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Digital Village:

Towards a Smart Society Tsunami Mitigation Using Arduino Based on Internet of Things

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***Abstract*—The research that will be carried out is to improve the current system used for tsunami disaster mitigation where the working system is an offshore detection tool that will trigger the SMS Gateway system at BMKG and simultaneously the people around the affected area will receive a warning through SMS earlier. When there is an earthquake or other causes that may have an impact on a Tsunami, officers convey information using the manual method, namely hitting a gong to warn the surrounding community to be alert because the water level has the potential to cause a Tsunami. This article presents the results of research that aims to mitigate the Tsunami disaster by building a flood early warning system using an Arduino microcontroller based on the Internet of Things. This study uses the Zachman Framework and the AIC model with an e-government approach. The result is a model of an intelligent village information system and a fast response to the Tsunami disaster digitally. The information system developed is in the form of a mobile friendly website that can display measurement results from sensors, display water levels, store measurement results from sensors in a database, online forums as a trigger for tsunami-aware public participation, and an expert system for tsunami response rapid socialization. The website is integrated with Arduino. The water level sensor is installed on the river water gate connected to the Arduino Uno device which is equipped with an SMS Gateway SIM900A. Automatically, this system monitors the potential for a Tsunami tirelessly and sends information to the Disaster Risk Reduction Forum Team in Purbayni village located on the outskirts of South Garut Beach and the Head of RT in the neighborhood around the South Sea Coast. The IoT technology in this study is used to store Earthquake data and turn on the siren as a warning sign for the Tsunami disaster when the data received reaches the Tsunami alert level.**

Keywords—IoT, tsunami warning, Arduino, website, Zachman framework, AIC model

I. INTRODUCTION

The system currently used for tsunami disaster mitigation is an offshore detection tool that will trigger the SMS Gateway system at BMKG and simultaneously the people around the affected area will receive a warning via SMS earlier. When there is an earthquake or other causes that may have an impact on a Tsunami, officers convey information using the manual method, namely hitting a gong to warn the surrounding community to be alert because the water level has the potential to cause a Tsunami. This article presents the results of research that aims to mitigate the Tsunami disaster by building a flood early warning system using an Arduino microcontroller based on the Internet of Things.

Purbayani village is located in South West Java or sometimes known as South West Java which is an area close to the potential for a Tsunami because it is not too far to the South Coast, such as Ranca Buaya. In addition to the need for a Tsunami detector, an efficient socialization media for tsunami alert response is also very necessary because the people of

South Garut, which includes the village of Purbayani, is a remote area from Garut Kota, so they live more in a rural style which in percentage terms of education is not as much as in urban areas.

Thus, it is appropriate to build a digital village which includes the concept of developing a digital tsunami detector application, as well as socialization media for the detector so that the public is actively involved in understanding each other's use. In addition, digitalization of the economy and village tourism management towards a prosperous, healthy, and disaster-aware society needs to be done because South Garut is known as an area that has very beautiful and natural scenery.

II. Research Methods

This study uses the Zachman Framework [1] and the Attract Inform Community (AIC) model with an e-government approach [2]. The main tools used as detectors use Arduino Uno based on the Internet of Things (IoT).

III. Discussion

Geographically, Purbayani village has potential for community economic empowerment through tourism because it is close to the South Beach which can be visited from Bandung, Garut Kota, and even Cianjur. From the direction of Bandung, along the winding road, you are treated to beautiful and natural mountain views. Rural nuances add comfort to tourists who are tired of city life.

However, when viewed from the urban center of Garut district, the village is very far away (remote) so that many resources do not get optimal attention. Even South Garut proposed to separate itself into South Garut regency because it has natural potential, such as the beauty of the South Coast which is one of the closest tourist destinations from the city of Bandung. Apart from the beauty of the beach which is very famous for its very high and hard wave height, the potential for a tsunami must be wary of local residents.

