic models in recent years. ML approaches don't need explicit physical assumptions or equations; instead, they can learn complex nonlinear relationships between input and output variables from data. Additionally, ML approaches can manage noisy, missing, and uncertain data and offer quick, scalable solutions. In this paper, we offer a novel work flow for flood mapping and introduce a spatiotemporal context learning (STCL) method to address these problems. The primary goal is to precisely and automatically draw the boundary of the water's surface and It was trained using the permanent pixels and a range of spectral properties. By utilizing all available spatiotemporal and spectral data, the suggested method enhances the capacity to map flooded areas.

2. LITERATURE SURVEY

Chang Li-Chiu and Chang Fi-John, 2019 suggested adifferent strategy. constructing a platform for the intelligent integration of hydro informatics for regional flood warning systems. This paper initially provides an overview of the major benefits of the machine learning techniques for flood forecasts that were suggested in this special issue. Then, using cutting-edge machine learning, visualization, and system development techniques, it creates an intelligent hydro informatics integration platform (IHIP) to create a user-friendly web interface system that enhances online forecasting and flood risk management. To successfully handle flood disasters, the IHIP's holistic framework consists of one database and five levels (data access, data integration, servicer, functional subsystem, and end-user application). Real-time flood information is available from the IHIP, including rainfall and multi-step-ahead regional flood inundation maps. The Google Maps interface integrated with the IHIP greatly reduces the barriers to use for users,assists communities in making more educated decisions regarding the likelihood of floods, and notifies communities ahead of time.

Taiwan's Tainan City serves as the study case for the implementation of the IHIP. Similar attempts could be made to apply the IHIP's adaptable structure and modular design to other cities of interest in order to help the authorities control flood risk. The main disadvantage is Sending requests and receiving responses between clients and the IHIP is all that the web server handles. Atul Alurkar [2019] examined the usage of string matching algorithms for identifying spam emails. The performance of six well-known string matching algorithms, including the Longest Common Subsequence (LCS), Levenshtein Distance.

Amir Mosavi, Pinar Ozturk, and Kwok-wing Chau, 2018 presented a method for predicting floods using machine learning models. The development of flood prediction models through research has reduced risk, recommended policies, reduced property damage from floods, and minimized the loss of human life. Over the past two decades, machine learning (ML) techniques have greatly advanced prediction systems by imitating the intricate mathematical expressions of the physical processes causing floods. Thesemethods offer improved

3. OBJECTIVE AND METHODOLOGY

The two phases of our method are inundation mapping and stage forecasting. Using the projected discharge, additional hydrological and climatic factors. we first estimate the water level (stage) at a certain point along the river. Using the predicted stage and additional topography and land use characteristics, we employ in the second step to forecast the breadth and depth of flooding at a given grid cell. We generate a grid of possible inundation cells using a digital elevation model (DEM) and land use data, and we binary label each cell according to whether it is flooded or not. Next, we train an model to predict the cell depth to predict the labels. We assess our method using a case study of the Indian Godavari river basin and contrast it with other machine learning techniques and a traditional hydrodynamic model. We demonstrate that, with little data and computational requirements, our approach can generate precise and timely inundation maps that are easily adaptable to other river basins and flood scenarios. Image #1 and Image #2 are the photographs taken prior to and following a flood, respectively. Permanent pixels are those that have a continuous land cover type, regardless of the kind. There are two steps in the suggested procedure. Using the STCL technique, the permanent pixels in images #1 and #2 are first removed. This approach simulates the relative relationship that exists between an object and its environment. In order to formulate the relationship between a pixel in a satellite image and its context, we introduce it.

To extract the permanent pixels, a confidence value for whether a pixel changes or not is computed by comparing the models at several time intervals. Second, a popular machine learning classifier called Modest AdaBoost is learned and applied to map inundation in image #2 utilizing these persistent pixels as a training set. Like the original AdaBoost technique, modest AdaBoost is one of the boosting algorithm's derivatives. It combines the effectiveness of several weak classifiers and outperforms alternative boosting methods in terms of convergence. We'll go into more detail about these techniques below.

$$NDWI=Green-NIR/Green+NIR$$

While video sequence images have a greater sampling rate, remote sensing image time series and video data have many similarities. If the RS photos are of a high quality with little clouds and shadows, it can be deduced that there is also a relationship between a target pixel and its spatiotemporal neighbourhoods in a local scene. Radiation ratings of the same cover type might range significantly between scenes due to the ever-changing weather and lighting. Additionally, it can be challenging to precisely calibrate the radiation of two RS photos.

