IOT-BASED MITIGATION SYSTEM WORKSHOP AND FLOOD DISASTER MANAGEMENT EDUCATION FOR RESIDENTS OF PEDURENAN, TANGERANG CITY

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ABSTRACT

Pedurenan Urban Village, Karang Tengah Sub district, is one of the most flood-prone areas in Tangerang City, often resulting in significant material losses. Effective flood disaster management and mitigation are urgently needed to reduce the negative impacts of flooding in this region. Therefore, a solution is required to ensure that residents are better prepared and more responsive to flood events. The objective of this community service program is to enhance public awareness and capacity to address flood disasters through IoT-based flood mitigation workshops and disaster management education. This activity provides both theoretical and practical knowledge to the community on effective mitigation strategies. The methods include workshops on IoT-based mitigation systems, interactive discussions, and simulations. The program focuses on introducing disaster mitigation concepts, identifying flood-prone areas, and practicing safe evacuation strategies. Field simulations reinforce participants' understanding through hands-on practice in near-real flood scenarios. The role of Universitas Budi Luhur is to raise awareness and build community preparedness for flood prevention in Pedurenan Village. The expected output includes a simple IoT-based flood mitigation tool that can serve as an early warning system, as well as academic contributions such as scientific publications, technology-based products, and intellectual property rights (IPR).

Keywords: Mitigation, IoT, Disaster Management, Flood, Early Warning.

1. INTRODUCTION

Karang Tengah District is one of the districts in Tangerang City with an area of 9.43 km^2. Based on data from Satu Data Kota Tangerang, Karang Tengah District does not yet have a disaster mitigation system that includes: a natural disaster early warning system, safety equipment, signs and disaster evacuation. However, there are already 4 sub-districts that have normalized rivers, canals, embankments, ditches, and drainage. Pedurenan Village, which is part of Karang Tengah District, has the smallest sub-district area with an area of 0.95 km^2.

This area is one of the locations frequently hit by flooding, as seen in Figure 1. One of the main causes of flooding is water flowing from upstream to downstream, as well as the condition of the Angke River retaining wall, which is unable to accommodate the water flow. Furthermore, a lack of green space is also a contributing factor to flooding in several areas. While vacant land is necessary to absorb water, the current situation is that more and more land is being built on.

Figure 1. Flood conditions in Ciledug Indah during July 2022 (Source: tvonenws.com)

Given the conditions mentioned above, flood mitigation facilities and education on steps that can be taken by the community to reduce the impact of flooding are urgently needed. Several studies and community service programs have been conducted related to IoT-based flood prevention and early warning systems (Najib, Nurcahyono, &

Metandi, 2022), including those using Arduino as a microcontroller. Flood mitigation education has also been conducted in several cities, namely Pekalongan City (Ilyas, Setiawan, & Binabar, 2020), Manado City (Katuuk, Makal, Pongoh, & Noya, 2020), Sedau Village (Kayohana, Switrayana, & Alfiansyah, 2023), and Tanjung Selamat city (Pujiati, Syarifah, Dalimunthe, & Ablisar, 2022).

The role of various parties in overcoming flood problems is very necessary, one of which is the role of universities, namely developing research and innovation as well as community service as alternative solutions to disasters, especially at the prevention and preparedness stages.

Based on the description in the situation analysis section, there are two partner problems that are the focus of the Community Service program which involves Electrical Engineering and Disaster Management science to be able to overcome existing problems, namely as follows:

a. Weather and heavy rainfall, which often cause flooding, often come suddenly. According to data from the 2022 Karang Tengah District Sectoral Statistics, the district does not yet have a disaster mitigation system.
b. Moderate to heavy rainfall can cause flooding, which can be detrimental to residents. Many residents lack the knowledge and understanding of flood prevention and management.

2. METHOD

The method for implementing Community Service activities consists of three stages, namely the preparation stage, the implementation stage, and the monitoring and evaluation stage.

