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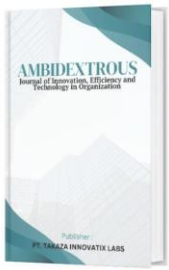

IoT Based Flood Warning Monitoring System with Using the Telegram Application

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Abstract : *Floods often occur suddenly and cause significant losses due to the limited availability of real-time, easily accessible early warning systems. This study aims to develop an Internet of Things (IoT)-based flood warning monitoring system that delivers automatic notifications via the Telegram application. The system was developed using the Research and Development (R&D) method with a prototyping approach, comprising three modules: sensor, data processing, and notification. An ESP32 microcontroller integrated with an HC-SR04 ultrasonic sensor and a rain sensor was used to detect water levels, while the Telegram Bot API enabled automatic warning delivery. The system was evaluated with 20 respondents in flood-prone areas based on notification response speed, sensor reading accuracy, ease of use, and user satisfaction. Results showed that the system delivered warning notifications with an average response time of 1.82 seconds and achieved a sensor reading accuracy of 98.50%. On a 4-point Likert scale, the system received an ease-of-use score of 3.42 and a user satisfaction score of 3.35. These findings indicate that the proposed IoT-based monitoring system with Telegram integration is effective in providing the public with faster and more accessible flood warning information.*

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Introduction

Floods remain the most frequent natural disaster in Indonesia and have a significant impact on people's lives. Heavy rainfall, overflowing rivers, poor drainage systems, and changes in land use are the main factors causing flooding in various regions. According to data from the National Disaster Management Agency (BNPB), floods cause significant losses in the form of casualties, infrastructure damage, and economic losses (Febriani et al., 2025). Although the government has implemented various mitigation efforts, such as the construction of embankments and early warning systems, their implementation still faces obstacles such as limited monitoring equipment, slow information delivery, and a lack of real-time monitoring (Diki & Rahman, 2026). As a result, communities often receive information late about rising water levels, hindering optimal evacuation processes.

The development of Internet of Things (IoT) technology provides an effective solution to address these issues through automated, real-time environmental monitoring (Talitha Putri et al., 2026). In its development, the ESP32 microcontroller and ultrasonic sensors can be utilized to detect and measure water levels, with data sent via the internet (Faturochman et al., 2023). Delivering early warning information is also crucial, with the Telegram application, with its Bot API service, becoming an efficient option due to its fast message delivery process, easy access, and no operational costs (Wikantama & Puspitasari, 2023). Several previous studies have developed similar systems, but there are still research gaps; For example, systems that focus solely on visual monitoring without automatic notifications (Talitha Putri et al., 2026), the use of the costly and complex WhatsApp API (Febriani et al., 2025), and the implementation of multi-sensors or fuzzy logic that have the potential to increase complexity and high power consumption in remote areas (Diki & Rahman, 2026; Subagia & Marodiyah, 2025). These conditions indicate the absence of a system that integrates real-time monitoring, data storage, and Telegram notifications in one integrated, lightweight, and easily replicated system.

Based on the research gap, this study developed an IoT-based flood warning monitoring system by utilizing ultrasonic sensors as water level detectors, an ESP32 microcontroller as a control center, and a Telegram application as an automatic notification medium. This system is designed to automatically measure water level height and provide warning notifications when the water status is in an alert or danger condition. With this system, the process of monitoring river or water channel conditions becomes more effective, efficient, and can be done 24 hours without having to wait for manual checks by officers. The delivery of real-time information via Telegram is expected to increase community preparedness so that the risk of losses and victims due to flood disasters can be minimized. Based on this description, this research was conducted with the title "Internet of Things (IoT) Based Flood Warning Monitoring System Using the Telegram Application."

Literature review

Internet of Things (IoT)

The Internet of Things (IoT) is a technological concept that connects physical devices to the internet to exchange data automatically without human intervention (Dauda et al., 2024). In a flood early warning system, the IoT architecture is implemented through three main layers: the Perception Layer that uses ultrasonic sensors for non-contact water level measurements, the Network Layer that utilizes an ESP32 microcontroller with Wi-Fi features and low power consumption for data transmission, and the Application Layer that provides an interface for receiving alerts through the Telegram application (Domínguez-Bolaño et al., 2022; Kumaran & Lias, 2024; Sujono & Rusli M., 2026). The main advantage of implementing IoT lies in its ability to perform continuous and automatic monitoring based on water level thresholds, where the system can immediately activate a warning mechanism when the water level enters the alert or danger zone (Kumaran & Lias, 2024; Sujono & Rusli M., 2026). The integration of ESP32 with ultrasonic sensors in this architecture has been proven to produce high measurement accuracy (reaching 97.69%) and reliable data transmission, thus significantly reducing response time and increasing community preparedness in disaster-prone areas (Sujono & Rusli M., 2026).

