



KEMENTERIAN PENDIDIKAN TINGGI

PITRAM 2026

Pertandingan Inovasi Antara Asasi Malaysia

Extended Abstract Book



11 dan 12 APRIL 2026

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KEMENTERIAN PENDIDIKAN TINGGI



MAJLIS DEKAN/PENGARAH ASASI
UNIVERSITI AWAM MALAYSIA

The Instant HydroWall

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ABSTRACT

Floods are a major concern in hydrology and civil engineering, causing loss of life, property damage and infrastructure destruction worldwide. Traditional flood defences, for example, sandbags, are labour-intensive, fragile and offer only short-term protection. This project introduces the Instant HydroWall, an automated flood barrier that harnesses hydrostatic pressure to deploy. A buoyant float attached to a watertight panel causes it to rise automatically as water enters an underground channel beneath the wall. The project objectives included designing this simplified wall, building a laboratory-scale prototype with an integrated sand filtration unit, and implementing an AI-based sensor-alert system. In the methodology, a Perspex prototype with silicone seals, tubing and an Arduino-based sensor array was constructed and tested by filling water under the wall. In experiments, the wall deployed successfully: as water filled the chamber, it rose instantaneously and smoothly, confirming the design's effectiveness. The built-in sand filter treated the diverted floodwater, and the AI-driven alerts, such as LED, siren, and SMS, were activated as intended. Overall, the Instant HydroWall proved to be a practical, sustainable flood protection solution, providing an automatic barrier, clean water output and early warning to enhance community safety. It is cost-effective, durable and low-maintenance, giving it strong commercial potential in residential, agricultural and industrial flood defence.

Keywords: Hydrostatic Hydro barrier, Automated floodwall, Sand filtration system, AI sensor-alert system, Resilient flood defence

1. INTRODUCTION

Flooding continues to threaten communities worldwide, with increasing frequency linked to urban growth, inadequate drainage and changing climate patterns [1][6]. Common defences, such as sandbag barriers, remain widely used but present clear drawbacks. They demand significant labour, take time to install and often fail under high water pressure, leading to leakage, structural collapse and environmental pollution [2]. These limitations highlight the need for more reliable and sustainable flood mitigation solutions.

Recent developments have focused on automated systems that respond directly to rising water levels. By applying hydrostatic pressure and buoyancy principles, flood barriers can deploy without external power or manual intervention, offering a faster and more dependable response [3]. At the same time, integrating water-level sensors and intelligent alert systems supports early warning and improves emergency preparedness [4][5]. Passive

filtration methods further enhance sustainability by reducing contamination from floodwater without requiring chemicals or electricity [7].

The Instant HydroWall is an automated flood mitigation system that overcomes these limitations:

A buoyant flood barrier rises on its own as water levels increase, driven by hydrostatic pressure and without manual effort or external power. A passive sand-filtration unit treats diverted floodwater (removing contaminants without electricity or chemicals), making the system sustainable and low-maintenance. Integrated water-level sensors and AI-based monitoring enable a staged warning system: when water reaches intermediate levels, yellow lights and intermittent buzzers activate; at critical levels, red lights, a continuous siren and SMS alerts warn residents and authorities for timely evacuation.

2. METHODOLOGY

The system, as shown in Figure 1, was built using a combination of simple materials and embedded electronics to demonstrate an automated flood response. A Perspex panel served as the main barrier, paired with a buoyant float attached to its rear. PVC tubing formed a narrow channel beneath the panel, with all joints carefully sealed using silicone to prevent leaks. At the outlet, a compact sand filtration unit was installed to trap debris and improve water quality.