Preparation stage

Based on the partner's request for a solution, a site survey was conducted to directly assess the condition of the project site. Following the site survey, the team held discussions and coordination with officials from Karang Tengah District and Pedurenan Village. The next phase involved preparing to purchase equipment and materials for the IoT system for flood mitigation, as well as preparing educational materials.

Implementation Stage

The implementation phase consists of two main parts: a workshop on developing a flood mitigation system and a flood management education program. School-aged students will participate in assembling the flood mitigation IoT system, which consists of several components, such as sensors and microcontrollers. This simple system can detect water levels, assumed to be floodwaters beginning to inundate homes. The system is connected to the Blynk application via the internet. If water appears or reaches a certain, adjustable height, users will receive a flood warning notification via the Blynk application. The required tools and components are shown in Figure 2. The flood disaster management agenda includes education on how to mitigate flooding at home using bio pores. The IoT-based flood disaster mitigation system consists of the following tools and components:

1. Sensor ultrasonic HC-SR04
2. ESP 8266
3. Jumper cables
4. Battery

Figure 2. ESP 8266 and HC-SR04 Ultrasonic Sensor.

Monitoring and Evaluation Stage

The monitoring and evaluation stage was carried out to assess the effectiveness of the community service activities. Monitoring was conducted during the implementation to ensure that the workshop and education program ran according to plan. Evaluation was carried out through participant feedback surveys, observations, and question and

answer sessions to measure the level of understanding and skills gained. The results of this evaluation provide input for improving future activities and ensuring that the program's objectives were achieved.

3. RESULTS AND DISCUSSION

The community service activity that has been carried out is a collaboration between a team of lecturers and students from the Electrical Engineering Study Program, Faculty of Engineering with the Disaster Management Study Program, Faculty of Economics and Business, Universitas Budi Luhur. The location of the activity is at the Pedurenan Village Office, Karang Tengah District, Tangerang City, Banten. The topics raised in the community service activity are increasing insight and skills in IoT-based mitigation systems and flood disaster management education. This activity was attended by two age groups: students (high school/vocational school)–College) and working age citizens.

The series of events began with remarks by the Head of Pedurenan Village, Mr. Abdurrahman, S.IP and the Secretary of the Village, Mr. Suyitno, SH.,MAP After the welcoming ceremony, residents were divided into two large groups. The first group was a group of school-age residents who participated in a training workshop on creating a simple IoT-based flood mitigation system guided by Nifty Fath, ST, M.Eng and Peby Wahyu Purnawan, ST, MT, and the second group was a group of working-age residents who participated in flood disaster management education guided by Ayu Wahyuningtyas, ST, M.Sc. Documentation of the community service team, the Head of Pedurenan Village, the Secretary of Pedurenan Village, and workshop participants can be seen in Figure 3.

Figure 3. Group Photo of Workshop Participants

Flood Mitigation System Development Training Workshop

The training on creating a simple IoT-based flood mitigation system began with an explanation of the tools and components. The student team also guided the participants in designing the system. The first step was to install the Arduino IDE on a laptop and install the Blynk application on the participants' mobile phones. The list of programs prepared by the team was first studied by the participants. After designing the software, the participants designed the hardware consisting of an ultrasonic sensor, ESP 8266, jumper cables, a Micro USB uploader cable, and a battery. A water reading simulation was carried out with a container filled with water. Participants set the desired water level. The ultrasonic sensor reading results will be processed by the ESP 8266 and sent to the Blynk application via the internet. When the water level has reached the maximum limit, a notification will appear in the Blynk application. This system can be used as a flood mitigation simulation. The workshop activity concluded with a feedback survey and a question and answer session with participants.

Questions and sample responses to the feedback survey are shown in Figure 4. Based on the participants' answers, 66.7% of participants understood the concept of IoT and the applicative functions that can be performed with IoT. On the other hand, 100% of participants understood how sensors work and the concept of flood detection devices. During the Q&A session, participants who answered the team's questions received door prizes. Overall, the workshop ran

smoothly, and participants participated enthusiastically. The presentation and simulation of IoT are shown in Figure 5 – Figure 8.

