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Capacity Building of Majalaya Village through Training on Designing Flood Detection Systems for Village Youth in an Effort to Mitigate Flood Disasters

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ABSTRACT

Flooding remains a significant issue in Majalaya Village, Bandung Regency, West Java, due to its geographical location near the Citarum River. This community service project aimed to enhance disaster mitigation efforts by training village youth to design and implement a flood detection system. The system utilized ESP32 microcontrollers, infrared sensors, and solar-powered technology to provide early flood warnings. Through a structured training program, participants gained practical skills in assembling, installing, and maintaining the system. The project emphasized community ownership, ensuring sustainability and fostering collaboration among local stakeholders. Evaluation results indicated high participant satisfaction and confidence in system operation, though follow-up support is recommended for long-term success. The initiative in flood detection and disaster preparedness serves as a potential model for other flood-prone regions seeking sustainable, community-driven solutions for effective disaster mitigation.

Keywords: *Flood detection, disaster mitigation, community service, ESP32, youth training*

1. INTRODUCTION

Flooding remains one of the most frequent and damaging natural disasters in Indonesia, affecting various regions, particularly rural areas with inadequate flood prevention infrastructure. Majalaya Village, located in the Bandung Regency of West Java, is a prime example of a community that frequently experiences severe flooding due to its low-lying geographical position and proximity to the Citarum River **(Jan et al., 2022).** These floods disrupt daily life, damage homes and property, and pose serious threats to the safety and well-being of its residents **(Dasril , Indou & Suppa, 2024)**.

In response to this ongoing threat, there is an urgent need for effective flood disaster mitigation strategies that are both practical and sustainable. Early detection systems can play a crucial role in flood management by providing timely warnings that allow residents to prepare and respond appropriately, thereby minimizing damage and loss **(Fawwazna et al., 2024)**. However, the development and implementation of such systems in rural areas are often hindered by limited access to technology and technical expertise **(Fauzan et al., 2024)**.

This community service project seeks to address these challenges by enhancing the technical capacity of the youth in Majalaya Village through targeted training programs. The primary objective is to equip young villagers with the skills and knowledge necessary to design and implement flood detection systems using readily available technology, such as infrared sensors and Arduino-based microcontrollers (Kurni**a et al., 2022)**. These devices will enable the village to detect rising water levels early and trigger warnings, giving residents valuable time to respond to impending floods **(Tasic & Cano, 2022)**.

In addition to providing technical training, this initiative aims to foster a sense of ownership and responsibility within the community, particularly among the youth, who are expected to take a leading role in maintaining and improving the flood detection system **(Akbar et al., 2022)**. By empowering local participants to manage and adapt these systems over time, the project ensures long-term sustainability and resilience **(Suwarno et al., 2020)**. Furthermore, the project encourages collaboration between various community stakeholders, reinforcing a collective approach to disaster preparedness and response **(Sabbatini et al., 2021)**.

In summary, this project not only enhances flood detection capabilities in Majalaya Village but also promotes community-driven solutions to disaster mitigation **(Esposito et al., 2022)**. By involving the village youth in the design and implementation process, the initiative builds a foundation for long-term resilience and fosters a proactive culture of disaster risk reduction.

2. METHODS

The methodology applied in this article aims to provide a detailed and structured explanation of the implementation process of training village youth in designing and installing flood detection systems in Majalaya Village. The primary objective is to ensure that each phase of the training, from socialization to practical implementation, is clearly outlined. By documenting this methodology, we hope to enable similar projects to be replicated or adapted in other flood-prone regions. This approach not only serves as a guide for understanding the article's content but also as a reference for other community service programs with similar goals.

2.1 Design Methods of Community Service

In an effort to enhance disaster mitigation capacities among the residents of Majalaya Village, this community service initiative was designed to provide both theoretical and practical training. The focus was on teaching youth participants to understand and implement flood detection technology using infrared sensors and microcontrollers.

The activities were structured to give participants a comprehensive understanding of the technology, beginning with an introduction to the basics of flood detection and disaster mitigation. This was followed by practical training on how to design, assemble, and install the flood detection systems. The training emphasized not only the technical aspects but also the importance of maintaining the systems to ensure long-term functionality. Through this approach, we aimed to foster a sense of responsibility and technical competence within the village youth.

2.2 Site Selection and Participants

The project took place in Majalaya Village, Bandung Regency, West Java, chosen for its frequent flooding and high disaster risk due to its geographical and hydrological conditions. This made it an ideal location for implementing a flood detection system.

