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Review Paper On Disaster Prediction and Monitoring System Using Machine Learning Algorithms

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Abstract – *Natural disasters like floods, earthquakes, and landslides can cause massive damage and loss of life. Many traditional disaster management systems focus on responding after a disaster happens, rather than predicting it in advance. To solve this problem, we have developed a smart disaster prediction and monitoring system that uses IoT sensors, cloud computing, and machine learning to provide early warnings. Our system works by collecting real-time data from different sensors, such as temperature, humidity, water level, ground vibrations, and soil moisture. This data is sent to a cloud platform called Thing Speak, where it is stored and analysed. We use machine learning algorithms to study patterns in the data and predict possible disasters before they happen. If a high-risk situation is detected, the system automatically sends alerts via SMS, email, or a mobile app to authorities and people in the affected areas, allowing them to take precautions. This system is affordable, efficient, and scalable, making it useful for disaster-prone areas. It helps reduce loss of life and property by giving people enough time to prepare. In the future, we can improve this system by adding artificial intelligence for better accuracy, real-time processing using edge computing, and block chain technology for data security.*

Keywords: *Smart Disaster System, IoT, ThingSpeak, Machine Learning, Early Warning, Cloud Computing*

I. INTRODUCTION

Natural disasters such as floods, landslides, and earthquakes pose significant threats to human life and property. Traditional disaster management systems often focus on reactive measures, addressing the After math rather than predicting and mitigating potential disasters. The integration of the Internet of Things (IoT) with Machine Learning (ML) offers a proactive approach, enabling real-time monitoring, prediction, and early warning systems. Platforms like Thing Speak facilitate the collection and analysis of environmental data from IoT sensors, while ML algorithms process this data to forecast potential disasters. This combination enhances disaster preparedness and response strategies, minimizing risks and damages.

II. LITERATURE REVIEW

This comprehensive assessment offers an in-depth overview of disaster management systems, methods, obstacles, and potential future paths. Specifically, it focuses on flood control, a significant and recurrent category of natural disasters. The analysis begins by exploring various types of natural catastrophes, including earthquakes, wildfires, and floods. It then delves into the different domains that collectively contribute to effective flood management. [1]

This paper presents a natural disaster prediction system that utilizes IoT devices to monitor environmental parameters. The system aims to detect early warning signs of disasters such as earthquakes, floods, and landslides by analyzing real-time data collected from sensors. The implementation involves deploying sensors in vulnerable areas to continuously monitor conditions and provide timely alerts to authorities and residents. [2]

This paper explores the application of AI-based techniques in all phases of the disaster management cycle. It discusses how AI can be leveraged to achieve a responsive and effective disaster management and mitigation system. The study highlights the role of AI in enhancing disaster preparedness, response, and recovery efforts by analyzing large datasets and predicting potential disaster scenarios. [3]

This review examines various IoT-based systems designed for monitoring and alerting natural disasters such as earthquakes, fires, and landslides. The paper discusses the integration of sensors, microcontrollers, and communication modules to create efficient monitoring systems. It also highlights the importance of real-time data analysis and early warning mechanisms to mitigate disaster impacts. [4]

This paper reviews different disaster monitoring systems and proposes an IoT-based approach to enhance disaster management. The study emphasizes the need for alert systems that can send messages through calls to notify villages and prevent social and economic losses. The proposed system integrates multiple Wi-Fi modules, sensors, microcontrollers, and actuators to monitor environmental conditions and provide timely alerts.[5]

This paper introduces "Master of Disaster" (MoD), an open-source event monitoring system that processes news streams to extract disaster-related information. MoD links extracted information to a knowledge graph (Wikidata) and visually discriminates event instances. The system aims to group event mentions referring to the same real-world event, facilitating efficient disaster monitoring and response.[6]

This study validates the hypothesis that a Low-Cost Automatic Weather Station system (LCAWS), developed from commercial off-the-shelf and open-source IoT technologies, can provide data as reliable as a Professional Weather Station (PWS) for natural disaster monitoring. The paper proposes an intelligent sensor calibration method to correct weather parameters, demonstrating that calibrated LCAWS sensors have no statistically significant differences compared to PWS results.[7]

This paper presents a novel large-scale crowdsourcing disaster monitoring system based on the Game-With-A-Purpose (GWAP) theory. The system analyzes tagged satellite pictures from anonymous players and reports aggregated monitoring results to stakeholders. An algorithm based on directed graph centralities is proposed to detect malicious users and calculate disaster levels, enhancing the reliability of crowdsourced data.[8]

This paper investigates the problem of detecting geolocation-content communities on Twitter and proposes a novel distributed system for near real-time hazard-related event reporting. The system analyzes social relationships among geolocated tweets, applies topic modeling to group tweets by topics, and creates a publisher-subscriber distribution model. A deep learning model is employed to detect and remove misinformation, ensuring the accuracy of disaster reports. [9]

PAGER is a monitoring system operated by the United States Geological Survey (USGS) that provides fatality and economic loss impact estimates following significant earthquakes worldwide. The system rapidly assesses earthquake impacts by combining data about populations exposed to estimated shaking intensity with models of economic and fatality losses based on past earthquakes. PAGER aims to inform emergency responders, government agencies, and the media regarding the potential scope of earthquake disasters. [10]

This article discusses the global utilization of AI to enhance response and monitoring systems for natural disasters, particularly in urban areas. It highlights AI applications such as improving forecasting accuracy, real-time disaster response, and public alert systems. The article also addresses challenges like data quality and model transparency, emphasizing the need for collaboration with national meteorological services to effectively leverage AI in disaster preparedness and response.[12]