Based on the problems above, the following must be considered:

- How to design an application to detect Tsunami hazards?
- How to design an application so that the community and related agencies can monitor the potential for a Tsunami?
- How to design an application to provide information to the public regarding Tsunami alert?
- How to design an application as an information medium to explore village potential, especially preparing for a digital village?
- How to design an integrated online application to meet the needs of the four features above.

The indicators for the success of this program are as follows:

- Communication between local residents, relevant agencies and visitors is well developed to understand each other about Tsunami alert.
- Online communication media is available to anticipate the difficulties of residents who want to understand Tsunami alert tips but cannot directly visit the Tsunami detection office.
- Online information media is available to explore village potential, such as tourist destinations so that tourists are not afraid to visit.
- A community group was formed as volunteer observers and practitioners of Tsunami detection to assist the government.

While the expected outcomes of this program are as follows:

- Purbayani Village must be able to implement a Tsunami detector application.
- Purbayani village must be able to convince tourists who want to visit Purbayani village or South Beach that the designed Tsunami detector can be a solution to Tsunami alert so that their safety is guaranteed.
- Purbayani Village has become a digital village where the potential for Tsunami and tourist destinations can be accessed by residents outside Garut online.

Fig. 1. Google Maps Purbayani village office.

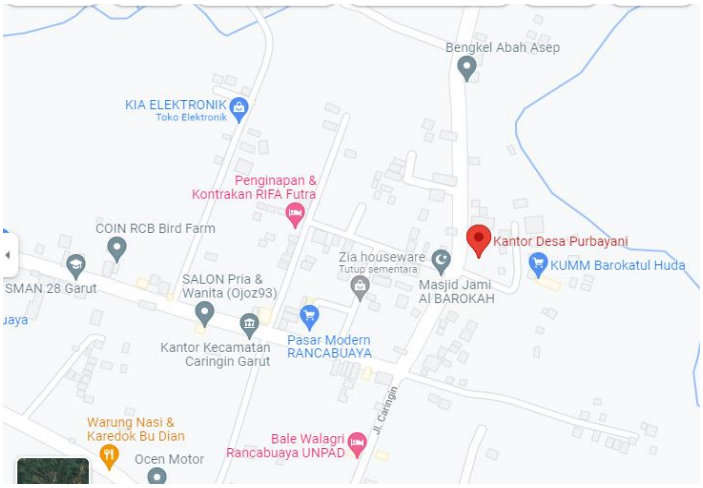

Fig. 2. Google Maps Purbayani village area.

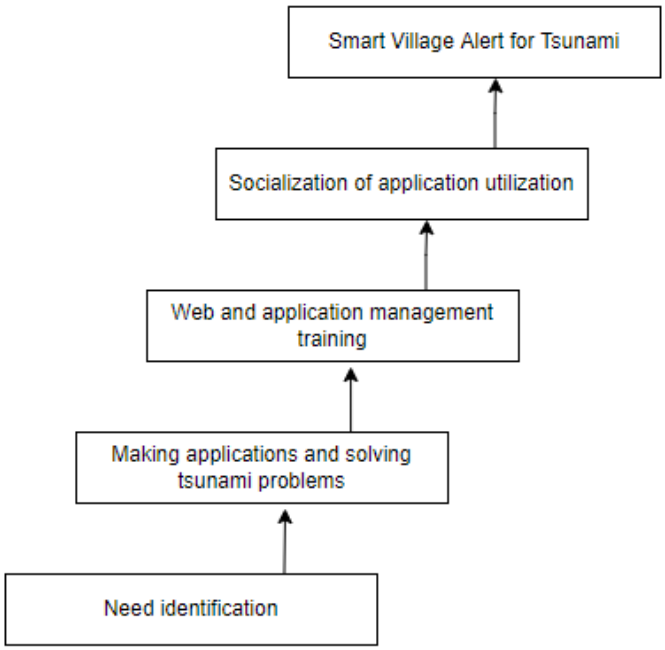

Fig. 3. Activity roadmap.