Participants included active village youth, selected to lead the system's maintenance and possible expansion, alongside village leaders and community members to ensure collaboration and community-wide support. Additional community enthusiasts with an interest in technology or experience in similar projects were also involved, aiming for long-term sustainability and potential replication in other high-risk areas.

2.3 Tools and Equipment

During the training in Majalaya Village, participants were introduced to essential tools and equipment necessary for the design and implementation of a flood detection system. These were categorized into Hardware, Mechanical Design, and Supporting Media to ensure a comprehensive understanding of the system.

2.3.1 Hardware

The hardware components form the technical backbone of the flood detection system. Below is a list of the key devices introduced during the training:

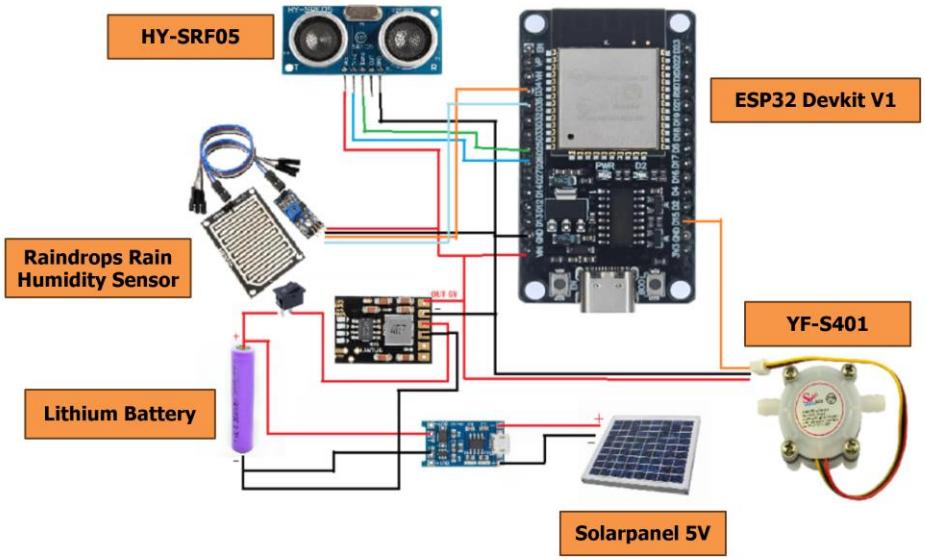


Figure 1. Schematic system

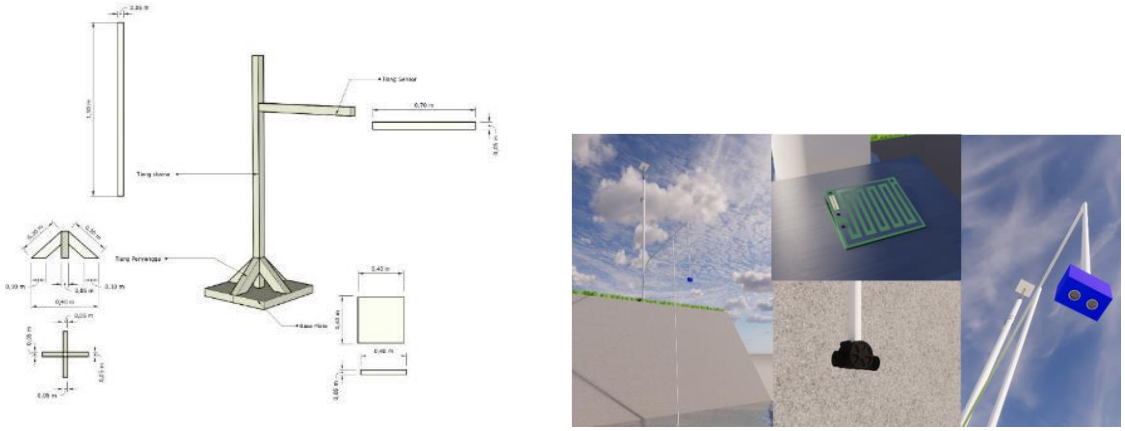
The system schematic shown in Figure 1 demonstrates the arrangement and integration of components within the flood detection setup. The Solar Panel (5V 2W) powers the system sustainably, while the Lithium Battery provides backup during low-light conditions, ensuring continuous operation. These power sources connect to the ESP32 Devkit V1 microcontroller, which serves as the central processing unit for the system, enabling wireless communication via Wi-Fi and Bluetooth.