Flood Early Warning System (EWS)

Flood early warning systems (EWS) exist to address information delays in manual monitoring systems, which often leave people with insufficient evacuation time (Wijaya & Rino, 2024; Al Farabi & Sintawati, 2024). EWS are designed to detect rising water levels as early as possible by using water level as the primary parameter, classified into hazard levels, such as Safe, Alert, Warning, and Danger (Wijaya & Rino, 2024; Susila et al., 2023). The accuracy of these stratification readings is generally optimized using calibrated ultrasonic sensors with a very low error rate (Susila et al., 2023). Furthermore, the success of EWS depends heavily on the speed of information delivery, with Internet of Things (IoT) technology enabling real-time transmission of sensor data to the cloud via a microcontroller (Siddique et al., 2023). The data is then translated into an easily accessible interface through various communication platforms, such as push notifications via Blynk, automated uploads to

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Twitter, or direct warning messages via Telegram Bot, often combined with local actuators such as buzzers as auditory alarms (Wijaya & Rino, 2024; Al Farabi & Sintawati, 2024; Ramadhiani et al., 2023). This automation of the chain from detection to information delivery has been shown to significantly improve community response times in the face of flood threats.

HC-SR04 Ultrasonic Sensor

The HC-SR04 Ultrasonic Sensor works based on the principle of ultrasonic wave reflection to calculate the distance of the water surface non-contactly using the formula Distance = (Time x Speed of Sound) / 2. This sensor was chosen because of its high accuracy, is not affected by water turbidity, is economical, and is empirically proven to produce linear and stable readings with very low Mean Absolute Error (MAE) (Fauzi & Suharjo, 2026; Yoga et al., 2026). As a control center, the ESP32 microcontroller processes data from the sensor and sends notifications via a Wi-Fi connection. The ESP32 is superior because of its dual-core architecture and 520KB RAM which allows smooth multitasking processing, thus preventing system crashes when reading sensors while sending emergency notifications. The integration of these two devices has proven to be very reliable; capable of transmitting data to the cloud with an average delay of 129.15 ms and 0% packet loss (Diono et al., 2026), sending automatic notifications to Telegram in less than 5 seconds (Ovid et al., 2025), and even processing Tiny Machine Learning (TinyML) models on-device without interruption (Fauzi & Suharjo, 2026). Based on this empirical evidence, the combination of HC-SR04 and ESP32 is an ideal, efficient, and stable foundation for water level monitoring and real-time notification delivery in this study.

Telegram Apps and Bot API

The Telegram application is utilized as an early warning medium due to its familiar nature and daily use by the public, thus eliminating the barriers to technology adoption compared to using dedicated monitoring applications (Ghazi et al., 2024). Technically, system integration is carried out through the open-source Telegram Bot API, where the ESP32 microcontroller communicates via the HTTPS protocol by sending an HTTP Request using the sendMessage command to the user or group Chat ID, so that the system is highly scalable (Wijaya & Rino, 2024; Rakhman et al., 2025). The main advantage of Telegram compared to conventional dashboards is its lightweight nature, where warning messages immediately appear as push notifications on the lock screen without the need to open a specific application, with a very fast empirical response speed ranging from 2 to 5 seconds (Rakhman et al., 2025; Romadoni et al., 2025). Furthermore, to optimize effectiveness and avoid notification fatigue, the notification delivery mechanism is designed to be event-based, meaning the system only sends automatic alerts when the water level transitions to a critical level ("Alert" or "Danger") and stops when it returns to "Safe" (Lengkong et al., 2025). This lightweight, fast, and intelligent approach has been proven to significantly accelerate community evacuation response times compared to conventional systems.

