Automatic Flood Control

Art D. Abrera[1], James D. Blancaflor[2], David A. Delgado[3] Roilan I. Lagunero[4], Arjay P. Satorre[5], Nemuel S. Verdaluza[6], Engr. Bernard C. Fabro[7]

Computer Engineering Department, Eulogio "Amang" Rodriguez Institute of Science and Technology, Nagtahan, Sampaloc, Manila 1008 Philippines

DOI: https://dx.doi.org/10.51244/IJRSI.2026.13010062

Received: 07 January 2026; Accepted: 14 January 2026; Published: 30 January 2026

ABSTRACT

Flooding is a common environmental problem that can cause serious damage to property and pose risks to human safety. Effective flood management requires early detection and timely response to rising water levels. This project, entitled "Automatic Flood Control", presents an Arduino-based prototype system designed to monitor water levels and automatically control water pumps. The system uses a water level sensor to continuously detect changes in water height. When the water level reaches a predefined threshold, the Arduino activates a pump through a relay module to drain excess water.

The project emphasizes the practical application of electronics and programming in solving real-world problems. Students were able to integrate hardware components, write control software, and test the system under different scenarios. This hands-on approach enhanced understanding of automation, sensor integration, and system design. The project also highlights the importance of developing affordable solutions that can be scaled up for larger, real-world applications.

This project presents an Arduino-based prototype for automatic flood control, designed to monitor water levels and activate a pump when necessary. Using a water level sensor and relay module. The prototype demonstrates a simple, low-cost approach to flood management, with potential for real-life application if scaled with industrial-grade components.

Keywords: Automatic Flood Control, Water Level Sensor, Arduino-Based System, Flood Management, Pump Automation

INTRODUCTION

Flooding is one of the most frequent natural disasters, particularly in areas with poor drainage systems and heavy rainfall. It can lead to loss of property, disruption of daily activities, and danger to human life. Traditional flood control methods often rely on manual monitoring, which may not provide a fast enough response during sudden flooding events. This highlights the need for automated flood management systems.

Recent advancements in microcontroller technology have made it possible to develop affordable and efficient monitoring systems. Arduino microcontrollers are widely used in prototype development due to their simplicity and flexibility. By integrating water level sensors with an Arduino controller, flood conditions can be monitored in real time and appropriate actions can be taken automatically.

The Automatic Flood Control project aims to develop an Arduino-based prototype that detects rising water levels and automatically activates water pumps to reduce flooding. The system is designed to provide an immediate response when critical water levels are reached. While the project is intended as a prototype, it represents a practical concept that can be scaled and improved for real-world flood control applications.

Objectives Of the Study

The main objective of this project is to design and develop an Arduino-based flood control prototype that automatically responds to rising water levels.

The specific objectives of the study are as follows:

1. To design a flood monitoring system using a water level sensor and an Arduino microcontroller.

2. To detect changes in water level and identify critical flood thresholds.

3. To automatically activate a water pump when the water level reaches a predefined limit.

4. To reduce the risk of flooding through automated water drainage.

5. To demonstrate the feasibility of using low-cost electronic components for flood management applications.

REVIEW OF RELATED LITERATURE

Effective flood control in small watersheds requires integrated approaches that combine structural, nonstructural, and natural management strategies. Shuaibu et al. (2023) demonstrated the efficacy of a GIS-based integrated methodology for estimating flood peaks and designing structural flood control channels in a microwatershed in Nigeria. Their study utilized GIS, HEC-HMS, and HEC-RAS modeling to identify flood-prone areas and design a trapezoidal channel capable of safely conveying a 100-year return period flood. This approach highlights the significance of integrating spatial analysis with hydrological and hydraulic modeling for localized flood control planning.

Complementing this perspective, Jakubinsky et al. (n.d.) emphasized the role of small watershed management in flood risk mitigation. Their study focused on non-structural and semi-structural interventions, including landuse planning, retention enhancement, and watershed-scale management practices, which reduce surface runoff and downstream flooding. These measures underscore the importance of proactive, catchment-level planning in preventing flood hazards.