Nama : Rayan Adi Saputra

Workshop Peningkatan Wawasan Dan Keterampilan Sistem Mitigasi Berbasis IoT Dan Edukasi Manajemen Bencana Banjir Pada Warga Kelurahan Pedurenan, Kecamatan Karang Tengah, Kota Tangerang
Kamis, 04 Juli 2024

Post-test

1. Apakah Anda mengetahui apa itu Internet of Things?
   a. Ya b. Tidak
2. Apakah Anda mengetahui fungsi aplikatif yang dapat dilakukan dengan IoT?
   a. Ya b. Tidak
3. Apakah Anda mengetahui cara kerja sensor?
   a. Ya b. Tidak
4. Apakah Anda mengetahui bagaimana konsep alat pendeteksi banjir?
   a. Ya b. Tidak
5. Apakah mengetahui aplikasi untuk monitoring aplikasi IoT?
   a. Ya b. Tidak

Figure 4. Sample Feedback Survey Answers

Figure 5. Presentation on IoT by Nifty Fath, ST, M.Eng

Figure 6. Presentation regarding IoT Tools and Components by Peby Wahyu Purnawan, ST, MT

Figure 7. Training on Creating A Simple Flood Disaster Mitigation System

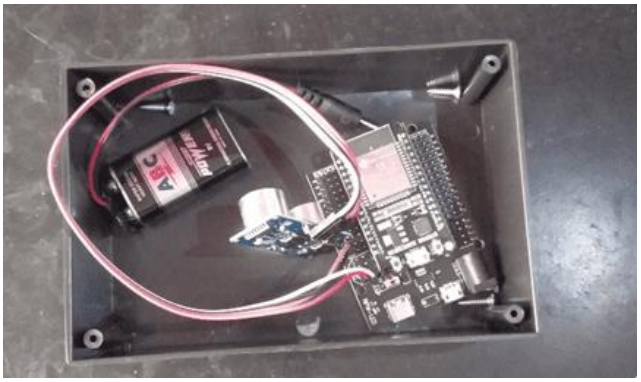

Figure 8. Simple IoT-Based Flood Disaster Mitigation System Tool

Flood Disaster Management Education

The working-age group of participants was educated on flood disaster management. The presentation session began with a two-way discussion with residents regarding the challenges they face in flood mitigation, as shown in Figure 9. The discussion revealed that some residents had already used biopores, while others had biopores but had never used them at home. Several years ago, the Ministry of Environment and Forestry (KLHK) launched a program to procure thousands of biopores. However, many residents did not receive biopore equipment, and the program was not followed up. The community service team then explained in detail how biopores can be used to reduce flooding, store infiltration, and compost. The residents learned that biopores can be used for composting.

The residents were explained the composting process, which has a positive impact on soil fertility. This increased their enthusiasm, as many enjoy caring for plants. The team also explained the ideal depth of biopores, how to create them, maintenance during the rainy and dry seasons, and modifications to the ideal and efficient placement of biopores to reduce flooding. A demonstration of the biopore installation process is shown in Figure 10. The disaster management education activity concluded with a question-and-answer session and the awarding of door prizes, as shown in Figure 11.

Figure 9. Discussion And Education on Flood Disaster Management With Ayu Wahyuningtyas, ST, M.Sc

Figure 10. Biopore installation practice

Figure 11. Community service team together with workshop participants

4. CONCLUSION

The community service program successfully enhanced residents' knowledge and practical skills in flood disaster preparedness. Through IoT-based mitigation workshops, school-age participants gained hands-on experience in assembling a simple flood detection and early warning system, while working-age residents improved their understanding of flood prevention techniques such as bio pore utilization. The results showed that participants could comprehend the basic concepts of IoT and apply them to real-life flood mitigation, while also recognizing the

importance of simple household-scale interventions. The combination of technology-based solutions and community education fostered active participation and enthusiasm among residents. In conclusion, this program demonstrates that integrating IoT-based early warning systems with community-based disaster management education can significantly improve flood preparedness in vulnerable urban areas. Such initiatives can serve as a model for other flood-prone regions, contributing to sustainable disaster resilience and risk reduction.

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