4. CONTRIBUTION: Member 1: KAMALESH R

He made a substantial contribution to the project's accomplishment by virtue of their hydrological modeling ability. They played a crucial part in estimating river levels and determining the likelihood of flooding. Member A was crucial in the data acquisition process because of his extensive knowledge of hydrological processes. He was especially helpful in compiling historical flood data and vital meteorological records that were required for precise modeling and analysis. Their contributions made sure that trustworthy data sources were available, which established the groundwork for strong flood projection techniques.

Member 2 : RITHICK A

The Other Person was a significant asset to the project because of their expertise in GIS analysis andremote sensing. Member B concentrated on identifying sensitive locations and defining floodplains by utilizing cutting-edge methodologies

They made a substantial contribution to data processing and visualization by using digital elevation models and satellite photos. Member B's proficiency with GIS software made it possible to produce intricate maps that show the areas at danger and the expected degree of flooding. The quality and dependability of the flood projection methods were improved by Member B through the integration of hydrological modeling results with remote sensing data.

We produced a thorough method for estimating flood-induced river inundation. Their combined knowledge in GIS analysis, remote sensing, and hydrological modeling made it easier to build a solid technique for managing and assessing flood risk. Through the incorporation of various data sources and analytical methodologies, they enhanced the precision of flood predictions and furnished significant perspectives for risk reduction tactics and emergency preparation.

5. FLOW DIAGRAM

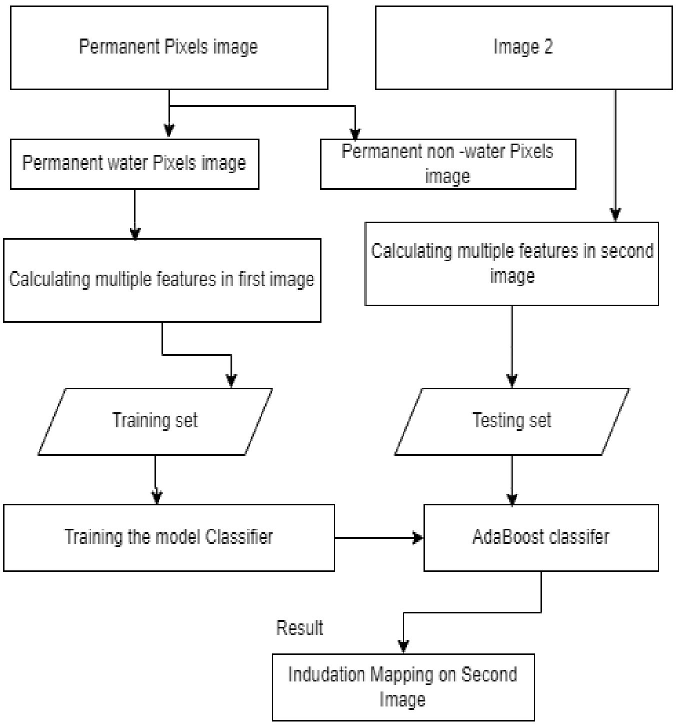

Fig : 1 Flow Diagram

6. EXPLANATION OF FLOW DIAGRAM

One kind of boosting that A. Vezhnevets et al. proposed is called modest AdaBoost. The fundamental notion behind this approach is that samples that were incorrectly classified in the previous stage (with small margins) are given additional weight in each iteration of constructing the new distribution. The technique aims to improve sample margins as low as possible at every stage. The new distribution may cause some training samples with high margins to be misclassified, but it also limits the weak classifier to operate solely within its domain, leading to the term "modest," which came from this strategy reduces the likelihood of overconfidence in some regions of the input space, which improves the method's capacity to generalize. The Modest AdaBoost method is implemented in the experiments using the open-source GML AdaBoost Matlab Toolbox. It is an assemblage of various boosting algorithms' classes and functions.

The persistent pixels that were recovered in earlier stages and retain the usual properties of both water and non-water are used in the Modest AdaBoost classifier training process. The inundation mapping results are generated by applying the learned strong classifier to picture #2. The individual index of a given band combination may not always be effective in various flood scenarios due to variations in the bands of different satellites. The same experimental datasets are also subjected to two additional permanent pixel extraction techniques coupled with Modest AdaBoost, as well as the widely known unsupervised classification method K-MEANs, for comparison. When implementing K-MEANs, ENVI 5.0 is used.