Sung et al. (2021) examined flood resilience under socio hydrological disturbances, assessing the long-term implications of structural flood control measures such as levees and reservoirs. The study revealed that although engineered interventions effectively reduce immediate flood impacts, they may inadvertently increase vulnerability over time by encouraging development in flood-prone areas. This finding emphasizes the need to integrate adaptive and non-structural strategies alongside traditional engineering solutions to enhance sustainable flood resilience.

Wilkinson et al. (2019) investigated Natural Flood Management (NFM) techniques, including leaky barriers, soil management, and floodplain reconnection, at small scales. While NFM interventions have proven effective in reducing peak flows within micro-catchments, the authors noted significant challenges in scaling these measures to larger watersheds. Their research highlights that NFM should be implemented in conjunction with engineered solutions to achieve optimal flood mitigation outcomes.

Collectively, these studies demonstrate that effective flood management in small watersheds requires a multifaceted approach, integrating structural engineering, watershed management, adaptive planning, natural interventions, and localized hydraulic storage. Such integrated strategies provide a robust framework for designing mini flood control systems that mitigate flood risks while ensuring environmental sustainability and long-term resilience.

Table 1. Comparison Matrix of Related Studies and Current Research about Mini Flood Control

Author(s) and Year	Study Focus	Methodology/ Approach	Key Findings	Relevance to Automatic Flood Control
Shuaibu et al., 2023	Flood estimation and structural control in a microwatershed	GIS, HEC-HMS, HECRAS modeling	Identified peak discharges; designed a trapezoidal channel for 100-year flood	Provides an example of integrating spatial analysis with hydrologic and hydraulic modeling for localized structural flood control
Jakubinsky et al., n.d.	Small watershed management for flood prevention	Watershed-scale non-structural and semi-structural interventions	Reduced surface runoff and mitigated downstream flooding	Highlights the importance of proactive watershed level planning and nonstructural measures
Sung et al., 2021	Flood resilience under socio hydrological disturbances	Socio hydrological modeling	Structural interventions reduce short-term flood impacts but may increase long-term vulnerability	Emphasizes combining adaptive strategies with structural solutions to improve long-term resilience
Wilkinson et al., 2019	Natural Flood Management (NFM)	Small-scale interventions: leaky barriers, soil management, floodplain reconnection	Effective at microscale; challenges exist in scaling up	Supports integration of natural and engineered measures for localized flood mitigation

METHODOLOGY

The materials and methods section, otherwise known as methodology, this describes all the necessary information and explains how the system works. This prototype aims to develop an automatic flood control system that detects water level and automatically control water pumps. The system is designed using an Arduino Uno R3 microcontroller as the central processing unit. A water level sensor is employed to continuously detect the water level in the designated area. When the water level reaches a predefined threshold, the sensor sends a signal to the Arduino, which processes the information and triggers a relay module. The relay acts as an electronic switch that powers the water pump, allowing it to turn on or off automatically without manual intervention.

The prototype is powered by a power supply (AC power source), which supplies electricity to all the components, ensuring the system operates continuously. The methodology involves assembling all components on a suitable platform, connecting the sensors and relay to the Arduino according to the circuit design, and programming the Arduino with code that dictates the system's response based on sensor readings. This setup ensures a fully automated mechanism where water levels are constantly monitored and controlled, thereby mitigating potential flood damage efficiently.