The preparation of the program consists of:

- Preparation
  - Initial survey (direct observation)
  - Communication with community leaders and local government
- Implementation
  - Application creation
  - Application management training
  - The division of socialization groups for the contents of the application containing the anticipation of the Tsunami
  - Presentation of application usage to core stakeholders, including community leaders, RT heads, RW heads, and village representatives
  - App usage socialization
  - Build a collaborative team between villages and software development for sustainable application management.

A. *Application of Zachman Framework*

1) What: The resulting product is a web and a Tsunami detector. The product will be installed by the government or an agency appointed by the government as a Tsunami detector and alert.

2) How: The application was developed by a team of experts with the direction of researchers. Implementation with permission from the local government. The residents of Purbayani village are the main end-users. When a Tsunami occurs, the sensor will send a message to the admin system and citizen gadgets. Reports on the detection of Tsunami signs, both those that have the potential for a Tsunami and those that actually occur, will become reports for policy makers.

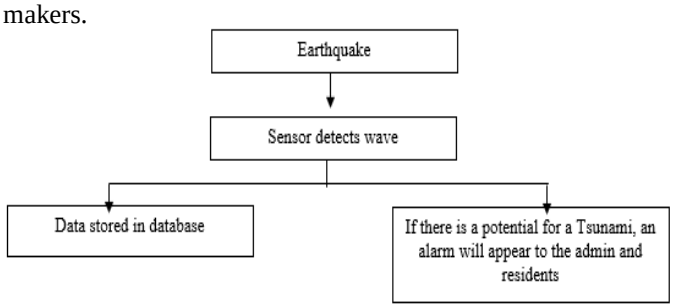

Fig. 4. Application usage flowchart.

3) Where: The application will be developed in Bandung and implemented in Purbayani Village located in Caringin sub-district, Garut, West Java. The village is used as a model for the first implementation. Once installed in Purbayani Village, an integrated detector will be installed in villages that have the potential for a Tsunami in South Garut as shown in Table 1. These villages can also be seen on a map as shown in Figure 5. Based on the map, the application will record the potential Tsunami based on village.

TABLE I. TSUNAMI POTENTIAL VILLAGE [3]

No.	Sub-district	Village	Danger Class
1	Caringin	Indralayang	High
2	Mekarmukti	Karangwangi	High
3	Cikelet	Pamalayan	High
4	Pameungpeuk	Mandalakasih	High
5	Cibalong	Mekarsari	High
6	Cibalong	Karya Sari	High
7	Cibalong	Karya Mukti	High
8	Cibalong	Sagara	High
9	Caringin	Cimahi	Medium
10	Caringin	Samudrajaya	Medium
11	Bungbulang	Sinarjaya	Medium
12	Mekarmukti	Cijayana	Medium
13	Mekarmukti	Jagabaya	Medium
14	Pakenjeng	Karangsari	Medium
15	Cikelet	Cigadog	Medium
16	Cikelet	Cijambe	Medium
17	Cikelet	Cikelet	Medium
18	Pameungpeuk	Mancagahar	Medium
19	Pameungpeuk	Pameungpeuk	Medium
20	Cibalong	Sancang	Medium

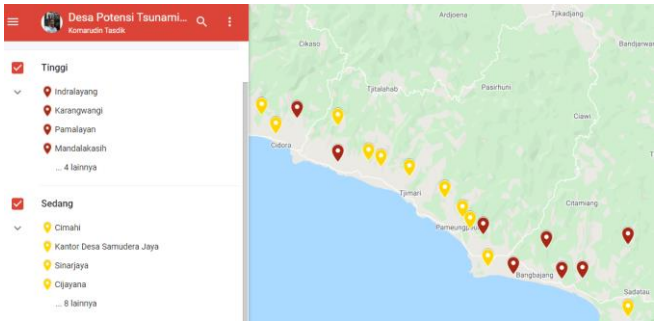

Fig. 5. Garut Tsunami potential village map.

4) Who: Those who play a role in the production of this Tsunami detector consist of researchers and a team of experts who master Information Systems, web programming, and Arduino. In addition, a team of experts was also involved to socialize the use of detectors to the public.

