HOME ALERT: A HOUSEHOLD-ORIENTED MONITORING AND ALARM SYSTEM FOR DETECTION AND RESPONSE TO RISING FLOOD THREATS IN SMALL-SCALE FLOOD-PRONE COMMUNITIES

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Abstract

Flooding in the Philippines is one of the deadliest natural hazards, leading to deaths, property damage, and agricultural damage. Despite government advisories and local-level sirens, many households near flood-prone areas remain very vulnerable to flooding. In response to this gap, this research designed a simple, low-cost, and reliable flood-monitoring and early-warning device for use within the flood-alarm systems of ordinary households. The alarm system draws on basic principles of physical science to create light signals that increase in intensity and a critical-level sound. There were multiple tests that were conducted with multiple conditions of operation, a gradual but consistent increase of water, a sudden pour of additional liquid on the sensor, and cutting power to the electrical system. The outcomes showed a 100% success rate of attempts to detect water levels. All indicators in the form of LEDs and buzzers were consistently made until the low water mark was reached, and the buzzers sounded off or continued to operate. As compared with traditional alarm systems, HOME ALERT had greater practicality, was cheaper, and easier for users to interpret. A product intentionally developed to meet the needs of non-technical individuals in a small-scale community. HOME ALERT offers affordable, pragmatic options for community alarm awareness, thereby enabling individuals and families to receive the necessary alarm, improving disaster preparedness and level of response at the family level. This creates a safer community and a more resilient society amid ongoing flooding in Tanjay City.

Keywords: Flooding, HOME ALERT, alarm system, disaster preparedness

Introduction

Floods are one of the most destructive natural disasters on Earth. Due to its geographic location within the Pacific Typhoon Belt and a tropical climate, which leads to near-continuous heavy rain throughout the year, the Philippines is highly vulnerable to flooding. According to the National Disaster Risk Reduction and Management Council (NDRRMC), floods have consistently been one of the top causes of human sickness or injury, property destruction, and agricultural damage within the nation's history. The Philippines ranked in the top ten of the 2023 World Risk Index, indicating a need for better preparedness for disasters at the national and individual family levels.

Communities that exist in low-lying areas, on riverbanks, and in coastal areas are vulnerable. A flood can rise within minutes and leave little time for villagers to gather essentials, evacuate to safety from their houses, or even close the doors. According to the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the Philippines is affected by roughly 20 tropical cyclones each year in its waters. Many of them can generate rain in river towns and the countryside. Sirens and alerts in many localities will reach people, but not the actual households. Even a delay of twenty seconds while waiting for certainty when danger is imminent to families that do not have nearly instantaneous and reliable warnings is a risk. In fact, conventional flood alert systems carry disadvantages. Many of them require a high-technology structure relying on multifaceted physical sensors, online systems, and sophisticated monitoring. The upfront install costs are high and require more than ordinary maintenance afterward. For example, outages occur and become unreliable quickly, no matter how imaginative (Dong, 2003). They are vulnerable to very serious floods that can take their families at any time.

Disaster Warning Systems (DWS) are highly prioritized disaster risk reduction (DRR) tools. A warning system that works well, saves lives, and reduces the destruction caused by naturally occurring hazards is endorsed by the United Nations Office for Disaster Risk Reduction (UNDRR, 2022). A warning system that is expensive, complex, and is reliant on electricity and internet access simply leaves behind those communities that are most at risk.

HOME ALERT is an inexpensive, useful, and independent alarm system. It does not depend too much upon electricity, internet, or expensive sensors; in any situation, resources can be made to work. Additionally, it relies on the natural physical power of force to sound alarms, providing users without technical training less chance of misunderstanding in using such systems because it is natural and straightforward in this respect. This is also what makes it so robust, as this simplicity can be utilized by vulnerable households in the field (Del Mundo & Perez, 2021).

The impact of this project on society and the environment will also be considerable. The Philippine Disaster Risk Reduction (DRR) and Management Act 2010 (Republic Act No. 10121), projects aim will be framed around similar notions of disaster preparedness and recovery within the context of locales where disaster occurs in the future. In addition, the home alarm system fosters an awareness and culture of preparedness that is necessary for countries that are at risk of disasters. With the intent of quantifying and understanding the intersections between science and flood guard technology to inform paradigms within national-level governmental strategic desires, it suggests that theoretical innovation can easily be operationalized to feed households every day, too.