IoT-Based Flood Warning Monitoring System

The IoT-based flood warning monitoring system in this study utilizes ultrasonic sensors and an ESP32 microcontroller to monitor water levels in real-time and classify them into critical statuses (Safe, Alert, Danger) based on programmed thresholds (Fauzi & Suharjo, 2026; Ovid et al., 2025; Mahardhika et al., 2025). When the system detects a status change, two warning mechanisms are activated simultaneously: a local warning in the form of activating an LED indicator and a buzzer as an audio-visual signal for the community around the monitoring point (Subagia & Marodiyah, 2025; Kumaran & Lias, 2024), and a remote warning in the form of sending automatic notifications to smartphones via the Telegram Bot API. The use of Telegram as a remote interface was chosen because it is able to bridge the information needs of the general public without the complexity of a dashboard, presenting concise, clear, and instant warning messages with a very fast response time of around 2-3 seconds (Wikantama & Puspitasari, 2023; Mahardhika et al., 2025). The integration of these two mechanisms has been proven to create an effective, fast, and accurate early warning system in conveying information on changes in water conditions to reduce the risk of flood disaster impacts (Ovid et al., 2025).

Research methods

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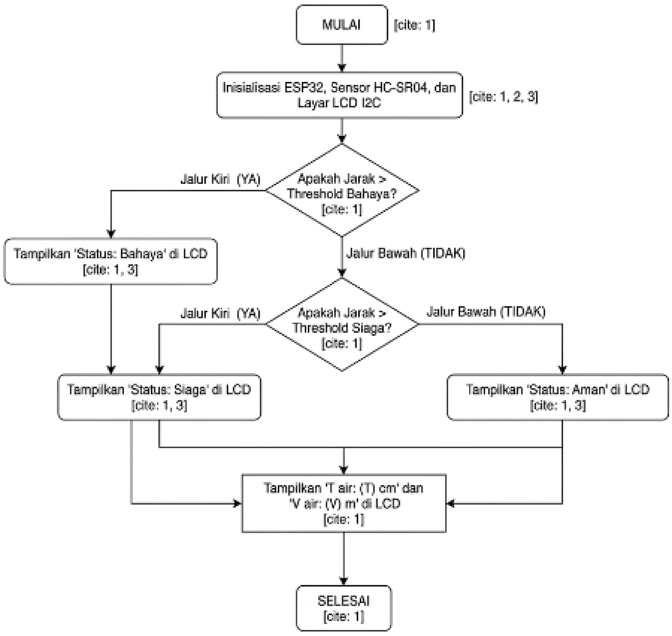
This study uses the Research and Development (R&D) method to develop and evaluate an Internet of Things (IoT)-based flood warning monitoring system utilizing the Telegram application. The R&D method was chosen because it includes structured product development stages starting from needs identification, design, implementation, to system evaluation. The system was developed by utilizing the ESP32 microcontroller and the HC-SR04 ultrasonic sensor as hardware components programmed through the Arduino IDE environment, and integrating the Telegram Bot API as a remote warning interface. The IoT approach is implemented with the ESP32 acting as a control center to read water level data periodically, calculate the danger level status based on the specified threshold, and trigger the sending of automatic notifications in real-time to the user's smartphone. The research stages carried out include problem identification, literature study, needs analysis, hardware and software design and implementation, and testing and evaluation of system functionality.

System Design

The flood warning monitoring system is designed using an Internet of Things (IoT) approach to automate the process of monitoring water levels and delivering early warnings to the public. This approach allows sensor devices, microcontrollers, and internet networks to work collaboratively to complete data acquisition and decision-making tasks through a structured workflow. The ESP32 microcontroller acts as a control center (orchestration) that regulates the coordination of sensor readings, logical data processing, and output command execution so that the monitoring process can run continuously and integrated. This system design also utilizes an HC-SR04 ultrasonic sensor as a water surface distance detector and the Telegram Bot API as an emergency communication interface, so that the resulting response is in accordance with the detected flood threat level.



Picture1. System Architecture

The system architecture and workflow are illustrated in Figure 1. The process begins when the system initializes the hardware, which includes the ESP32 microcontroller, the HC-SR04 ultrasonic sensor, and the I2C LCD. After successful initialization, the system actively reads the distance measured by the ultrasonic sensor. Next, the system checks the logical condition: does the measured distance indicate a "Danger" status (passing the critical threshold)? If yes (YES), the system will set the water status to "Danger"; otherwise (NO), the system will continue checking whether the distance indicates a "Standby" status. If the alert condition is met, the status is set to "Standby", and if not, the status is set to "Safe". After the status is determined, the system displays the water level (T water) and water status (V water) data on the I2C LCD, before the process loops back to the sensor reading stage or ends (FINISH).