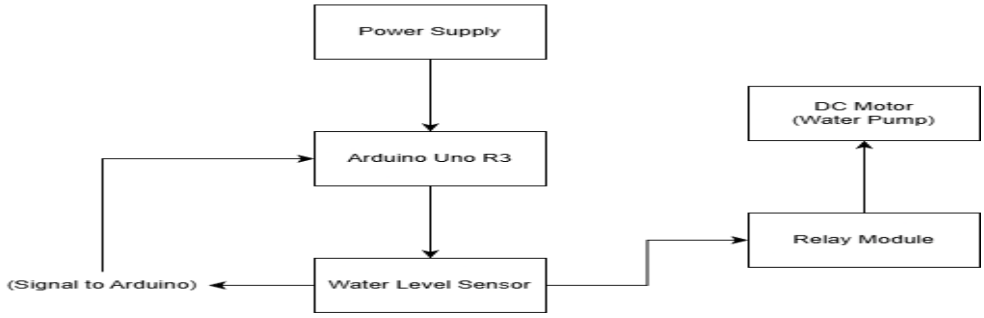
System Block Diagram

The system is powered by an AC power supply that provides electrical energy to all components, ensuring continuous operation. The Arduino Uno R3 serves as the main control unit, receiving input signals from the water level sensor, which detects changes in water level. Based on the sensor readings, the Arduino processes the data and sends control signals to the relay module. The relay module acts as an electrical switch that safely

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue I January 2026

controls the DC motor or water pump. When the water level reaches a predefined threshold, the pump is automatically activated to drain excess water, and it is turned off once the water level returns to a safe level. This automated process enables real-time monitoring and efficient flood control with minimal human intervention.

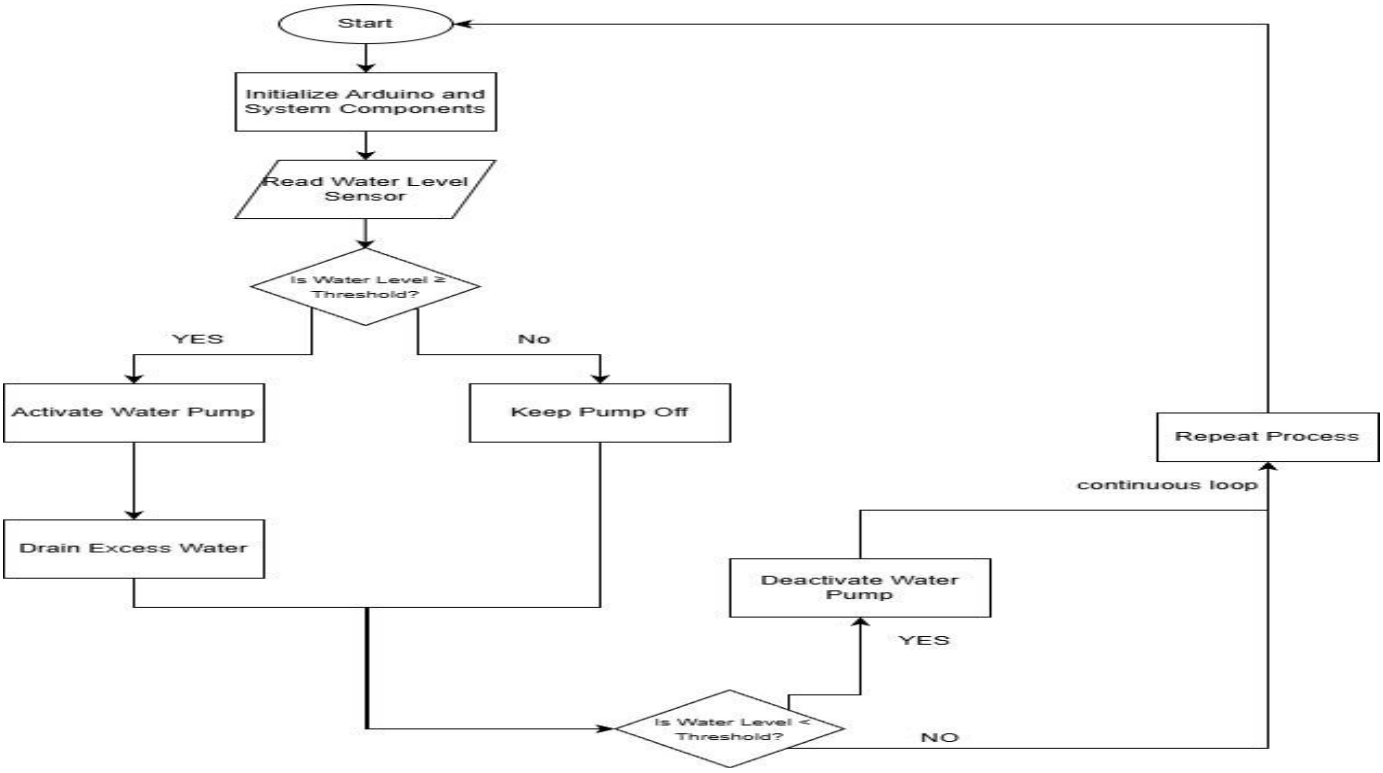
Figure 1. System Block Diagram of the Automatic Flood Control



