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DT Based Enhanced Technology For Flood Threat Protection Using AI

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Abstract: Flood is one of the most devastating natural hazards affecting life and damaging properties, so we came up with an idea "Design Thinking based Enhanced Technology for flood threat protection using AI" in which we implement in 2 methods. One is by reducing the flood threat damage by constructing moveable walls in the downstream which at-least reduce the destruction damage by 20% by increasing the height of the with the aspects of flood and another method is to prevent life's from flood when it occurred, we deploy a bot which analyse the humans who struck in the flood and save them. Which will we in standby mode when in has flood threat alert so when flood occurs as much as possible the deployed bot can save lives from flood. This is an energy efficient and low power consumption bot which might be efficient in all aspects. The bot we deploy which detects the people using AI and through AI it predicts the high-risk zone where people have the probability of being struck.

Keywords - Flood, Design Thinking, AI, Bot, Low power consumption.

I. INTRODUCTION

In recent years, the surge in the frequency and intensity of flooding events on a global scale has prompted a heightened awareness of the pressing need to understand and address the root causes behind these devastating phenomena. Statistics paint a vivid picture of this disconcerting trend, showcasing a substantial increase in the number of flood-related incidents across the world. The urgency of the matter is further underscored by the profound impact these events have on communities, economies, and the environment.As our communities grapple with the aftermath of floods, it becomes imperative to not only unravel the intricate web of factors contributing to these occurrences but also to benchmark our experiences against those of other nations. This final year project takes on the formidable task of delving into the multifaceted causes of flooding, employing a comparative approach with statistical data from other countries to assess the efficacy of existing mitigation efforts.The comparative analysis is integral to understanding the nuances of flood prevention strategies on a global scale. By examining statistical trends and patterns, we aim to identify similarities, differences, and potential best practices that can inform and enhance our local efforts. The inclusion of international data provides a broader context for our findings, fostering a collaborative, cross-cultural perspective on disaster resilience and sustainable urban development. Within the context of this study, statistical comparisons will not only shed light on the effectiveness of various flood prevention measures but will also allow us to glean insights into the socio-economic and environmental factors that influence vulnerability. The examination of these factors on a global scale contributes to a more comprehensive understanding of the complex interplay between human activitiesand natural disasters.In conclusion, this final year project is poised to make a meaningful contribution to the ongoing discourse surrounding flood prevention and mitigation efforts. By integrating statistical comparisons with other countries, we aspire to not only strengthen the resilience of our local communities but also to foster a collaborative and informed global approach to addressing the challenges posed by increasingly frequent and severe flooding events. Through this endeavor, we aim to pave the way for more effective, sustainable, and universally applicable strategies in the realm of disaster resilience.

II. LITERATURE SURVEY

The study [1], conducted by Wang and Li (2018) explores the use of AI techniques, including convolutional neural networks (CNNs), for flood extent mapping through remote sensing and satellite imagery. The research emphasizes the potential of AI in automating the analysis of flood-prone area.In [2], The literature review by Garcia and Rodriguez (2018) emphasizes the importance of community engagement in flood protection using AI. The study discusses the integration of AI algorithms in communication systems to provide early warnings and evacuation guidance, fostering a proactive response from the affected population.The researchers, [3],Smith et al. (2019) highlights the use of machine learning algorithms for flood prediction based on historical data, weather patterns, and topographical information. The study emphasizes the accuracy and efficiency of AI models in forecasting flood events with improved lead times.In [4], A study by Gupta and Jain (2019) explores the integration of AI with the Internet of Things (IoT) in flood protection. The research emphasizes the use of AI algorithms to analyze real-time data from IoT devices, such as water level sensors and weather stations, to dynamically adapt flood protection measures.The [5]Urban flooding poses unique challenges, and a study by Das et al. (2019) investigates the use of predictive analytics and AI for managing flood risks in urban areas. The research employs machine learning algorithms to analyze urban infrastructure data, historical flood patterns, and climate models. The results contribute to the development of AI-driven tools for urban planners to enhance flood resilience and design effective mitigation strategies.The authors [6] Research by Zhang et al. (2020) delves into AI applications for adaptive infrastructure and resilience planning. The study explores how AI models can optimize the design of flood protection structures, considering changing environmental conditions and future climate scenarios.The authors [7], Chen et al. (2020) focus on the integration of AI with sensor networks for real-time data collection. The study discusses the role of AI algorithms in processing data from various sources, such as rainfall sensors, river gauges, and satellite imagery, to provide a comprehensive understanding of flood threats.Research [8] by Kumar et al. (2021) investigates the development of decision support systems using AI for flood threat protection. The study discusses the implementation of AI models to assess the impact of potential flooding, enabling authorities to make informed decisions for evacuation and resource allocation.In a [9] study by Johnson et al. (2021), the focus is on AI-driven humanitarian assistance and disaster response in the context of floods. The research explores the use of natural language processing (NLP) and sentiment analysis to analyze social media data for real-time information on flood impacts. This approach aids in assessing the immediate needs of affected populations and optimizing the deployment of rescue and relief efforts.The work [10] of Li et al. (2022) focuses on AI-driven risk assessment and vulnerability mapping. The study discusses the use of machine learning algorithms to analyze socio-economic factors, land use patterns, and historical flood data to identify areas at higher risk and prioritize protective interventions.v