Each sensor feeds data into the ESP32: the HY-SRF05 Ultrasonic Sensor monitors water levels by measuring distances to the water surface, the Raindrops Rain Humidity Sensor detects rainfall intensity, and the Water Flow Sensor (YF-S401) tracks water flow rates in flood-prone

areas. This data is processed by the ESP32, which then sends alerts to mobile devices or cloud systems, allowing for remote monitoring and early warning of flood risks.

2.3.2 Mechanical Design

The mechanical design involves creating protective and functional enclosures for the system components. During the training, participants were introduced to designing and building a case that houses the sensors and electronics, ensuring durability and ease of use. The case design includes waterproof features to protect sensitive components from environmental exposure, especially during heavy rain or floods shown in figure 2.



(a) (b)

Figure 2. (a) Mechanical Design of IoT-based early disaster detection system and (b) sensor placement on the device

In designing the IoT-based disaster detection system shown in Figure 2, structural components like iron poles (a) are essential for supporting sensors and electronic devices (b). Iron is chosen for its strength, load-bearing capacity, and durability against extreme weather, making it ideal for outdoor use. When coated with anti-corrosion materials like paint or galvanized layers, iron offers long-lasting resilience in diverse weather conditions, especially suited to the Citarum River environment.

The iron poles are assembled using welding techniques, creating strong, permanent joints that withstand both static and dynamic loads. This method ensures stability under wind and vibration, allowing flexibility in design for various installation sites. Final treatments, such as galvanization, improve corrosion resistance, ensuring the IoT sensors remain functional over extended periods in challenging environments.

2.3.3 Supporting Media

To ensure that the participants fully understand the operation and maintenance of the flood detection system, a comprehensive user guide was developed and distributed. The guide provides detailed instructions on the installation, configuration, and troubleshooting of the system shown in figure 3.

Figure 3. User Guide Manual Book

2.4 Socialization and training procedures

The training on designing and implementing flood detection systems in Majalaya Village was structured to provide participants, particularly the village youth, with a comprehensive understanding of the technology. The process involved several stages, from socialization and introduction of equipment to hands-on practice with installation. The training was designed to be interactive and ensure that participants could apply the skills learned in real-world scenarios as illustrated in Figure 4.

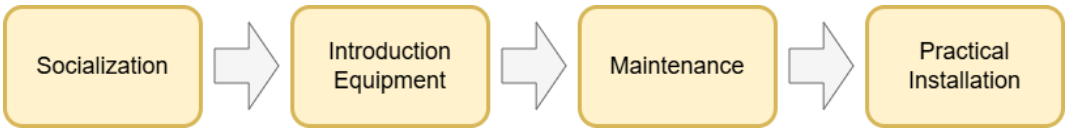


Figure 4. Flow of Community Service Implementation

The training began with a socialization phase where organizers worked with village authorities to distribute official invitations to youth members and local stakeholders, who were the main participants. Attendance confirmations were then conducted to ensure full participation. In the equipment introduction session, the instructor provided a comprehensive presentation covering essential components like the ESP32 microcontroller, ultrasonic sensors, rain sensors, water flow sensors, solar panels, and lithium batteries, explaining how each part contributed to the flood detection system. A Q&A session followed to address any questions and solidify participants' understanding of the equipment.

During the practical maintenance session, participants received a step-by-step guide and hands-on demonstrations on maintaining the system, including checking sensors, testing battery levels, and keeping solar panels functional. Troubleshooting methods, such as replacing faulty sensors or reconfiguring the microcontroller, were also covered. The practical installation phase involved identifying strategic flood-prone locations within Majalaya Village where participants, guided by the instructor, gained hands-on experience setting up the detection system. This practice not only built their confidence but also emphasized the importance of accurate placement and functionality of each component for effective flood detection.

2.5 Duration of Training and Socialization

This activity was conducted over the course of a full day, with detailed event timings as shown in Table 1 below:

Table 1. Event Rundown Community Service

Time	Event
09:00 - 09:30	Registration and Opening
09:30 - 10:00	Introduction and official opening of the training

Time	Event
10:00 - 11:30	Introduction to the tools and equipment for flood detection systems
11:30 - 11:45	Coffee Break
11:45 - 12:30	Q&A session and discussion about the introduced tools and equipment
12:30 - 13:30	Lunch Break
13:30 - 15:00	Training on the maintenance of the flood detection system
15:00 - 16:15	Hands-on practice of installing the flood detection system at selected points
16:15 - 16:30	Closing and evaluation of the training

2.6 Evaluation

Evaluation played a crucial role in measuring the success and effectiveness of the training sessions. This process aimed to assess participants' understanding of the materials and gather feedback to enhance future sessions. The training involved 20 youth participants, all selected for their commitment to community development in the flood detection program. To evaluate training effectiveness, participants completed a questionnaire after the socialization session, covering topics such as hardware, installation, and maintenance. Key focus areas included the completeness of information, clarity, and content relevance, providing an overall assessment of the training's impact.