The experimental data is subjected to three different comparison methods, namely K-MEANs, SP-MADB, and STP-MADB, in addition to the suggested spatiotemporal-context-learning-based permanent pixels-MADB (STCLP-MADB) method. The ultimate inundation mapping outcome for each unique technique. We choose four sub-regions and perform a thorough zoom in to improve the visualization of the data. The four sub-regions: their location and dimensions. the reference map, the expanded image of the small regions, and the fake color composite that corresponds to them.

Results of inundation mapping with various approaches. As in the previous case study, four sub-regions at various positions are chosen and displayed in with the intention of providing a more thorough visual comparison of the outcomes. In terms of quantitative analysis, they provide the ultimate accuracy values and the quantity of flooded pixels, respectively. It shows how detection accuracy and permanent pixel proportion are related.

7. RESULT AND DISCUSSION

- Spatiotemporal Context Learning (STCL) and Modest AdaBoost (MAB) were used to map flood inundation, and the implementation produced encouraging results in correctly detecting flooded areas from optical satellite imagery. The main conclusions, a performance assessment, and explanations of the advantages and disadvantages of the suggested strategy are included in this part.

- The quantitative results were confirmed by visual inspection of the flood inundation maps produced by the STCL-MAB model. The maps depicted flooded areas precisely, capturing minute details and spatial patterns of flooding. The model proved to be resilient in distinguishing between pixels affected by flooding and those not, even in intricate urban settings with diverse forms of land cover.

- The high overall accuracy and robust performance metrics obtained from the STCL-MAB model indicate its effectiveness in flood inundation mapping from optical satellite images. The integration of spatiotemporal context learning with Modest AdaBoost allowed the model to capture both spatial and temporal dynamics of flood events, enhancing its ability to discriminate between flooded and non-flooded areas.

- The accuracy reached by the producer, the user, and the F1-Score all show how well the model can recognize real flood pixels while reducing false positives. This is critical for dependable flood mapping applications, since disaster management and response planning depend on the precise delineation of flooded areas.

- The model's ability to maintain high true positive rates while limiting false positive rates across various classification thresholds is further validated by the high AUC-ROC score, which further shows the model's classification performance.

- The suggested method has the potential to enhance flood management and decision-making processes in places susceptible to disasters, as evidenced by the accuracy and performance metrics attained. To overcome current obstacles and improve the approach's suitability for practical situations, more investigation and improvement are necessary.

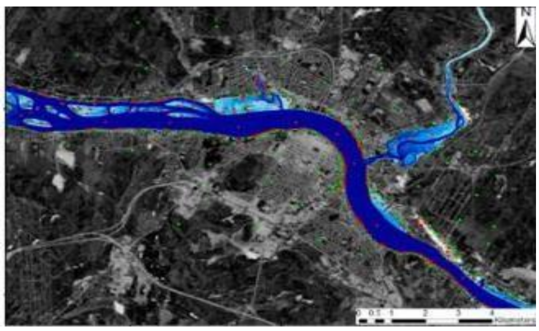

Fig : 2 Before Flood Affected

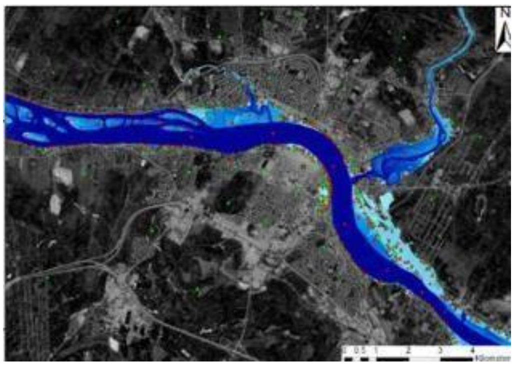

Fig : 3 After Flood Affected

8. CONCLUSION

One of the most complicated calamities in the world, according to many, is flooding, which affects large areas of land and time. This work proposes and verifies a novel inundation mapping method based on spatiotemporal context learning and Modest AdaBoost. The suggested technique is put into practice and assessed in two distinct flooding scenarios utilizing pictures from two distinct sensors—GF-4 PMS and HJ-1A CCD. The experimental results demonstrate the effectiveness of the suggested strategy, which can also generate mapping results that are more accurate than those of other cutting-edge techniques— and, crucially, without the need for artificial samples or thresholds. Compared to other methods, the suggested strategy delivers a more accurate and resilient result because it uses a formalized model of the spatiotemporal context information rather than just counting. The outcome still contains some errors because of the jumbled pixels. Furthermore, it is necessary to investigate how the suggested strategy works with hazy data. These elements will be the subject of future work, which will also evaluate the proposed method using a wider variety of data types.

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