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Artificial Intelligence-Assisted IoT Model for Water Level Monitoring and Prediction Systems: A Review and Analysis

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Article Info	ABSTRACT
Corresponding Author: I Gede Iwan Sudipa E-mail: iwansudipa@instiki.ac.id	Flood disasters have become increasingly frequent and severe due to climate change and urban expansion. Traditional water level monitoring systems often lack real-time data processing and predictive capabilities. The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) presents a promising solution for enhancing water level monitoring and flood prediction systems. This paper provides a comprehensive review and analysis of AI-assisted IoT models for water level monitoring and prediction. It examines system architectures, sensor networks, and the application of AI algorithms such as Fuzzy Logic and Long Short-Term Memory (LSTM) networks. The study highlights the benefits of combining real-time IoT data with AI-based predictive models to improve the accuracy and responsiveness of flood early warning systems. Challenges related to data quality, sensor network infrastructure, and model optimization are also discussed. This review aims to inform future research and development in intelligent disaster mitigation systems.
	Keywords: Artificial Intelligence, Internet of Things, Water Level Monitoring, Flood Prediction.

INTRODUCTION

Flooding is one of the most devastating natural disasters, causing significant damage to infrastructure, economies, and human lives worldwide. Traditional methods of water level monitoring often rely on manual observations or basic sensors, which lack the capability for real-time data analysis and predictive insights. The advent of the Internet of Things (IoT) has enabled the deployment of interconnected sensor networks that collect environmental data in real-time. When combined with Artificial Intelligence (AI), these systems can analyze vast amounts of data to predict water level changes and potential flooding events. AI algorithms, such as Fuzzy Logic and Long Short-Term Memory (LSTM) networks, offer advanced data processing capabilities that enhance the accuracy of flood predictions. This integration of AI and IoT technologies holds significant promise for improving flood early warning systems and mitigating the impact of such disasters.

METHOD

This study employs a systematic literature review approach to analyze existing research on AI-assisted IoT models for water level monitoring and prediction. Relevant articles were identified through databases such as Scopus, IEEE Xplore, and ScienceDirect, focusing on publications from 2017 to 2024. Keywords used in the search included "IoT," "Artificial Intelligence," "Water Level Monitoring," "Flood Prediction," "Fuzzy Logic," and "LSTM." The selected studies were analyzed to extract information on system architectures, sensor technologies, AI algorithms employed, and the challenges faced in implementing these systems.

RESULTS AND DISCUSSION

The integration of AI and IoT in water level monitoring systems typically involves several key components. Sensor nodes equipped with ultrasonic, pressure, or float sensors collect real-time data on water levels. These sensors transmit data via communication protocols such as LoRaWAN, Wi-Fi, or GSM to centralized processing units. AI algorithms process this data to detect patterns and predict future water level trends. Fuzzy Logic systems are often used for rule-based decision-making, categorizing water levels into states like "normal," "alert," or "danger," based on predefined thresholds. LSTM networks, a type of recurrent neural network, are employed for time-series forecasting, capable of learning long-term dependencies in sequential data, making them suitable for predicting water level fluctuations. The combination of these AI techniques with IoT infrastructure enhances the system's ability to provide timely and accurate flood warnings.

However, several challenges persist in the implementation of AI-assisted IoT water level monitoring systems. Data quality issues, such as sensor inaccuracies and data loss, can affect the reliability of predictions. Infrastructure limitations, particularly in remote or underdeveloped regions, hinder the deployment of comprehensive sensor networks. Additionally, the complexity of AI models requires significant computational resources, which may not be readily available in all settings. Addressing these challenges is crucial for the effective deployment of intelligent flood monitoring systems.