This study presents an IoT system designed to predict and monitor landslides using sensors like the MPU6050 gyroscope and ADXL345 accelerometer, interfaced with a NodeMCU microcontroller. The NodeMCU's Wi-Fi capability allows real-time data transmission to the

ThingSpeak platform. By analyzing sensor data on ThingSpeak, the system can detect early signs of landslides and send timely alerts to relevant authorities and communities, enhancing disaster preparedness.[13]

This paper proposes an efficient IoT-based sensor system combined with Machine Learning to monitor and predict floods. The system sends SMS alerts when water levels and rainfall exceed predefined thresholds. By employing ML algorithms, the system predicts future floods and heavy rainfall, bridging the gap between disaster onset and preventive measures.[14]

The research aims to develop an affordable IoT-based framework for landslide detection, monitoring, prediction, and warning. It integrates ensemble learning techniques for risk prediction and provides timely alerts to authorities and residents in landslide-prone areas, enhancing disaster management strategies.[15]

This survey explores various IoT and Machine Learning techniques for flood prediction and alerting systems. It highlights the use of ThingSpeak for data collection and MATLAB for implementing Artificial Neural Networks (ANN) and Nonlinear Autoregressive networks with Exogenous inputs (NARX) for prediction analysis, emphasizing the importance of real-time data processing in disaster management.[16]

This article discusses the role of IoT and Machine Learning in disaster management within industrial settings. It presents IoT-based disaster management solutions for various types of disasters, comparing existing market solutions and showcasing implementations that enhance safety and preventive measures in industries. [17]

The paper examines the application of Artificial Intelligence (AI) in disaster prediction and early warning systems. It discusses how AI, particularly Machine Learning and Deep Learning, can analyze large-scale datasets to predict events like earthquakes, floods, hurricanes, and wildfires, thereby improving the accuracy and timeliness of disaster responses.[18]

This research focuses on developing an IoT-based real-time climate monitoring system capable of collecting accurate data on key climate parameters. It implements Machine Learning models to predict extreme weather events such as floods and storms, providing an early warning system that disseminates timely alerts to relevant stakeholders. [19]

The study addresses the process of disaster management by utilizing IoT to minimize risks through early warning systems. It discusses the integration of IoT in monitoring natural and artificial disasters, emphasizing the importance of real-time data collection and dissemination to relevant authorities for prompt action.[20]

III. METHODOLOGY

The IoT-Driven Disaster Prediction and Monitoring System is built using Raspberry Pi Pico W for data collection, ThingSpeak for cloud storage, and Python-based Machine Learning algorithms for disaster prediction. The system follows a structured approach, divided into different stages:

Data Collection Using Raspberry Pi Pico W:

The Raspberry Pi Pico W is used as the main microcontroller to collect real-time environmental data. Various sensors are connected to it, including a DHT11 for temperature and humidity, vibration sensor, ADXL345 accelerometer for detecting seismic activity, and a water level sensor for flood monitoring. These sensors continuously measure environmental parameters and send data to the microcontroller.

Data Transmission to the Cloud (ThingSpeak):

The Pico W, with its built-in Wi-Fi, transmits the collected data to the ThingSpeak cloud platform. It uses either HTTP requests or MQTT protocol to send data at regular intervals. ThingSpeak organizes the data into channels, where each environmental parameter is stored separately for easy visualization and analysis.

Real-Time Monitoring and Alerts:

ThingSpeak provides real-time graphs and dashboards to monitor the environmental conditions. It also has a built-in feature to trigger alerts when certain threshold values are exceeded. For example, if the temperature crosses a set limit, the system can send an alert to authorities or display warnings.

Data Processing and Machine Learning in Python:

The collected data from ThingSpeak is further analyzed using Python-based Machine Learning algorithms. The data is first cleaned and preprocessed to remove missing values and unwanted noise. Important features such as temperature, humidity, pressure, and vibration levels are selected for training the model.

Disaster Prediction Using Machine Learning:

Machine Learning models are used to analyze historical patterns and predict potential disasters. Techniques like regression models help in forecasting trends, while clustering algorithms (K-Means) group similar data points to detect anomalies. This step helps in predicting disasters before they happen, allowing authorities to take preventive measures.

Decision-Making and Response System:

Based on the Machine Learning predictions, the system can automatically trigger early warnings for disaster-prone areas. This information can be used by local authorities and emergency response teams to take necessary actions, such as evacuations or infrastructure protection.

. IV. CONCLUSION

The IoT-Driven Disaster Prediction and Monitoring System provides an efficient and real-time approach to disaster management by integrating Raspberry Pi Pico W, ThingSpeak cloud storage, and Machine Learning algorithms. This system enables continuous environmental monitoring through various sensors, ensuring that critical data such as temperature, humidity, pressure, and seismic activity are collected and analyzed effectively. By leveraging IoT and cloud computing, data is transmitted to ThingSpeak in real time, allowing for visualization, storage, and alert generation when predefined thresholds are exceeded.

The integration of Machine Learning algorithms in Python enhances the system's ability to predict potential disasters. By analyzing historical and real-time data patterns, the system can forecast possible hazards like floods, wildfires, or earthquakes, enabling authorities and communities to take proactive measures. The use of regression models and clustering techniques ensures accurate predictions, reducing the risks associated with natural disasters.

Overall, this system offers a cost-effective, scalable, and automated disaster monitoring solution. It not only improves early warning capabilities but also helps in decision-making for disaster response teams. Future improvements can include AI-driven anomaly detection, edge computing for faster processing, and expanded sensor integration to cover a wider range of disaster scenarios. By implementing such IoT and AI-driven solutions, we can significantly enhance disaster preparedness and minimize the loss of life and property.

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