Additionally, random interviews were conducted with several participants to capture more detailed feedback, including suggestions for improvement and comments on training structure. The combined results from questionnaires and interviews allowed the training team to evaluate the program comprehensively and identify areas for enhancement, ensuring the knowledge and skills imparted were applicable for effective flood mitigation in real-world settings.

3. RESULT AND DISCUSSION

This section outlines the outcomes of the community service project conducted in Majalaya Village, focusing on training the youth in designing and implementing flood detection systems. Figure 5 shows a banner designed for community service activities. Figures capturing key moments of the event, such as the installation process and community engagement, were included to document the project's progress.

Figure 5. Banner Designed for Community Services

3.1 Result of Training and Socialization Implementation

The training and socialization event in Majalaya Village marked a significant step toward empowering the community with the knowledge and skills needed to address flood risks. Below is a detailed overview of the event's outcomes:

- Opening Ceremony:
  The event commenced with a formal opening ceremony attended by community leaders, trainers, and participants shown in figure 6. The local leadership emphasized the importance of flood mitigation efforts, highlighting the role that the youth would play in maintaining the flood detection systems.

Figure 6. Opening Ceremony of Community Service

- Socialization Section:
  After the opening, the first session focused on socializing the concept of flood detection systems and explaining their importance for mitigating flood risks in flood-prone areas like Majalaya Village shown in figure 7. The instructor introduced the participants to the key equipment—such as ESP32 microcontrollers, water level sensors, rain sensors, and solar panels. In addition, the participants were trained on the maintenance of the system to ensure its long-term functionality.

Figure 7. Socialization Section

- Practical Installation:
  One of the event's highlights was the practical installation session shown in figure 8, where participants were guided by the instructor to install flood detection systems at identified strategic points. This hands-on experience provided the participants with the confidence and knowledge needed to set up and manage the system.

Figure 8. Practical Instalation

- Closing Ceremony:
  The event concluded with a closing ceremony during which feedback was collected, and certificates of participation were distributed to the attendees shown in figure 9. The community leaders expressed their gratitude and emphasized the importance of continuing efforts to improve flood preparedness.

Figure 9. Closing Ceremony

3.2 Feedback from the Questionnaire

To evaluate the effectiveness of the training, participants were given a 10-question questionnaire at the end of the event. The participants, totaling 20 individuals, were young community members who met specific criteria and demonstrated dedication to the community. Table 2 below shows the questionnaire results, designed to assess various aspects of the training, including the quality of the content, the delivery of information, and the overall participant experience. The responses were analyzed using a Likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree."

Table 2. Results of The Satisfaction And Opinion Questionnaire

No	Question	Scale	Mean
1	Was the information presented during the socialization comprehensive and covering all essential aspects related to flood detection systems?	1-5	4.4
2	Was the method of delivering information during the socialization easy to understand and engaging?	1-5	4.5
3	Was the information presented relevant to your needs and expectations as a participant?	1-5	4.3
4	Was the instructor responsive to questions and provided adequate clarifications during the Q&A session?	1-5	4.0
5	After attending the socialization, do you feel you have a good understanding of flood detection systems?	1-5	4.1

No	Question	Scale	Mean
6	Was the presentation material of good quality and systematically arranged?	1-5	4.4
7	Overall, how would you rate your experience during the socialization activity?	1-5	4.2
8	Did the practical installation session help in reinforcing the theoretical knowledge provided during the socialization?	1-5	4.6
9	Were the supporting materials (user guide, documentation) useful and easy to follow?	1-5	4.3
10	Do you feel confident in maintaining and troubleshooting the flood detection system on your own?	1-5	4.0

The results in Table 2 demonstrate that participants were highly satisfied with the training, with mean scores ranging between 4.0 and 4.6. The practical installation session received the highest rating (4.6), highlighting the value of hands-on experience in reinforcing theoretical knowledge. Other areas, such as the clarity of the presentation (4.5) and the relevance of the information (4.3), also received high scores, indicating that participants found the content engaging and applicable.

While participants reported a solid understanding of the flood detection system (4.1) and found the supporting materials helpful (4.3), the confidence level in maintaining and troubleshooting the system received a slightly lower score of 4.0. This feedback suggests a potential need for follow-up support to ensure long-term success. Overall, the responses indicate a positive reception, with high engagement and satisfaction across all evaluated aspects.

