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Flood Detection using a Submersible Pump and SMS Alert

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***Abstract*— This Internet of Things (IoT) project presents an automated Flood Detecting System using a Submersible Pump and SMS Alert, designed to provide an efficient and timely response to rising water levels. The system integrates a suite of sensors for continuous water level monitoring, a submersible pump for active water drainage, and a GSM module for instant SMS notifications. Upon detecting predefined critical water levels, the system automatically activates the pump to mitigate flooding and simultaneously dispatches alerts to designated users. The core objective is to minimize flood damage, enhance safety, and provide real-time information, making it an invaluable solution for protecting vulnerable areas such as basements, low-lying lands, and agricultural fields from the destructive impacts of water accumulation.**

***Index Terms*— IoT, Flood Detection, Flood Mitigation, Submersible Pump, SMS Alert, Water level Sensor, Dis-aster Management and Smart Systems.**

I. INTRODUCTION

Flooding remains one of the most devastating natural disasters globally, inflicting substantial economic losses, severe infrastructure damage, and, tragically, loss of human lives. Whether it's the rapid inunda-tion of urban areas due to overwhelmed drainage systems, the slow creep of water across agricultural plains, or the sudden overflow into residential basements, the consequences of unmanaged water ac-cumulation are profound. Traditional approaches to flood management, often reliant on manual obser-vation or post-event assessments, are inherently reactive and frequently prove insufficient in prevent-ing extensive damage. The escalating frequency and intensity of extreme weather events, compounded by the impacts of climate change, further intensify the demand for proactive, automated, and highly responsive flood mitigation strategies.
In response to this pressing global challenge, this paper proposes an innovative Internet of Things (IoT) -enabled system: the Flood Detecting System using Submersible Pump and SMS Alert. This pro-ject moves beyond mere detection by integrating a comprehensive, multi-layered approach that not only identifies rising water levels but also actively intervenes to mitigate the threat and immediately communicates critical information to stakeholders. By combining precise water level sensing with an automated pumping mechanism and instant cellular, notifications, our IoT-based system aims to pro-vide both an early warning and a crucial first line of defense against inundation.

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The overarching goal is to significantly minimize the destructive impact of floods, enhance public and private safety, and empower individuals and authorities with the timely data necessary for effective response and damage control, thereby safeguarding assets and well-being in areas particularly susceptible to water accumulation.

II. Literature Survey

In recent years, the integration of the Internet of Things (IoT) with advanced machine learning tech-niques has led to significant improvements in real-time flood monitoring and forecasting systems. IoT-based systems typically employ a range of environmental sensors, such as water level detectors, rain-fall gauges, and meteorological sensors, to continuously monitor conditions in real time. These data are transmitted through wireless communication protocols like GSM, Wi-Fi, or LoRa to centralized or cloud-based platforms for analysis and visualization.

Several studies have proposed architectures that combine IoT sensing with predictive models to provide early warnings and reduce the impact of flood-ing. For instance, Prakash et al. developed a system called FLOODWALL that uses hydrometeorologi-cal sensors and Long Short-Term Memory (LSTM) networks to forecast flood risk levels, achieving over 96% accuracy in multi-class alert classification. Similarly, Faudzi et al. integrated rainfall and wa-ter level sensors with an IoT-based dashboard and LSTM model to predict future flood conditions, en-abling effective early warnings.

Other works have explored hybrid modeling approaches. A study by Ali et al. combined neuro-fuzzy systems with genetic algorithms and IoT sensor data to improve prediction accuracy and system ro-bustness. This hybrid model achieved high forecasting accuracy while incorporating data encryption for secure transmission. Meanwhile, Das et al. proposed a low-cost system using NodeMCU, water lev-el sensors, and basic machine learning models to monitor and predict floods, focusing on affordability and accessibility in rural regions. Additionally, real-time risk mapping has been addressed by systems that visualize dynamic flood risk zones using live IoT data combined with ML models, providing ac-tionable insights for disaster response teams.