5) Why: Tsunami detection is a part of digital village design. Every aspect must be digitized in order to realize the digitization of the economy and village tourism management towards a prosperous, healthy, and disaster-aware society.

B. AIC Model

Based on the AIC model, one of the recommended features in this study is an online forum. The government must be able to act as a good moderator, respond quickly, and be communicative. Citizens must be built to understand that socialization of Tsunami alert is not only the duty of the government, but also the duty of all competent citizens. This forum is also useful so that residents can take advantage of an expert system that residents can ask about signs of a Tsunami and the solution is enough in front of the website, there is no need to go directly to the Tsunami monitoring office like during the Covid-19 pandemic, people can detect themselves through the website.

C. Application Design

Monitoring			
No	Tinggi Gelombang	Status Gempa	Waktu
1	0 (cm)	Ada/Tidak	Tahun-bulan-tanggal jam:menit:detik
2	0 (cm)	Ada/Tidak	Tahun-bulan-tanggal jam:menit:detik
3	0 (cm)	Ada/Tidak	Tahun-bulan-tanggal jam:menit:detik
4	0 (cm)	Ada/Tidak	Tahun-bulan-tanggal jam:menit:detik
5	0 (cm)	Ada/Tidak	Tahun-bulan-tanggal jam:menit:detik

Fig. 6. Measurement result from sensor.

The "No" column is filled in automatically for ease of documentation only. Wave Height will appear differently according to the results of the report from the detector application. Earthquake Status will be filled with "Yes" if it has the potential for Tsunami, the status will be "No" if it does not have the potential for a Tsunami. When the settings were made YYYY-MM-DD H:M:S so that the collected data was easy to sort.

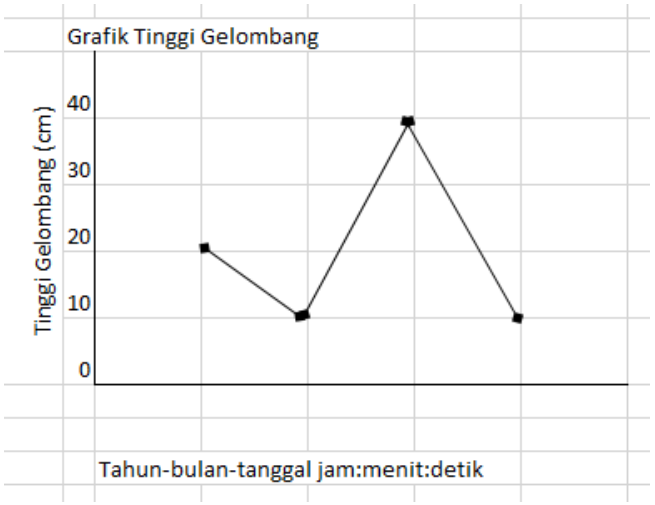

Fig. 7. Water level

The graph above will be developed based on Tsunami potential data, even involving Tsunami experts so that tsunami potential detection is more accurate, not causing confusion in the community such as the decision between having to evacuate to the highlands or not.

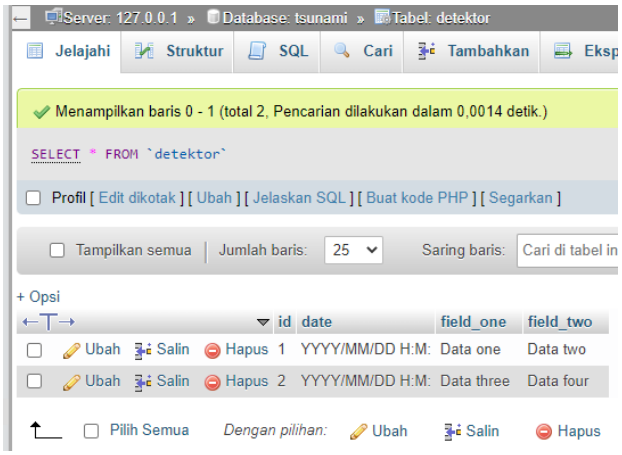

Fig. 8. Measurement result database.