System Flowchart

This flowchart shows how the automatic flood control system continuously monitors water level using a sensor and controls a pump via Arduino. If the water level exceeds the set threshold, the pump turns ON to drain excess water, and once the level drops below the threshold, the pump is turned OFF. The process repeats in a continuous loop to ensure real-time flood prevention.

Figure 2. System Flowchart of the Automatic Flood Control



System Setup

The automatic flood control system is implemented using an Arduino Uno, relay module, water level sensor, and water pump, all connected as shown in the Figure below. The water level sensor monitors the water height and sends signals to the Arduino, which processes the data and controls the pump through the relay to prevent overflow.

Figure 3. System Setup of the Automatic Flood Control

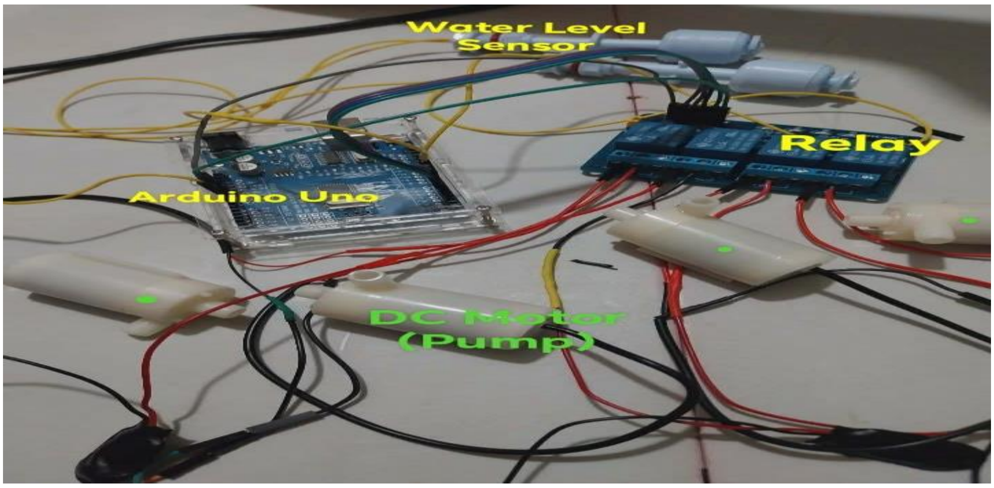


Figure 3 shows the system setup of the Automatic Flood Control prototype. It consists of an Arduino Uno as the main controller, connected to a 4-channel relay module that controls multiple DC pumps. Two float-type water level sensors monitor the water level in the system and send signals to the Arduino, which triggers the relays to turn the pumps on or off accordingly.