III. PREVIOUS WORKS OF THE PAPER

In this paper the study by Pham et al. (2021) proposes a flood risk assessment framework integrating hybrid artificial intelligence (AI) models with multi-criteria decision analysis (MCDA) for Quang Nam Province, Vietnam. Two AI models, ABMDT (AdaBoost-DT) and BDT (Bagging-DT), are developed using Decision Table (DT) as a base classifier for flood susceptibility assessment. The models utilize 847 flood locations from major events in 2007, 2009, and 2013, along with 14 influencing factors. Performance evaluation, including Area Under Receiver Operating Characteristic (ROC) Curve (AUC), indicates the superiority of the BDT model (AUC = 0.96) compared to ABMDT (AUC = 0.953) and single DT (AUC = 0.929). The flood susceptibility map produced by the BDT model is integrated with a flood consequences map using AHP, resulting in a reliable flood risk assessment map. The study emphasizes the potential application of the proposed framework in flood-prone areas for improved risk management.The study by Pham et al. (2021) proposes a flood risk assessment framework integrating hybrid artificial intelligence (AI) models with multi-criteria decision analysis (MCDA) for Quang Nam Province, Vietnam. Two AI models, ABMDT (AdaBoost-DT) and BDT (Bagging-DT), are developed using Decision Table (DT) as a base classifier for flood susceptibility assessment. The models utilize 847 flood locations from major events in 2007, 2009, and 2013, along with 14 influencing factors. Performance evaluation, including Area Under Receiver Operating Characteristic (ROC) Curve (AUC), indicates the superiority of the BDT model (AUC = 0.96) compared to ABMDT (AUC = 0.953) and single DT (AUC = 0.929). The flood susceptibility map produced by the BDT model is integrated with a flood consequences map using AHP, resulting in a reliable flood risk assessment map.

IV. PROPOSED METHOD

The primary objective of this project is to develop an advanced flood rescue system utilizing IoT technologies to enhance early warning, data analysis, and autonomous response. The key objectives include:

A. EARLY WARNING AND DATA COLLECTION

- Implement a water level sensor at the sea shore end to provide real-time data on rising water levels.
- Utilize the Atmega 328p microcontroller to process analog data received from the water level sensor.

B. DATA TRANSMISSION AND COMMUNICATION

- Employ the Sim900A GSM/GPRS module for efficient transmission of processed data to the rover.
- Establish a reliable communication link between the sea shore end and the rover to ensure seamless data transfer.

C. INTEGRATION WITH IOT AND THINGSPEAK AI

- Connect the rover to the Thingspeak AI-based website using IoT technology.
- Utilize the website to collect and analyze the received data, generating graphical representations of flood-damaged zones.

D. AUTONOMOUS RESPONSE SYSTEM

- Develop a responsive rover that interprets the analyzed data to identify high to low damage zones.
- Enable the rover to autonomously navigate from high damage zones to low damage zones for effective and timely rescue operations.

E. STANDBY MODE ACTIVATION

- Implement a standby mode for the rover when not in active rescue mode.
- Activate the rover instantly upon receiving flood data, ensuring a swift response to impending flood situations.

F. LIFE-SAVING MISSION

- Prioritize the project's main scope, which is to save lives during floods with a focus on areas with lower rescue probabilities.
- Design the system to act as an early responder, reaching flood-stricken areas before traditional rescue plans can be activated.

G. ENHANCING FLOOD PREPAREDNESS

- Contribute to flood preparedness by providing timely and actionable data to emergency responders.
- Offer a solution that bridges the gap in early intervention during the initial stages of flooding when conventional plans might not be in place.

H.TECHNOLOGY INNOVATION FOR DISASTER MANAGEMENT

- Showcase the potential of IoT technologies in innovating disaster management strategies.

- Demonstrate how technological advancements can significantly improve the efficiency and effectiveness of flood rescue operations.

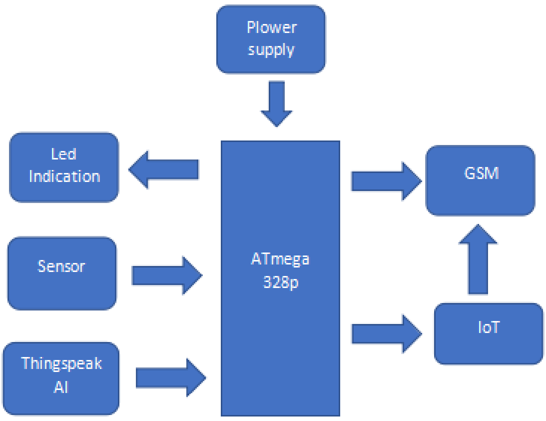

Figure 1.Proposed method block diagram transmitter

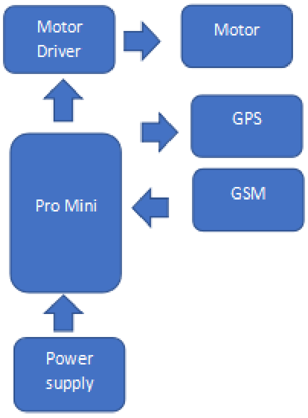

Figure 2.Proposed method block diagram receiver

V. RESULTS AND DISCUSSION

Our project is divided into three parts:

- Data Processing and Transmission
- Receiver end and Rover rescue
- Graphical representation for rescue in risk zones

The success of the proposed flood monitoring and rescue system hinges on a multifaceted evaluation of its performance metrics. First and foremost is the timeliness of the system's response, assessing how rapidly the rover reacts to incoming flood data and navigates from high to low damage zones. The accuracy of data analysis on the Thingspeak AI-based website stands as a critical measure, ensuring reliable identification of areas with varying degrees of impact. The precision of the rover's autonomous navigation through different zones is evaluated to demonstrate the system's reliability in executing efficient rescue missions. Additionally, the success rate of life-saving missions in prioritizing areas with lower rescue probabilities during initial flooding stages is a pivotal outcome.The system's adaptability to diverse flood conditions, including variations in water levels, terrain complexities, and environmental factors, is a key consideration. The efficiency of standby mode activation, enabling a rapid and proactive response, adds another layer to the evaluation. User-friendliness is assessed in terms of deployment simplicity, maintenance ease, and the comprehensibility of graphical representations generated by the Thingspeak AI-based website. Robustness to data variability, encompassing the system's ability to handle fluctuations in water levels consistently, contributes to its overall effectiveness.Cost-effectiveness is a crucial metric, taking into account initial setup costs, ongoing maintenance expenses, and the broader return on investment in terms of lives saved. Lastly, ethical considerations, including the impact on human lives, potential biases In decision-making, and adherence to ethical standards in disaster management.

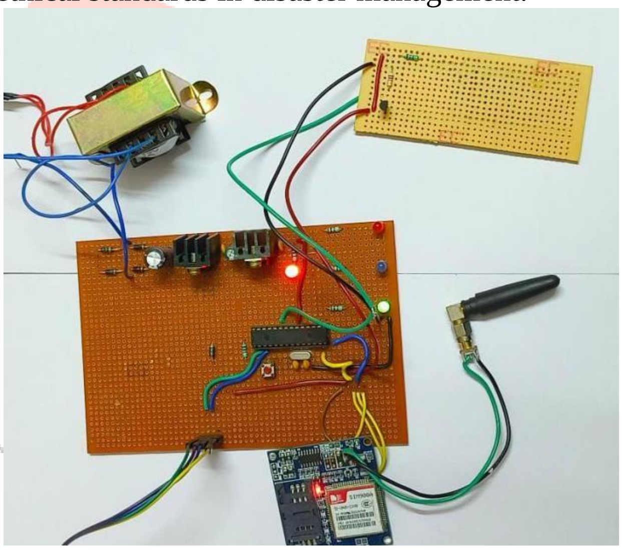

Figure 3.Hardware model

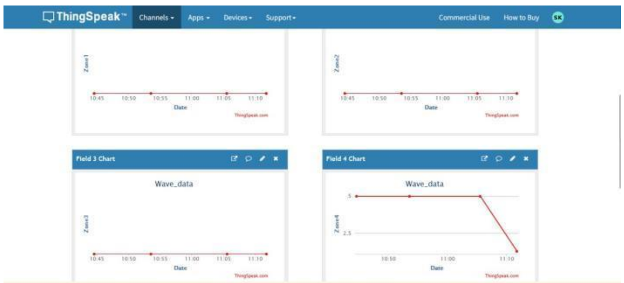

Figure 4.Statistical Output from Thinkspeak AI

VI. CONCLUSION AND FUTURE WORKS

In conclusion, the proposed flood monitoring and rescue system presents a comprehensive and innovative solution to address the challenges posed by rising water levels. By seamlessly integrating sensor technologies, microcontroller processing, and wireless communication, the system establishes a robust framework for real-time flood data analysis. The rover, equipped with an IoT device, serves as a responsive agent, connecting to the Thingspeak AI-based website to gain insights into varying damage zones.The autonomous navigation of the rover from high to low impact areas demonstrates a proactive approach to flood rescue missions. The standby mode activation ensures immediate responsiveness, bridging the crucial gap in the initial stages of flooding when formal rescue plans may not be readily available. The system's overarching goal is clear: to prioritize and optimize life-saving efforts in the face of floods.

This innovative project not only leverages cutting-edge technology but also addresses the inherent challenges of flood response, offering a dynamic and adaptable solution. As cities and regions grapple with increasing instances of flooding, the proposed system stands as a beacon of efficient, data-driven rescue operations. It is a testament to the potential of technology to significantly enhance disaster management and underscores the importance of proactive measures in safeguarding human lives during natural disasters.

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