While these systems demonstrate promising capabilities, they also face limitations, including sensor calibration issues, limited spatial coverage, data transmission reliability, and challenges in adapting models to new geographical areas.

Many models depend heavily on historical data, which may not cap-ture unprecedented events caused by climate change. Furthermore, few systems address the integration of forecasting with real-world actuation, such as controlling pumps or floodgates automatically. Securi-ty and power reliability are also critical considerations, particularly in flood-prone or remote areas.

Despite these challenges, the convergence of IoT, machine learning, and cloud technologies continues to offer scalable and efficient solutions for flood monitoring and forecasting, and ongoing research seeks to enhance system resilience, forecasting accuracy, and user-centric alerting.

III. Proposed Methodology

The proposed flood detection system integrates a water level sensor, a submersible pump, a microcon-troller, and a GSM module to monitor and respond to rising water levels in flood-prone areas. The sys-tem is designed to detect flooding conditions in real-time and respond immediately by both mitigating water accumulation and alerting relevant stakeholders. Initially, the system remains in standby mode, continuously monitoring the water level through a sensor such as an ultrasonic or float sensor.

The sensor data is processed by a microcontroller, such as an Arduino, which has been programmed with a predefined water level threshold. Once the water level rises above this threshold, the microcontroller triggers two simultaneous actions: it activates a submersible pump through a relay module to begin removing excess water from the area, and it sends an SMS alert to designated phone numbers using a GSM module (e.g., SIM800L). The SMS alert informs users about the high water level and the activa-tion of the pump, enabling them to take further action if necessary.

The pump continues to operate until the water level returns to normal, at which point the system automatically turns off the pump and resets to monitoring mode. This setup ensures early flood detection, automatic response, and timely notifica-tion, making it suitable for homes, basements, or small-scale flood-prone areas. Additionally, the sys-tem can be enhanced with features such as battery backup, solar power, cloud-based data logging, or mobile app integration for improved reliability and scalability.

IV. Design Considerations

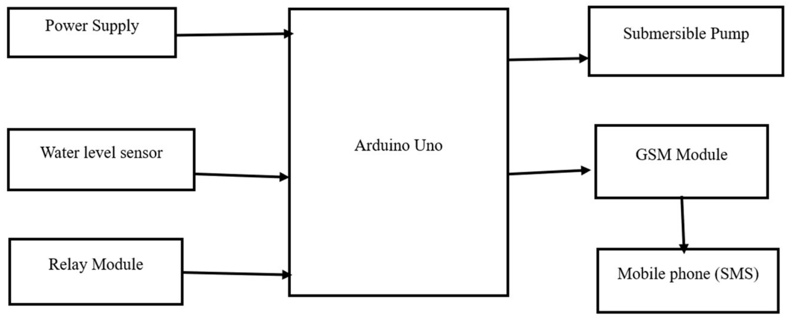


Fig 1

A. Hardware Components

- Water Level Sensor – Detects the height of water to monitor flooding conditions.
- Microcontroller Unit (MCU) – Processes sensor data and controls the pump and GSM module.
- Submersible Pump – Pumps out excess water when the flood level is detected.
- Relay Module – Acts as an electronic switch to control the submersible pump.
- GSM Module – Sends SMS alerts to predefined phone numbers in case of flooding.
- Power Supply – Provides electrical power to the microcontroller and other components.
- SIM Card – Enables mobile communication for the GSM module to send SMS messages.
- Connecting Wires and Jumpers – Used to connect all hardware components together.

B. Working Principle

The working principle of the system is based on real-time monitoring of water levels using a sensor connected to a microcontroller. When the water level rises and crosses a predefined threshold, the sensor sends a signal to the microcontroller, which then activates a submersible pump through a relay module to start draining the excess water. Simultaneously, the microcontroller triggers a GSM module to send an SMS alert to predefined mobile numbers, informing users about the potential flooding situation. The pump continues to operate until the water level drops below the threshold, after which the system automatically turns off the pump and resets to its normal monitoring mode. This automated cycle of detection, alerting, and drainage ensures early flood response and minimizes water damage.