Furthermore, based on the logic flow in Figure 1, the ESP32's determination of water status is not only displayed locally via the LCD but also triggers a remote alert mechanism. When the system detects

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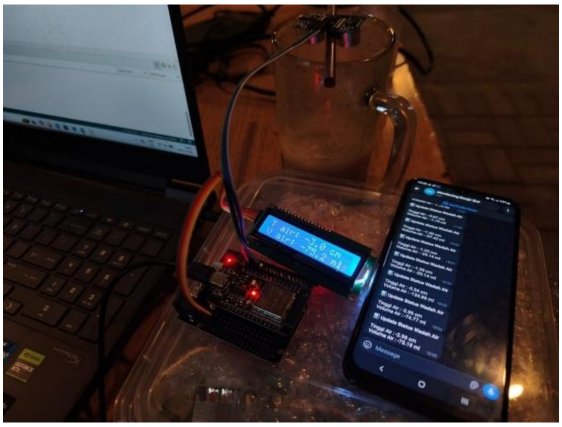
a status change to "Alert" or "Danger," the ESP32 automatically sends data via Wi-Fi to the Telegram Bot API using the HTTPS protocol. Text notifications containing the alert status and water level information are then instantly forwarded to the smartphone of the registered user or community group. This collaboration between hardware components and cloud services produces interconnected outputs, enabling the process of flood monitoring and early warning to be carried out automatically, efficiently, and in a timely manner, while maintaining consistency between field condition detection and information delivery to the public.

Evaluation Method

The evaluation of the IoT-based flood warning monitoring system was conducted through functional testing of the hardware and software, as well as testing the effectiveness of notification delivery via the Telegram application. The system performance assessment focused on three main aspects: the accuracy of ultrasonic sensor readings, the speed of notification response (delay), and the success of delivering flood status information to users, as shown in Figure 2.



Picture2. Functional Test Environment of Flood Monitoring System

Figure 2 displays the documentation of the system's functional testing environment. In the test, the ESP32 microcontroller module and ultrasonic sensor are placed on top of a transparent container (water tank) to simulate water level monitoring conditions in a river or drainage channel. The system displays sensor readings locally on an LCD screen, showing real-time water level (U water) and water volume measurements. Simultaneously, the data is processed by the ESP32 and sent remotely to the user's smartphone via the internet, indicated by the appearance of a "Water Container Status Update" notification message in the Telegram application on the mobile device.

Sensor accuracy measurements were performed by comparing the distance values measured by the HC-SR04 ultrasonic sensor with the results of manual measurements using physical measuring instruments. The accuracy percentage and error percentage were calculated to determine the level of deviation in system readings. Furthermore, the notification speed evaluation was carried out by measuring the time difference (delay) between the status change detected by the ESP32 microcontroller until the message was received on the user's smartphone device. The measurement results from several delivery attempts were then analyzed using the average value (mean) to determine the level of consistency and reliability of the system in delivering early warnings. Data from the accuracy and response time evaluation results were then presented in tables and graphs to facilitate the analysis process in the results and discussion sections.

Results and Discussion

System Evaluation Results

A system evaluation was conducted to determine the effectiveness of the IoT-based flood warning monitoring system in detecting water levels and communicating information to the public. The evaluation involved direct functional testing of the hardware and software. Aspects evaluated included the accuracy of ultrasonic sensor readings, notification response speed (delay), and flood status classification success. The evaluation results were used to measure the system's success in meeting real-

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time monitoring needs and to determine its effectiveness compared to conventional manual monitoring methods.

Picture3. Notification Delivery Evaluation Results on the Telegram Application

Based on the evaluation results visualized in Figure 3, the system successfully sent notifications automatically and in real-time via the "Flood Detection" Telegram Bot. The screenshot shows that the system is able to send an "Automatic Report" containing the water status (LOWER/FLOOD), water level data (Water Level), and water volume accurately, and precisely sends a "FLOOD WARNING!" message when the water level exceeds a pre-programmed threshold. These results indicate that the monitoring process, previously carried out manually through visual inspections on site by officers, can be effectively automated through the integration of the HC-SR04 ultrasonic sensor, ESP32 microcontroller, and Telegram Bot API. Each component works in a structured manner, starting from detecting the water distance, processing the logic of the danger status, to executing the sending of warning messages. These findings are in line with research stating that notifications via Telegram have a very fast and reliable response time, and which proves that the integration of ESP32 and ultrasonic sensors is capable of producing high measurement accuracy. Thus, the application of the IoT system in this study is able to help the public obtain early flood warning information more quickly and accurately without reducing the reliability of communication between devices in the field and the user's smartphone.