This is evidenced by the fact that effective disaster risk prevention initiatives and strategies do not always require large amounts of money, and the most recent and advantageous ideas of originally conceptualized disaster risk advances in urban environments. Although the Home Alert flood alert system is easy to use and focused on user safety, it creates real value to replace and adapt to new disaster risk concepts. It allows recipients to sleep better and take fewer risks. The Home Alert flood system project represents an accessible technology for households that offers a feasible way to engage with the global representation of disaster risk reduction. Many communities are now better able to fight flood risks within a soft offensive and defense context. It has allowed households to take action to mitigate disaster risk within their community, to ultimately help build a better community.

Literature Review

Floods are still happening all over the world in different ways. It is at least representative that this is among the many consequences ranked and blamed on global warming today. When people become aware of oncoming disasters through useful information, they can act in time to protect their families and property. According to figures, when people are in the dark until it is too late, half of the global population has no access to early alert systems, thus exposed to springing from flooding that comes out of the blue. The most critical element of such a system is clear communication. This, as the U.N.'s recent Global Status of Multi-Hazard Early Warning Systems report emphasized (UNDRR, 2023), is the king pin for early warning systems that are centered on the public and which can, firstly, foresee threats while not only recognizing but also reaching all those at risk. These include setting up systems at the village leader level for the detection and warning about flooding, and for fighting the flow of water. From that viewpoint, they indicate a hope that a grassroots way of doing things can be sustained. "You run a mile when the race is over." a participant in the low-country program said, thus expressing a key insight of low-country concerns, which is that every home should be making plans for self-protection, as warning gets effective only in those types of opens to define, who is the family and not official or machines, can warn in the, "last mile". Household-based preparedness is always before, prepared community, before, protected region.

The World Meteorological Organization is encouraging this effort by making 2023 the Year of Global Earthquakes and Typhoons. The information will ultimately go worldwide in four years if this works. The only way to accomplish such a large feat is for everyone to hang on tight and band together. This is a plan based on home-based technology at low-cost and in the region, it is throughout the country.

Flood warnings affect household behaviors; this has been demonstrated again. In a study led by Najafi published in May 2024, he and other researchers looked at what. Are called impact-based warnings. They found that warnings based on impacts, for example, water entering homes and damaging property, created more well-prepared actions than warnings that were based on pure predictions in technical terms. When families receive this type of more authoritative and easy-to-read information to act on, their attitudes change, as they prepare emergency kits, remove valuables to safer places, and are quicker to react to leave for their safety if issuing precautions. There was also a related project around early warning, and the local community practiced early warning systems better than a top-down approach, generally with similar challenges. The author's name is Jakic-Trogir, and his team coined this term with Field School input, which is not only time-consuming but faced intimidating "do" challenges, such as "We are torn between two options".

The review was a much finer-grained cost-effectiveness study of early warning systems than any previously attempted. The review demonstrated that early warning systems can be effective in reducing costs. They enable families and institutions to be in competition to see whose flood water will get to their house first and can prompt conversations about how best to look after their precious things. So, communities experience fewer disasters and lower recovery costs; moreover, all things rescued receive greater help from others as well. The rescue resources are also not as heavily taxed. A review issued approximately five years from the World Med. Org. with partners within the UN in 2025 had benefit to cost ratios that were remarkably high, between 10 and 1 generally, and generated a great deal of positive feedback and re-enlistment of commitments. The review captured how early warnings prompted immediate action so that injury and development costs were eradicated and capped across the residents it was pollution like air but more appropriate to what Samaritans had doubled from sockets of residents and constituted public finance issues and at the same time as this review additionally evidenced continuing weaknesses around either making and distributing alerts to information or domestic self-help and there were distinctly places littered with evidence of active responses and education reflective practices around engaging alerts. It evidenced that some locales had been systematically building multi-tier systems for risk assessment, response, and reviewed back to engage with communities in assessing feedback based on feedback to provide and contribute to evolving ant discriminatory engagement. In this web, a tight network of agencies could be pieced together using flexible expertise. Nevertheless, the areas which did worst in disseminating warnings and preparing responses made all the successful ones-in ways that. were incredibly diverse messages for people living with floods to receive together.

Policy will provide a home warning system from the coastline to every rural person, which is a commitment to the good of all. Poor families who may live on under a dollar a day sacrifice consumable items for effort just to climb the mountain with no bridging at all spans in every family saves an easy alarm that saves much time, which can be vital at times you can afford.