The results of the detection of potential signs will be stored in the database so that the data can be processed for subsequent analysis. Not only analysis for pragmatic Tsunami alert but for decision support, such as for further information system development.

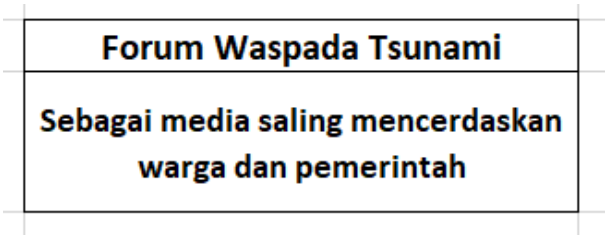

Fig. 9. Online forum as a trigger for tsunami-aware public participation.

Forums are useful not only when the potential for a Tsunami appears, but also extends to education on Tsunami alert. The community must understand the solution when a potential Tsunami has raised an alarm, even when a disaster occurs. They have to build their village with various factors that are earthquake and tsunami friendly.

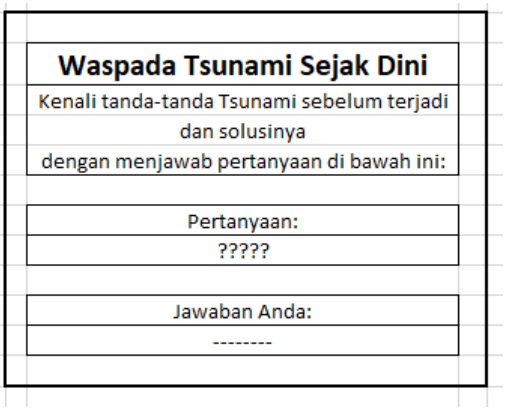

Fig. 10. Tsunami response expert socialization expert system.

The expert system is also to educate residents on Tsunami alert. Those who are busy or feel embarrassed to consult with the Tsunami response office can consult online with a website-based system, not directly with humans. In addition to easing the Tsunami response officers, the system will serve the community tirelessly and without being limited by space and time, 7 days a week, 24 hours a day, the expert system can be accessed by anyone.

IV. Conclusion

The results in this study are in the form of a smart village information system model and a fast response to the Tsunami disaster digitally. The information system developed is in the form of a mobile friendly website that can display measurement results from sensors, display water levels, store measurement results from sensors in a database, online forums as a trigger for tsunami-aware public participation, and an expert system for socialization of tsunami response.

The website is integrated with Arduino. The water level sensor is installed on the river water gate connected to the Arduino Uno device which is equipped with an SMS Gateway SIM900A. Automatically, this system monitors the potential for Tsunami tirelessly and sends information to the Purbayani Village Disaster Risk Reduction Forum Team and the Head of RT in the South Sea Coast area. The IoT technology in this study is used to store Earthquake data and turn on the siren as a warning sign for the Tsunami disaster when the data received reaches the Tsunami alert level.

References

[1] R. F. Awaludin, S. Bahri, and M. Muslih, “Penerapan Zachman Framework Dalam Perancangan Sistem Informasi Manajemen Keuangan Sekolah,” CESS (Journal of Computer Engineering, System and Science), vol.. 6, pp. 78-83, 2021.

[2] R. Irfanto and J. F. Andry, Perancangan enterprise architecture menggunakan Zachman framework (studi kasus: pt. vivamas Adipratama). Jakarta: Fakultas Teknik Universitas Muhammadiyah Jakarta, 2017, pp. 1-9.

[3] I. Kristian, Strategi penguatan kapasitas kelembagaan Badan Penanggulangan Bencana Daerah (BPBD) di Kabupaten Garut (Strategy for strengthening institutional capacity institutions of disaster management agency (BPBD) in District Garut). Bandung: UNPAS, 2018.