V. Implementation

A. Assemble Hardware Components

Gather the water level sensor, microcontroller (Arduino), relay module, submersible pump, GSM mod-ule, power supply, and connecting wires.

B. Install Water Level Sensor

Place the water level sensor at the location where flood monitoring is needed, such as a basement or sump pit.

C. Connect Sensor to Microcontroller

Wire the water level sensor’s output pins to the analog or digital input pins of the Arduino.

D. Connect Relay to Microcontroller and Pump

Interface the relay module with the Arduino to act as a switch for the submersible pump’s power line.

E. Integrate GSM Module

Connect the GSM module to the Arduino’s serial pins (using SoftwareSerial if needed) to enable SMS communication.

F. Insert SIM Card into GSM Module

Use an active SIM card with SMS capabilities to enable sending alerts.

G. Power Up the System

Connect appropriate power supplies to the Arduino, GSM module, and pump; use batteries or adapters as required.

H. Program the Microcontroller

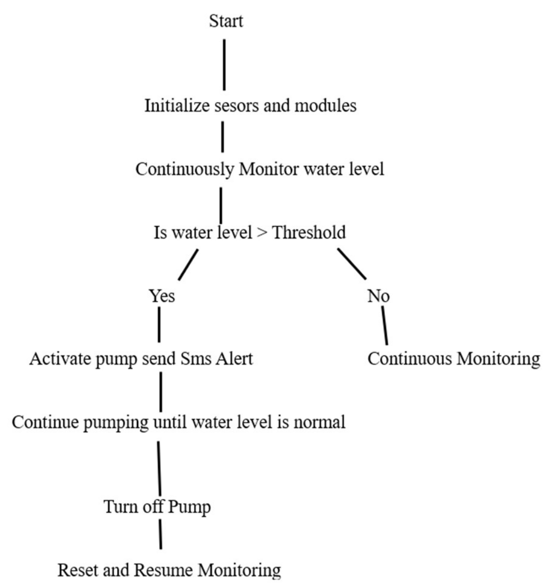
Write and upload the code using the Arduino IDE to:

- Continuously read the water level sensor.
- Activate the pump via the relay when water level exceeds threshold.
- Send SMS alerts through the GSM module when flooding is detected.

I .Test the System

Simulate rising water levels to verify that the sensor detects correctly, the pump activates, and SMS alerts are sent.

VI. FLOW CHART



VII. RESULT AND DISCUSSION

The implemented flood detection system successfully monitored water levels and responded automati-cally to flooding conditions. During testing, the water level sensor accurately detected rising water and triggered the submersible pump once the predefined threshold was reached. The relay module effec-tively switched the pump on and off, demonstrating reliable control of the pump operation. Concurrent-ly, the GSM module sent timely SMS alerts to designated phone numbers, ensuring that users received instant notifications about potential flooding.

The system's real-time response helped prevent water accumulation, reducing the risk of damage to property. The SMS alert functionality provided an additional safety layer by enabling users to take pre-ventive measures or intervene manually if necessary. The use of a microcontroller allowed for flexible programming, making threshold adjustments and sensor calibration straightforward.

Some limitations observed included the dependency on GSM network availability for SMS alerts, which may be affected in remote or low-signal areas. Additionally, the submersible pump's effective-ness depends on its capacity relative to the volume of water, which suggests scaling considerations for larger flood-prone zones. Power backup is also crucial to maintain continuous operation during outag-es.

Overall, the system demonstrated a practical, cost-effective approach to early flood detection and miti-gation. Future improvements could include integration with IoT platforms for remote monitoring, so-lar-powered backups, and multiple sensor nodes for enhanced area coverage.

VIII. Conclusion

The Flood Detection using a Submersible Pump and SMS Alert System provides an effective and automated solution for early flood detection and mitigation. By continuously monitoring water levels and activating a submersible pump when necessary, the system helps prevent water damage in vulnerable areas. The addition of real-time SMS alerts ensures that users are promptly informed of flooding conditions, allowing for timely intervention. The project successfully demonstrates how affordable hardware components and simple programming can be integrated to create a reliable flood management system. With further enhancements such as IoT connectivity and power backup, this system has the potential to be scaled and adapted for wider applications in flood-prone regions.