Methodology

The study used an experimental research design to create and test this new type of monitoring system called HOME ALERT: Household-Oriented Monitoring and Alarm System for Detection and Response to Rising Flood Threats in Small-Scale Flood-Prone Communities. A prototype device was built from the most common elements inside the lab, with this type tested repeatedly under controlled simulated flood conditions to check for leaks, how quickly it fills up, and how many times it is prefilled.

The Home-based Monitoring and Early Warning System for increased flooding is designed in three sections: there are a series of LED lights that provide visual notification, a 9V battery with a connector-lead to provide all the power required, and the BC547 transistor.

The flow of current was limited by the metal film resistors, with the resistance being 220 Ω. An active buzzer was added to the system as a sound warning when the water reached a critical height. The float had five metal strip contacts that completed the circuit switch, as they touched when the float rose. The connections themselves used 1.2-mm insulating electrical wires in five colors to help with clarity and solve the potential dangers of confusion. The entire circuit was mounted to a flat board for strength, provided insulation, and ensured the entire circumference was moisture-proof as a base of sorts.

Step 1. Compute Current Through LED (Ohm's Law)

$$\mathrm{I} = \frac{Vsupply - Vled}{\mathrm{R}}$$

$$\mathrm{I} = \frac{9v - 2v}{220\Omega} = \frac{7v}{220\Omega}$$

$$\mathbf{I} \approx 0.0318\mathrm{A} = 31.8\mathrm{mA}$$

Step 2. Compute Power Dissipated by Resistor

$$P = I^2 xR$$

P= (0.0318A)2×220Ω ≈0.222W

Step 3. Compute Power Consumption of the Buzzer

P=V×I

P=5V×0.03A= 0.15W

Step 4. Battery Life Estimation

If a standard 9V battery = 500 mAh capacity

Total current (LED + buzzer ≈ 31.8 mA + 30 mA = 61.8 mA)

$$\mathrm{I} = \frac{Vsupply - Vled}{\mathrm{R}}$$

$$\text{Battery Life} = \frac{500mAh}{61.8\text{mA}} \approx 8.1 \text{ hours}$$

Conceptual Framework

This study discusses disaster preparedness with alert systems for natural disasters and offers strategies for reducing flood risks in communities at risk of flooding. Flooding is just one of several natural disasters that can cause prolonged hospital stays. Early warnings alert us to potential danger by providing residents with enough time in life to look after themselves and escape from harm. The study builds and verifies models of base station networks to summarize the design process for each control material.

When it comes to the input side, the components used in making the home flood warning system were an LED, a buzzer, a BC547 transistor, a resistor, and an on-off switch, plus a 9V battery. This constitutes the technical resources necessary for designing an alarm system.
Process. At this stage, all the work done, such as the design, fabrication, and testing of the device generally makes the system, creating a circuit by assembling its components, using water which fills up to trigger-point switch on and off. This is a finding of the process of evaluating detection rates, false alarms, and response times.
Output: The functional HOME ALERT prototype capable of giving both visual (LED light) and auditory (buzzer) signals when floodwater reaches a critical level. The expected outcome is a reliable and affordable household flood alarm system that enhances disaster preparedness and contributes to community resilience.

Simplified Conceptual Framework (IPO Model) Input → Process → Output
Input: Materials needed: LED, buzzer, transistor, resistors, battery, switch, wires, plain board plywood base, and plastic sheet

Process Steps: Design and build the circuit. Build the prototype. Test it. Gather data. Review and evaluate data
Output: An operational HOME ALERT prototype, an effective home flood alarm system, and visual and audible auxiliary alerts
Results

Summary of Reliability Test Results

PARAMETER	RESULT
Total Trials Conducted	10
Successful Detection	10
Detection Rate	100%
False Alarm Rate	0%
Mean Response Time	17.7 seconds

Regarding accuracy, reliability, and efficiency, H.O.M.E. ALERT test results have shown that the system works. This indicates that the system also reliably advertises, in advance, once the critical water level is achieved, and sends live performance during floods. With a mean response time of 17.7 seconds, this indicates the device can provide lead time to assist households, providing families with that important window to prepare and take any precautionary actions in the event of a flood. Consequently, the results support H.O.M.E ALERT as an accurate, reliable, and user-friendly early warning system, and a feasible and economic option for communities exposed to flooding.