3.3 Discussion

The positive feedback and high participation rates from the training reflect the success of the flood detection system project in Majalaya Village. Participants gained valuable hands-on experience during the installation session, which reinforced their theoretical understanding and boosted their confidence in using the system. However, despite this success, the slightly lower score for confidence in system maintenance suggests that additional support, such as follow-up sessions and advanced training, may be needed to ensure long-term sustainability.

To maintain the system effectively, it is crucial that the community receives continued guidance and technical assistance. Regular monitoring and refresher workshops will help participants handle maintenance and troubleshooting independently. Overall, while the initial training was a success, ensuring the system's durability will require ongoing commitment and efforts from both the community and supporting stakeholders.

4. CONCLUSIONS

The socialization and training activities in Majalaya Village successfully provided the community with a deeper understanding of the importance of flood detection systems. From the opening to the closing, the enthusiasm and active involvement of the participants demonstrated the community's commitment to flood mitigation efforts. The flood detection system not only offers a practical solution for early warning during flood events but also promotes community ownership in managing and maintaining critical infrastructure.

The training empowered the youth of Majalaya Village with the skills and knowledge necessary to take the lead in operating and maintaining the system, ensuring its long-term sustainability. This project also highlighted the importance of collaboration among the youth, local leaders, and other stakeholders. With continued support and engagement from the community,

Majalaya Village can serve as a model for other flood-prone areas looking to adopt similar technology for disaster mitigation.

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LIST OF REFERENCES

Akbar, M., Murdiyat, Prihadi, & Putra, M. A. (2022). Rancang Bangun Peringatan Banjir Di Jalan Cipto Mangun Kusumo Berbasis Arduino. *PoliGrid*, *3*(2), 41. https://doi.org/10.46964/poligrid.v3i2.1710

Dasril , Indou, H., Suppa , R. (2024). Prototype Alat Pendeteksi Banjir Menggunakan Arduino Berbasis IoT. *JITET*, *12*(3). https://doi.org/http://dx.doi.org/10.23960/jitet.v12i3.5135

Esposito, M., Palma, L., Belli, A., Sabbatini, L., & Pierleoni, P. (2022). Recent Advances in Internet of Things Solutions for Early Warning Systems: A Review. *Sensors*, *22*(6). https://doi.org/10.3390/s22062124

Fauzan, M. R., Khairi, S. F., Kaniarudi, N. P., Ath, S., & Al, T. (2024). One-Phase Smart Switch using OpenCV Hand Gesture Recognition. *Ultima Computing : Jurnal Sistem Komputer*, *16*(1), 26–32. https://doi.org/https://doi.org/10.31937/sk.v16i1.3633

Fawwazna, M. L., Rahman, R., Ramdani, M. R., & Fau, A. (2024). Rancang Bangun Alat Pendeteksi Banjir Berbasis Arduino Dengan Sensor Untuk Mengurangi Resiko Bencana. *Nanggroe : Jurnal Pengabdian Cendikia*, *3*(2), 17–27. https://doi.org/https://doi.org/10.5281/zenodo.11190309

Jan, O. R., Jo, H. S., Jo, R. S., & Kua, J. (2022). Real-Time Flood Monitoring with Computer Vision through Edge Computing-Based Internet of Things. *Future Internet*, *14*(11), 1–19. https://doi.org/10.3390/fi14110308

Kurnia, A., Mustafa, R., & Listiana, R. (2022). Rancang Bangun Sistem Peringatan Dini Dalam Pencegahan Banjir Akibat Luapan Sungai Berbasis Arduino Menggunakan Metode Fuzzy Logic. *Journal of Informatics And Electronics Engineering*, *2*(2), 60–65.

Sabbatini, L., Palma, L., Belli, A., Sini, F., & Pierleoni, P. (2021). A Computer Vision System for Staff Gauge in River Flood Monitoring. *Inventions*, *6*(4), 1–16. https://doi.org/10.3390/inventions6040079

Suwarno, I., Ma'arif, A., Raharja, N. M., Nurjanah, A., Ikhsan, J., & Mutiarin, D. (2020). IoT-based Lava Flood Early Warning System with Rainfall Intensity Monitoring and Disaster

Communication Technology. *Emerging Science Journal*, *4*(Special issue), 154–166. https://doi.org/10.28991/ESJ-2021-SP1-011

Tasic, I., & Cano, M. D. (2022). Sparking Innovation in a Crisis: An IoT Sensor Location-Based Early Warning System for Pandemic Control. *Applied Sciences (Switzerland)*, *12*(9). https://doi.org/10.3390/app12094407