Figure 4. Schematic View

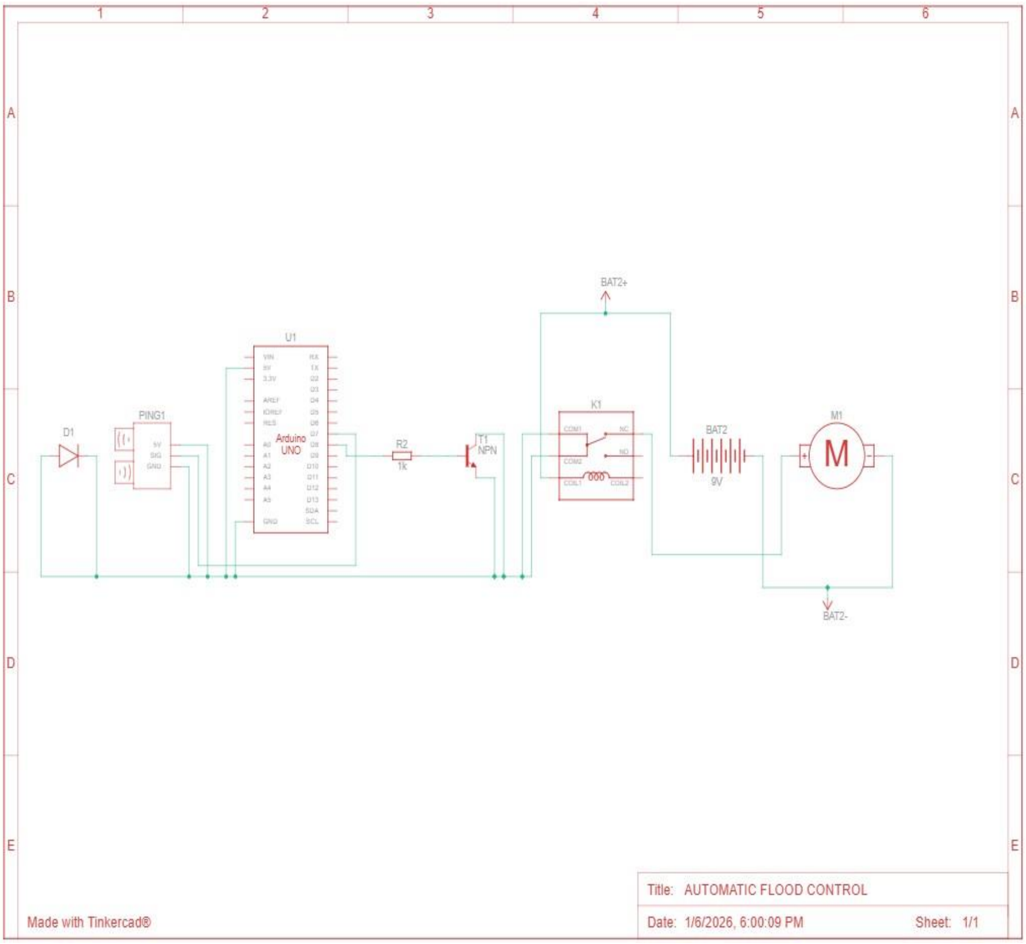


Figure 4 shows the schematic view of the automatic flood control prototype. For simulation purposes, replacement components were used due to component limitations in the simulation environment. A floattype water level sensor was replaced with an ultrasonic sensor, and a relay module was replaced with a bare electromechanical relay driven by a transistor and protection diode. These components provide equivalent functionality and allow accurate validation of the system's operational logic.

System Assembly and Setup

The prototype system was assembled by mounting the control components inside protective enclosures and connecting the necessary wiring. An AC power source was used to supply electrical power to the entire system through a regulated power supply unit. This setup was used to demonstrate and test the operation of the prototype.

Research Instruments

The following instruments and components were utilized in the conduct of the study. An Arduino microcontroller served as the primary control unit responsible for processing sensor inputs and controlling system operations. A water level sensor was used to detect and measure variations in water height. A relay module functioned as an interface between the Arduino microcontroller and the water pump, enabling safe and efficient switching. The water pump was employed to drain excess water once the predefined threshold level was reached.