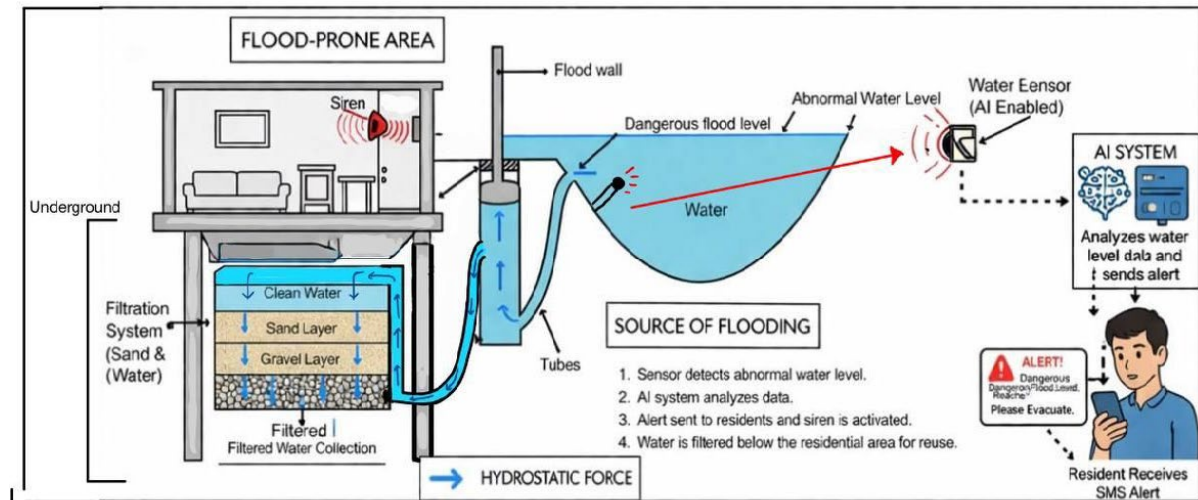


Figure 1. Instant HydroWall system

During assembly, Figure 2, the panel was positioned vertically within the channel, allowing it to rise freely as water levels increased. A base stopper ensured stability when no water was present. The entire setup was secured and tested by gradually introducing water, confirming smooth upward movement driven by buoyancy.

For monitoring, three water-level sensors were fixed at the low, medium and high chambers. These sensors were connected to an Arduino Uno, which controlled LEDs, buzzers and a siren to signal different alert stages. A GSM module enabled SMS

notifications at critical levels. The system was tested step by step to ensure each alert was triggered correctly as water levels rose.

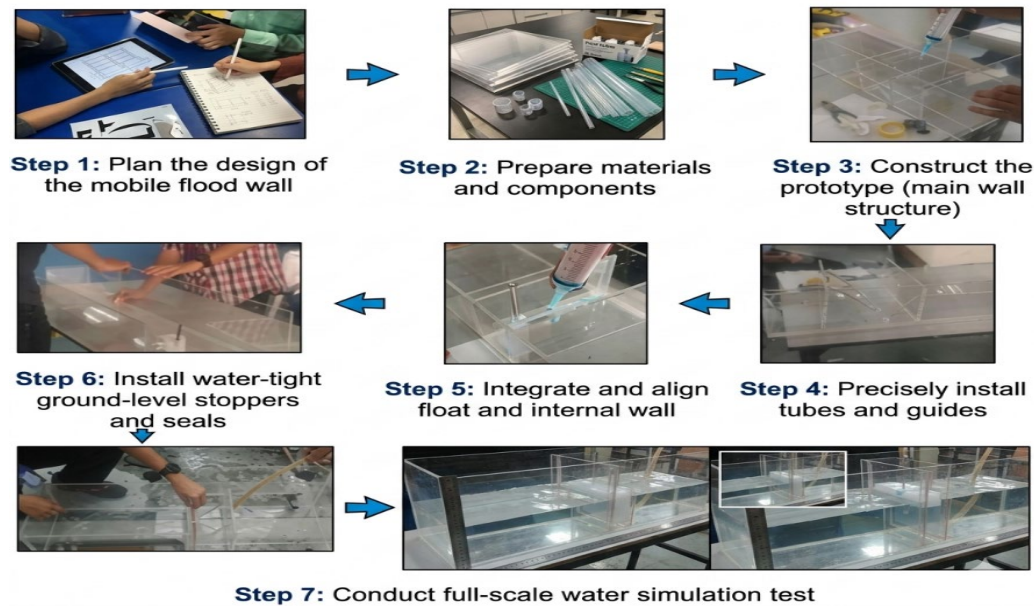


Figure 2. Construction of the Instant HydroWall

3. RESULTS AND DISCUSSION

Various volumes of water were used to determine if the wall would rise in accordance with the water flow. After testing, it was observed that when the water reached a dangerous flood level, it was channelled through the flowing underground tubes. Subsequently, the water filled the area under the wall, which was already equipped with a float. As a result, in Figure 3, the wall operated successfully and instantaneously as the water continued to fill the area. A smooth rising motion of the wall was achieved, indicating a direct proportionality between the wall's movement and the movement of water under the float.