Conclusion

This research has successfully developed an Internet of Things (IoT)-based flood warning monitoring system utilizing the HC-SR04 ultrasonic sensor, ESP32 microcontroller, and Telegram application that is capable of monitoring water levels in real-time and sending early warning notifications automatically. Test results show that the system is able to read water levels accurately and classify water status into Safe, Alert, and Danger categories based on predetermined thresholds. In addition, warning notifications via Telegram Bot proved responsive with a message delivery delay of only seconds, while local actuators in the form of buzzers and LED indicators function well as audio-visual warnings at the monitoring location. These results indicate that this system can help the community and related parties in obtaining flood threat information more quickly, accurately, and efficiently without the need for continuous manual monitoring. Further research can develop the system by adding multi-parameter sensors (such as rainfall and current velocity sensors), integrating a web dashboard for historical data visualization, and conducting field testing on a wider scale to obtain more comprehensive evaluation results.

Thank-you note

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Bibliography

S. Febriani, M. Aziz Arrozaq, R. Nugraha, and A. Cipta Lestari, "Intelligent Flood Monitoring System Using IoT and Real-Time Notifications," Sains dan Teknol., vol. 8, no. 2, pp. 570–582, 2025, [Online]. Available: https://doi.org/10.55606/isaintek.v8i2.384

J. Ilmiah, T. Industri, M. Diki, and M. Rahman, "Implementasi Early Warning System (EWS) Banjir Berbasis IoT untuk Monitoring Kondisi Lingkungan dalam Mendukung Mitigasi Bencana di Indonesia dan menimbulkan dampak besar terhadap kehidupan masyarakat , baik berbagai perangkat untuk melakukan monitoring," vol. 4, no. April, 2026.

I. Talitha Putri, K. Fitriamalia, and W. Aji Pulungan, "Sistem Monitoring Ketinggian Air sebagai Pendeteksi Banjir Berbasis Internet of Things (IoT) dengan Eksperimental Kuantitatif Water Level Monitoring System as a Flood Detection System Based on the Internet of Things (IoT) with Quantitative Experimental Me," J. Armada Inform., vol. 10, no. 1, pp. 35–42, 2026, doi: 10.36520/jai.v10i1.222.

W. Faturochman, P. Dauni, E. Teguh Arujisaputra, A. Husain, and I. Abdurrohim, "Design of Flood Early Warning Monitoring System Using a Microcontroller Ultrasonic Sensor Based on Website and Telegram Chat Bot," JESII J. Elektron. Sist. Inf., vol. 1, no. 2, pp. 101–110, 2023, doi: 10.31848/jesii.v1i2.3358.

P. T. Wikantama and R. Puspitasari, "Perancangan Perangkat Pengukur Ketinggian Banjir dengan ESP32 dan Telegram Berbasis IoT," Elektriese J. Sains dan Teknol. Elektro, vol. 13, no. 02, pp. 107–114, 2023, doi: 10.47709/elektriese.v13i02.3108.

R. A. Subagia and I. Marodiyah, "Indonesian Journal of Innovation Studies," Indones. J. Innov. Stud., vol. 26, no. 1, pp. 1–14, 2025, doi: 10.21070/ijins.v26i3.2185.

A. Dauda, O. Flauzac, and F. Nolot, "A Survey on IoT Application Architectures," Sensors, vol. 24, no. 16, pp. 0–17, 2024, doi: 10.3390/s24165320.

T. Domínguez-Bolaño, O. Campos, V. Barral, C. J. Escudero, and J. A. García-Naya, "An overview of IoT architectures, technologies, and existing open-source projects," Internet of Things (Netherlands), vol. 20, 2022, doi: 10.1016/j.iot.2022.100626.

G. A. / L. Kumaran and J. Lias, "IoT-Based Flood Monitoring System using ESP32," Evol. Electr. Electron. Eng., vol. 5, no. 1, pp. 470–478, 2024, [Online]. Available: https://publisher.uthm.edu.my/periodicals/index.php/eeee/article/view/15390

S. Sujono and M. Rusli M, "Implementasi Sistem Peringatan Banjir Dini dengan Sensor HC-SR04 Berbasis ESP32 Internet of Things," Comput. J., vol. 4, no. 1, pp. 41–51, 2026, doi: 10.58477/cj.v4i1.385.

A. Wijaya and Rino, "Flood Monitoring Early Warning System using Internet of Things-based Telegram," bit-Tech, vol. 6, no. 3, pp. 281–286, 2024, doi: 10.32877/bt.v6i3.971.