Variables and Conditions

The study considered several variables and experimental conditions to evaluate the performance of the Automatic Flood Control System. The independent variable was the water level, which was continuously measured by the water level sensor and used as the primary input for system control. The dependent variable was the water pump status, which changed in response to the detected water level by activating when the threshold was exceeded and deactivating when the level dropped below the threshold. Controlled variables included the threshold level programmed into the Arduino, the power supply, and the Arduino and relay module, all of which were maintained at constant conditions to ensure consistent and reliable system operation. Extraneous variables such as environmental factors, including water turbulence, debris, and temperature variations, were minimized through proper sensor placement, regular maintenance, and controlled testing conditions. These measures ensured the accuracy, consistency, and repeatability of the system’s performance throughout the experimental trials.

Table 2. Variables and Conditions of the Automatic Flood Control

Variable Type	Variable	Variable Description	Condition / Measurement	System Response / Action
Independent Variable	Water Level	Height of water detected by the sensor, serving as the primary input to control the pump.	Measured continuously; pump activates automatically when water reaches the predetermined threshold.	Sends data to Arduino for processing; triggers pump activation when threshold is reached.
Dependent Variable	Water Pump Status	Operational state of the pump, which responds directly to water level readings to control water discharge.	Pump turns ON when water $\geq$ threshold and OFF when water $<$ threshold.	Activates or deactivates the pump to maintain safe water levels and prevent flooding.
Control Variable	Threshold Level	Predefined water limit programmed into the Arduino to ensure consistent and reliable pump operation.	Fixed during system calibration to maintain repeatable performance.	Determines the point at which the pump is triggered or turned off.
Control	Power Supply	Electrical source powering all system components, ensuring	Maintained constant to prevent fluctuations	Provides reliable power for continuous system operation and

Variable		stable and uninterrupted operation.	affecting sensors or pump.	isolates Arduino from motor power.
Control Variable	Arduino & Relay Module	Processes sensor data, executes programmed logic, and switches the pump on/off while isolating motor power for safety.	Operates continuously using Arduino logic; relay controls motor power.	Reads sensor inputs, executes control logic, activates relay to safely power pump only when needed.
Extraneous Variable	Environmental Factors	External conditions such as debris, water turbulence, or temperature changes that may affect sensor accuracy or pump performance.	Minimized through proper sensor placement, regular maintenance, and controlled testing conditions.	System performance may be slightly affected, but careful placement and maintenance reduce errors or false triggers.

RESULTS AND DISCUSSION

The system was tested ten (10) times to evaluate its response to varying water levels. During all test trials, the water pump consistently activated when the water level reached approximately 200 mL, indicating that the predefined threshold was accurately detected by the water level sensor. In contrast, when the water level was reduced to approximately 100 mL, the pump did not activate, confirming that the system correctly distinguished between threshold and non-threshold conditions. These results demonstrate the reliability and consistency of the automatic flood control system in responding only to critical water levels, thereby preventing unnecessary pump operation and ensuring efficient system performance.

The water levels of 200 mL and 100 mL are the threshold and non-threshold conditions of the system. The 200 mL level corresponds to the predefined activation point at which the pump is expected to operate, while the 100 mL level represents a safe water level below the threshold where pump activation is unnecessary. Using these two levels allowed clear evaluation of the system's decision accuracy, consistency, and reliability in distinguishing between critical and non-critical water conditions.

Table 3. System Response to Threshold and Non-Threshold Water Levels

Test #	Water Level(ml)	Observed Output	Expected Output	Pass/Fail	Remarks/Explanation
1	100 mL (below threshold)	Pump OFF	Pump should remain OFF	Pass	System correctly identifies nonthreshold condition.
2	200 mL (at/above threshold)	Pump ON	Pump should activate	Pass	Pump activated as water level reached threshold.
3	100 mL (below threshold)	Pump OFF	Pump should remain OFF	Pass	No unnecessary pump activation observed.

4	200 mL (at/above threshold)	Pump ON	Pump should activate	Pass	Consistent pump response at threshold level.
5	100 mL (below threshold)	Pump OFF	Pump should remain OFF	Pass	System remains idle under safe water level.
6	200 mL (at/above threshold)	Pump ON	Pump should activate	Pass	Reliable activation across repeated trials.
7	100 mL (below threshold)	Pump OFF	Pump should remain OFF	Pass	Threshold logic correctly enforced.
8	200 mL (at/above threshold)	Pump ON	Pump should activate	Pass	Sensor and relay respond correctly
9	100 mL (below threshold)	Pump OFF	Pump should remain OFF	Pass	Prevents unnecessary pump operation.
10	200 mL (at/above threshold)	Pump ON	Pump should activate	Pass	Confirms consistency and reliability of the system.