References

[1] Gunanandhini, S., et al. "Forecasting and Real Time Flood Monitoring System using IoT." 2024 10th International Conference on Advanced Computing and Communication Systems (ICACCS). Vol. 1. IEEE, 2024.

[2] O. Mendoza-Cano et al., “Experiments of an IoT-based wireless sensor network for flood monitor-ing in Colima, Mexico,” J. Hydroinformatics, vol. 23, no. 3, pp. 385–401, May 2021.

[3] J. Al Qundus, K. Dabbour, S. Gupta, R. Meissonier, and A. Paschke, “Wireless sensor network for AI-based flood disaster detection,” Ann.Oper. Res., pp. 1–23, Aug. 2020.

[4] M. P. Mohanty, S. Mudgil, and S. Karmakar, “Flood management in India: A focussed review on the current status and future challenges,” Int. J. Disaster Risk Reduction, vol. 49, Oct. 2020, Art. no. 101660.

[5] M. Ishiwatari, T. Koike, K. Hiroki, T. Toda, and T. Katsube, “Managing disasters amid COVID-19 pandemic: Approaches of response to flood disasters,” Prog. Disaster Sci., vol. 6, Apr. 2020, Art. no. 100096.

[6] S. I. Abdullahi, M. H. Habaebi, and N. A. Malik, “Intelligent flood disaster warning on the fly: Developing IoT-based management platform and using 2-class neural network to predict flood status,” Bull. Electr. Eng. Informat., vol. 8, no. 2, pp. 706–717, Jun. 2019.

[7] L. Zhou, X. Wu, Z. Xu, and H. Fujita, “Emergency decision making for natural disasters: An over-view,” Int. J. Disaster Risk Reduction, vol. 27, pp. 567–576, Mar. 2018.

[8] G. Furquim, G. Filho, R. Jalali, G. Pessin, R. Pazzi, and J. Ueyama, “How to improve fault tolerance in disaster predictions: A case study about flash floods using IoT, ML and real data,” Sensors, vol. 18, no. 3,p. 907, Mar. 2018.

[9] W. M. Shah, F. Arif, A. A. Shahrin, and A. Hassan, “The implementation of an IoT-based flood alert system,” Int. J. Adv. Comput. Sci. Appl.,vol. 9, no. 11, pp. 620–623, 2018.

[10] A. A. Ghapar, S. Yussof, and A. A. Bakar, “Internet of Things (IoT) architecture for flood data man-agement,” Int. J. Future Gener Commun.Netw., vol. 11, no. 1, pp. 55–62, Jan. 2018.

[11] K. Han, D. Zhang, J. Bo, and Z. Zhang, “Hydrological monitoring system design and implementa-tion based on IoT,” Phys. Proc., vol. 33, pp. 449–454, Dec. 2012.

[12] M. Mousa, X. Zhang, and C. Claudel, “Flash flood detection in urban cities using ultrasonic and infrared sensors,” IEEE Sensors J., vol. 16, no. 19, pp. 7204–7216, Oct. 2016.

[13] S.-W. Lo, J.-H. Wu, F.-P. Lin, and C.-H. Hsu, “Visual sensing for urban flood monitoring,” Sensors, vol. 15, no. 8, pp. 20006–20029, Aug. 2015.

[14] G. Merkuryeva, Y. Merkuryev, B. V. Sokolov, S. Potryasaev, V. A. Zelentsov, and A. Lektauers, “Advanced river flood monitoring, modelling and forecasting,” J. Comput. Sci., vol. 10, pp. 77–85, Sep. 2015.

[15] K. Han, D. Zhang, J. Bo, and Z. Zhang, “Hydrological monitoring system design and implementa-tion based on IoT,” Phys. Proc., vol. 33, pp. 449–454, Dec. 2012.