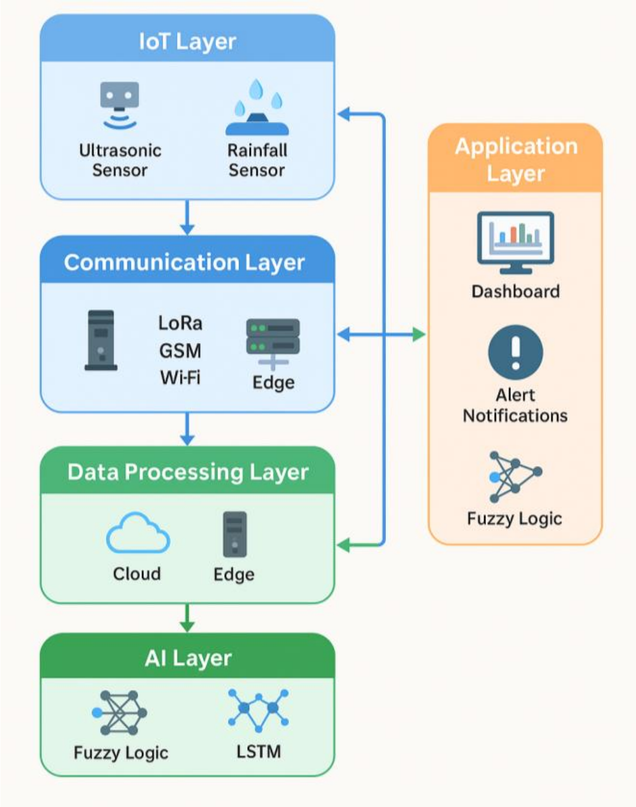

Figure 1. AIoT Model for Water Levelling and Prediction

The model consists of five main layers. First, the IoT Layer serves as a real-time environmental data collector using various sensors, such as water level, rainfall, and water flow speed sensors. Second, the Communication Layer plays a role in transmitting data from sensors to the server using network technologies such as LoRa, GSM, or Wi-Fi. Third, the Data Processing Layer is responsible for storing, processing, and cleaning data, both in the cloud and on edge computing for process efficiency. Fourth, the AI Layer is the core of the prediction system, where Fuzzy Logic algorithms are used for rule-based decision making and LSTM is used to predict water level trends based on time-series data. Fifth, the Application Layer is the output part of the system, in the form of data visualization dashboards, early warning notifications, and information systems that can be accessed by users or relevant stakeholders in flood disaster mitigation. This model illustrates the integration between IoT and artificial intelligence to support a more effective and responsive technology-based flood early warning system.

CONCLUSION

The integration of Artificial Intelligence and Internet of Things technologies offers a transformative approach to water level monitoring and flood prediction. AI-assisted IoT systems enhance the capability to collect, analyze, and interpret environmental data in real-time, leading to more accurate and timely flood warnings. While promising, the implementation of these systems faces challenges related to data quality, infrastructure, and computational demands. Future research should focus on developing robust, scalable, and cost-effective solutions that can be deployed in diverse environments to mitigate the risks associated with flooding.

REFERENCES

Shah, I., Doshi, C., Patel, M., Tanwar, S., Hong, W.-C., & Sharma, R. (2022). A comprehensive review of the technological solutions to analyse the effects of pandemic outbreak on human lives. *Medicina*, *58*(2), 311.

Si, P., Zhao, J., Han, H., Lam, K.-Y., & Liu, Y. (2022). Resource allocation and resolution control in the metaverse with mobile augmented reality. *GLOBECOM 2022-2022 IEEE Global Communications Conference*, 3265–3271.

Sutandi, S. (2018). Pengaruh Big Data Dan Teknologi Blockchain Terhadap Model Bisnis Sektor Logistik Dengan Pendekatan Business Model Canvas. *Jurnal Logistik Indonesia*, *2*(1), 9–20. https://doi.org/10.31334/jli.v2i1.214

Tao, B., Dai, H.-N., Xie, H., & Wang, F. L. (2023). Structural identity representation learning for blockchain-enabled metaverse based on complex network analysis. *IEEE Transactions on Computational Social Systems*.

Theuermann, K. (2019). Trustworthy privacy-preserving service compositions. *2019 18th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/13th IEEE International Conference On Big Data Science And Engineering (TrustCom/BigDataSE)*, 10–17.

Truong, V. T., Le, L. B., & Niyato, D. (2023). Blockchain meets metaverse and digital asset management: A comprehensive survey. *Ieee Access*.

Verhulst, I., Woods, A., Whittaker, L., Bennett, J., & Dalton, P. (2021). Do VR and AR versions of an immersive cultural experience engender different user experiences? *Computers in Human Behavior*, *125*, 106951. https://doi.org/https://doi.org/10.1016/j.chb.2021.106951

Yan, R. (2022). A sustainable fashion industry Business model revolution based on the metaverse: Practices and reciprocal processes. *Highlights in Business, Economics and Management*, *4*, 363–369.

Jan, F., Min-Allah, N., Saeed, S., Iqbal, S. Z., & Ahmed, R. (2022). IoT-based solutions to monitor water level, leakage, and motor control for smart water tanks. *Water*, 14(3), 309. https://doi.org/10.3390/w14030309MDPI

Liu, P., Wang, J., Sangaiah, A. K., Xie, Y., & Yin, X. (2019). Analysis and prediction of water quality using LSTM deep neural networks in IoT environment. *Sustainability*, 11(7), 2058. https://doi.org/10.3390/su11072058MDPI

Natividad, J., & Palaoag, T. (2019). IoT-based model for monitoring and controlling water distribution. *IOP Conference Series: Materials Science and Engineering*, 482(1), 012045. https://doi.org/10.1088/1757-899X/482/1/012045MDPI

Asif, S. S., Doddaguni, S. R., Kamagond, T. G., & Anala, M. R. (2020). Household water resource monitoring and leakage detection. *International Journal of Soft Computing and Engineering*, 9(1), 12–17.MDPI

Dissanayaka, R. M. S. M., & Wickramaarachchi, H. (2019). IoT-based water level