Future Improvements

To enhance the effectiveness and real-world applicability of the flood control system, several improvements may be considered. The use of waterproof and industrial-grade sensors and controllers would increase system durability and reliability. Higher-capacity pumps can be integrated to manage larger volumes of water. Adding a backup power source such as solar panels would allow continuous operation during power outages. Wireless communication modules may also be incorporated to enable remote monitoring. These improvements would help transform the prototype into a more robust flood management system.

CONCLUSION

The Automatic Flood Control project successfully demonstrates an Arduino-based prototype capable of monitoring water levels and automatically controlling water pumps. The system uses an Arduino Uno R3 to analyze data from a water level sensor and execute control logic to activate or deactivate the pump based on predefined thresholds. The software, written in Python, enables the system to respond quickly to changes in water levels, reducing the risk of flooding in monitored areas.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue I January 2026

Through testing, the prototype proved that automation and sensor-based technology can provide reliable flood management even at a small scale. Although the project is limited in size and scope, it clearly illustrates the potential of combining electronics, programming, and automated systems to address real-world environmental challenges. With further development, such as integration with higher-capacity pumps, wireless monitoring, and industrial-grade components, the system could be scaled for practical applications in flood-prone communities. Overall, the project highlights the importance of innovative, low-cost engineering solutions in promoting safety and minimizing the impact of flooding.

ACKNOWLEDGEMENT

First and foremost, we would like to express our sincerest gratitude to Engineer Bernard C. Fabro, our professor, for his invaluable guidance, support, and encouragement throughout the development of our prototype research entitled *"Automatic Flood Control."* His expertise and advice greatly contributed to the successful completion of this project.

Our heartfelt appreciation goes to our families, especially James Blancaflor's family, who graciously allowed us to conduct our prototype in their home and supported us throughout the process. Their understanding and cooperation were essential to the success of our project.

Lastly, we give our deepest thanks to our Almighty God for His unwavering guidance, strength, and blessings throughout this research. Without his wisdom and protection, we would not have had the patience, perseverance, and clarity of mind needed to complete this project.

REFERENCES

1. Jakubinsky, J., Bacova, R., Svobodova, E., Kubicek, P., & Herber, V. (n.d.). Small watershed management as a tool of flood risk prevention.
2. Kumar, G. N., Laya, M. C., Kumidini, P., Meghana, D., & Amruthavalli, K. (2024). Flood detection and monitoring using Arduino based sensor technology. i-manager's Journal on Embedded Systems, 12(2), 7–14. https://doi.org/10.26634/jes.12.2.20891
3. Linganagouda R., Avinash N. M., Anjali G., Nethravathi K., and Shivashankar N. Automatic Flood Gate and Flood Control System with Power Generation using ARDUINO UNO. Thesis. Dept of Electrical and Electronics Engineering, RYMEC College; 2020
4. Magnaye, A. A. B., Cruz, S. M. S. Reguyal, V. X. M., Ascaño ,A. J. L., Quilit, M. A.A., & Limos Galay,J. A. (2024). Automated flood water level sensor and alarm system using Arduino Uno. International Journal of Research Studies in Educational Technology. https://scholar.google.com/scholar?q=Automated+flood+water+level+sensor+and+alarm+system+usin g +Arduino+Uno
5. Patel, R. et al. (2022). Automated Flood Management System Incorporating IoT and Machine Learning. International Journal of Advanced Research in Computer Engineering & Technology. — Example of controlled variables and real-time response metrics.
6. Qinggong Ma, Bo Yang, and Jipeng Wang, Application of Internet of Things in Urban Flooding Prevention Management System, Scientific Research Publishing, Advances in Internet of Things, ISSN https://www.e3sconferences.org/articles/e3sconf/abs/2025/04/e3sconf_icdm2024_04004/e3sconf_icdm2 024_04004.html
7. Rosidin, M. K., Farhan, A. F., Ilman, S., Pradana, C. A., Hadi, B. D., & Kurnianingtyas, R. (2021). Design and construction of flood water level detector based on Arduino Uno. Journal of Applied Mechanical Technology. https://scholar.google.com/scholar?q=Design+and+Construction+of+Flood+Water+Level+Detector+B as ed+on+Arduino+Uno
8. Saragih, H., & Silaban, R. (2020). Design of automatic water flood control and monitoring systems. International Journal of Engineering Research and Technology. https://scholar.google.com/scholar?q=Design+of+Automatic+Water+Flood+Control+and+Monitoring+ System