M. R. Al Farabi and A. Sintawati, "Flood early warning system at Jakarta dam using internet of things (IoT)-based real-time fishbone method to support industrial revolution 4.0," J. Soft Comput. Explor., vol. 5, no. 2, pp. 99–106, 2024, doi: 10.52465/joscex.v5i2.293.

M. T. A. Susila, I. N. Firdaus, M. F. Chuzairi, and D. Rahmawati, "Flood Early Warning System Prototype Based on Ultrasonic Sensor and Internet of Things," J. Rekayasa Elektr., vol. 19, no. 3, pp. 100–106, 2023, doi: 10.17529/jre.v19i3.33147.

M. Siddique, T. Ahmed, and M. S. Husain, "Flood Monitoring and Early Warning Systems – An IoT Based Perspective," EAI Endorsed Trans. Internet Things, vol. 9, no. 2, pp. 1–10, 2023, doi: 10.4108/eetiot.v9i2.2968.

D. D. Ramadhiani, D. Dinda Ramadhiani, and A. Name, "2023, Flood Early Warning System Using Ultrasonic and Rainfall Sensors IoT-Assisted with Smartphone Display," J. Exp. Appl. Phys., vol. 1, no. 1, pp. 58–66, 2023, [Online]. Available: https://doi.org/10.24036/jeap.v1i1.4

https://doi.org/10.61536/ambidextrous.v5i02.658

Laily Rahmad Fauzi, Imam Suharjo, "Prototipe Alat Deteksi Banjir Berbasis ESP32, TinyML, dan Notifikasi Telegram," J. Kridatama Sains dan Teknol., vol. 8, no. 01, pp. 115–137, 2026, [Online]. Available: https://jurnal.umnu.ac.id/index.php/kst/article/view/2115

D. Yoga et al., "Perancangan dan Implementasi Sistem Pengukuran Ketinggian dan Volume Air pada Tandon Berbasis Sensor Jarak dan IoT dengan Monitoring melalui Aplikasi Mobile," J. Mech. Eng. Appl. Technol., vol. 4, no. 1, pp. 7–14, 2026.

Diono, Muhammad Syafei Gozali, and H. Tri Guntoro, "IoT Implementation in Water Level Monitoring System Using ESP32 and Antares Platform," J. Integr., vol. 18, no. 1, pp. 18–24, 2026, doi: 10.30871/ji.v18i1.12814.

A. Ovid, Efri Yandani, and Asril, "Prototype Sistem Pemantauan Tinggi Muka Air Berbasis Esp32 Untuk Sistem Pringatan Dini Banjir Melalui Telegram," JEKIN - J. Tek. Inform., vol. 5, no. 3, pp. 1081–1089, 2025, doi: 10.58794/jekin.v5i3.1634.

A. Ghazi, I. A. Syaputra, N. Salam, and K. Setiawan, "Implementasi Alat Pendeteksi Banjir Berbasis Internet Of Things Via Telegram Pada Kampung Pengarengan," INTECOMS J. Inf. Technol. Comput. Sci., vol. 7, no. 5, pp. 1509–1513, 2024, doi: 10.31539/intecoms.v7i5.11514.

A. D. Rakhman, I. K. Somawirata, and M. Ardita, "Flood Early Warning System with Notification Using Telegram Bot Based on IoT System," J. Electr. Eng. Comput., vol. 7, no. 1, pp. 206–216, 2025, doi: 10.33650/jeecom.v7i1.10850.

D. Aldi Romadoni, T. Umi Kalsum, H. Alamsyah, and U. Dehasen Bengkulu, "Ototype Deteksi Banjir Menggunakan Platform Thinger.Io Dan Notifikasi Telegram," J. Multimed. Dehasen, vol. 4, no. 4, pp. 845–858, 2025.

A. G. Lengkong, D. T. Salaki, and E. Alfonsius, "Implementation of An Internet of Things (IoT)-Based Water Level Early Warning System with Telegram Notification," vol. 6, no. 2, pp. 196–207, 2025, [Online]. Available: https://doi.org/10.33365/jatika.v6i2.349

P. Mahardhika et al., "Rancang Bangun Prototype Sistem Monitoring Ketinggian Air Sungai Berbasis Mikrokontroler ESP32 dan Telegram Sebagai Upaya Deteksi Banjir Secara Dini," Repositor, vol. 7, no. 4, pp. 537–548, 2025.

https://doi.org/10.61536/ambidextrous.v5i02.658