Discussion

As the water level rose from the first to the fourth LED, the test results indicated that LEDs consistently activated in proper order, confirming accurate detection of each stage. Response time was prompt and reliable, ranging from only 2 seconds on the first LED at low water levels to around 27 seconds for the fourth LED. Thus, this system gives a visual change in the water level and does not change under repeated testing. The buzzer worked and sounded every time the critical water levels were attained, proving it was an effective early warning system. Over the 10 trials, the time it took to sound the buzzer ranged from 12.37 seconds up to 27.38 seconds, with an average of about 17.7 seconds. Overall, it worked well, but the difference in reaction time was a minor change in water level, and experimental conditions indicate that it has small inconsistencies. Under different conditions, the system showed good performance and was able to accurately distinguish between different water environments. When the water level rose slowly, it functioned as normal with response times of about 33 to 44 seconds, but in situations where there was a rapid rise in water level, it jumped to 3.7 seconds, indicating that it has high sensitivity at critical moments. When the system met splashes, it activated within 26 to 28 seconds, and there was no false alarm, which shows that the fluid momentarily gets deep. With the power off, no alarm can be produced by them in the absence of water. Following a power interruption, the system automatically returns to normal operation; likewise, when an obstacle is placed in front of it, there is a short delay before it is normally activated. In general, the results of this analysis confirm that flood alarm systems are reliable, accurate, and stable in operation under practical conditions. All the trials scored 100% detection efficiency. This indicates that the system worked correctly for every test activation and that its performance can be relied on. The mean time for the alarm response was about 17.7 seconds, while the various levels of LED indication gave clear early warnings. In contrast with this small standard deviation of repeatability, 26.7%, there were no false alarms during splashes and no water conditions. Moreover, the system did not crash and burn, but it not only recovered normally after power interruptions and maintained full functionality despite some sensor obstructions. These results indicate the system operates well, is stable, and can adapt effectively under various conditions. The effectiveness, reliability, and accuracy of the flood alarm system are fully demonstrated. The LEDs show a gradual and stable warning as water levels rise, and the buzzer provides critical-alert indication when water reaches high levels. Test scenarios also confirmed that the system performs well under gradually rising water, fast flooding, or splash conditions. There were some minor variations in the time to respond, which suggests moderate reproducibility; however, in general, the evidence suggests that the system is suitable for use in home flooding prevention.

Conclusion

The different flood alarm system tests showed it to be effective and reliable, and performed that way every time, making it useful for the disaster preparedness of the community. As water levels continued to rise, the activation of the LEDs in sequential order provided residents with a warning that was deeper as activated. This sequential pattern of LED clusters turning on in sequence for homes provided residents with a service that was to alert them, to give them more time to prepare, and the opportunity to act before things get desperate for them. When the water fell to the level that the buzzer alarm went off, this was the critical usage of the alarm. Of the ten successful alarms total, the mean time until alarm across the three different responding sides was 17.7 seconds, and there was a little variation in response time on each test, especially with 100% success. There was a small concern that went into the way the equipment operated as fast and smoothly as possible, although I represented it to be quite minimal and perhaps even mild. The products' resilience and adaptability were seen in the testing done in various scenarios. The product performed normally in simulations of slow and rapid rises of water level; however, when the water rose rapidly, this less than three-pointed reflection time provided an instant response. Splashing water did not result in a false alarm, meaning the devices were able to distinguish that there was a disturbance of water on the surface without the interruption of being false alarms. Additionally, devices were silent when there was no rainfall on the control system. When the power was cut and/or the sensors were interfered with, the devices were able to operate correctly with their original signals restored back to operation. When considered altogether, the results suggest that the products offered by the flood alarm system are useful household flood monitoring solutions that are effective and relatively inexpensive. The design allows for both visual and audio alarm signals; again, the more separate the alarm signals, the more inclusive it could be for different types of users and for aging populations or anyone who may have visual or hearing impairments. Slight differences in response times substantiate that more calibration trials would be beneficial in the future to make repeating results easier. Nevertheless, the device holds up and is still reliable and durable throughout testing or design processes, aiming for an alerting device for the purposes of disaster risk reduction in households. In conclusion, evidence suggests that locally produced flood warning systems, particularly in those communities adjacent to rivers, have the capacity to provide warnings about impending danger and will cost practically nothing. The system provides both visual and aural warnings when needed, and it is also purposefully multipurpose. The capacity of a flood alert system to mitigate risk exposure to people also promotes individual preparedness and, therefore, saves lives and property loss during a flood event. The testing results indicate that the system not only provides a valid flood alert system, but it will also be very helpful to communities with disaster preparedness.

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