9. Shuaibu, A., Muhammad, M. M., Bello, A. A. D., Sulaiman, K., & Kalin, R. M. (2023). Flood estimation and control in a micro-watershed using GIS-based integrated approach. Water, 15(24), 4201. https://doi.org/10.3390/w15244201
10. Sung, K., Jeong, H., Sangwan, N., & Yu, D. J. (2021). Effects of flood control strategies on flood resilience under sociohydrological disturbances. Water Resources Research, 57(10), e2020WR028378. https://doi.org/10.1029/2020WR028378
11. Utama, S. R., Firdausi, A., & Hakim, G. P. (2023). Control and monitoring automatic floodgate based on NodeMCU and IoT with fuzzy logic testing. Journal of Robotics and Control (JRC). https://doi.org/10.18196/jrc.v3i1.11199
12. Wilkinson, M. E., Addy, S., Quinn, P. F., & Stutter, M. (2019). Natural flood management: Small-scale progress and larger-scale challenges. Journal of Flood Risk Management, 12(1), e12505. https://doi.org/10.1111/jfr3.12505

About The Authors

Art D. Abrera is a third-year Computer Engineering student at Eulogio “Amang” Rodriguez Institute of Science and Technology with a focus on drafting and software. He enjoys programming and using digital tools for engineering projects. He wants to keep improving his skills and contribute to technology-driven solutions through practical experience.

James Blancaflor is a third-year Computer Engineering student at Eulogio “Amang” Rodriguez Institute of Science and Technology interested in innovative technology and engineering solutions. He wants subjects involving system design, electronics, and software. He hopes to use his skills to help develop technology that has a positive impact on people’s lives.

David Delgado is a third-year Computer Engineering student at Eulogio “Amang” Rodriguez Institute of Science and Technology who enjoys programming and software development. He likes courses related to coding and system analysis. He wants to become a software engineer and apply his skills to develop reliable and useful software solutions.

Roilan Lagunero is a third-year Computer Engineering student at Eulogio “Amang” Rodriguez Institute of Science and Technology. He enjoys hands-on engineering and problem-solving and participates in projects related to system design and electronics. He hopes to combine his technical skills with discipline to contribute to organized engineering projects in the future.

Arjay Satorre is a third-year Computer Engineering student at Eulogio “Amang” Rodriguez Institute of Science and Technology interested in technology innovation. His goal is to start his own tech business and create practical solutions that can make a difference in the engineering industry.

Nemuel Verdaluza is a third-year Computer Engineering student at Eulogio “Amang” Rodriguez Institute of Science and Technology. He is interested in circuits and electronics and enjoys working on activities involving circuit analysis and electronic design. He likes learning by doing and aims to use his technical knowledge to build practical and efficient engineering solutions.

Engr. Bernard C. Fabro is a Professional Computer Engineer and A Professor at Eulogio “Amang” Rodriguez Institute of Science and Technology. He has over 15 years of teaching experience in computer engineering, specializing in robotics, programming, and control systems. His research interests include automation, deep learning applications, and smart systems, with several published works in international conferences and journals.