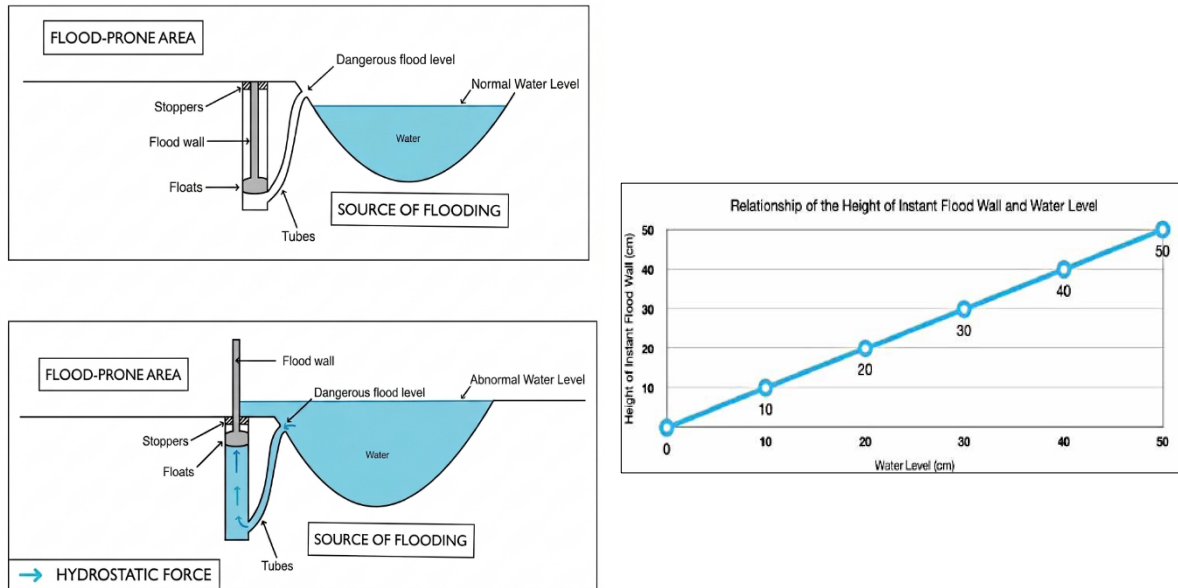


Figure 3. Relationship between the water level and the height of the Instant HydroWall.

4. CONCLUSION

The Instant Flood Wall demonstrates a practical improvement over traditional sandbag barriers through its automatic deployment using hydrostatic force. It rises instantly with increasing water levels, removing the need for manual effort or external power. The simple design allows easy installation in different settings, while the buoyant float ensures smooth and controlled movement. A built-in stopper enhances stability by preventing tipping when fully raised. The inclusion of a passive sand filtration system improves water quality without chemicals or electricity, and the monitoring system provides staged alerts and SMS notifications for timely response.

The system also shows strong potential for real-world application across residential, agricultural and industrial areas. It offers a cost-effective and durable solution with minimal maintenance requirements. Compared to sandbags, it provides more reliable protection and reduces environmental pollution caused by debris and waste. Its automatic operation improves response time during floods, while added safety and alert features increase user confidence. Overall, the Instant HydroWall presents a sustainable and practical approach to modern flood management.

ACKNOWLEDGEMENT

We would like to express our gratitude to Centre for Foundation Studies in Science of Universiti Putra Malaysia (ASPutra) for providing the resources and facilities required to complete this project.

REFERENCES

- Hosseini, S. A., & Ghasemi, A. (2020). Smart flood warning systems: A review of recent developments. *Journal of Hydrology*, 590, 125235.
- Kvočka, D., Falconer, R. A., & Bray, M. (2020). Flood hazard assessment for extreme events under climate variability. *Natural Hazards*, 104(1), 123–145.
- Morsy, M. M., Goodall, J. L., O’Neil, G. L., Sadler, J. M., Voce, D., Hassan, G., & Huxley, C. (2020). Design of flood warning systems for urban environments. *Journal of Hydrology*, 586, 124850.
- Shah, M. A., & Mishra, A. K. (2021). Application of IoT in flood monitoring and early warning systems. *Environmental Monitoring and Assessment*, 193(5), 1–15.
- Tellman, B., Sullivan, J. A., Kuhn, C., Kettner, A. J., Doyle, C. S., Brakenridge, G. R., Erickson, T. A., & Slayback, D. A. (2021). Increased flood exposure detected via satellite observations. *Nature*, 596(7870), 80–86.
- UNDRR. (2022). *Global assessment report on disaster risk reduction 2022*. United Nations Office for Disaster Risk Reduction.
- Zhang, Y., Li, X., & Wang, Q. (2023). Sustainable flood management using smart monitoring and automated barriers. *Water*, 15(4), 789.