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Integrating Management and Education in The Implementation of An Early Warning System Using Crowdsourcing for Disaster Mapping on A Web Platform

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ABSTRACT

This study examines the implementation of an Early Warning System (EWS) for disaster mapping utilizing a web-based crowdsourcing approach, with a multidisciplinary focus on information technology, management, and education. From a management perspective, the system enhances decision-making, organizational coordination, and disaster governance through real-time reporting and structured workflows. The research employs a descriptive analysis method combined with system development and field observation. The developed system achieved a response time of less than 2 minutes for disaster reporting and successfully integrated 150 community reporters in the pilot area. From an educational perspective, the system functions as a medium for disaster literacy, enabling community-based learning and integration into Disaster Risk Reduction (DRR) curricula. The findings demonstrate that integrating technology, management principles, and educational strategies enhances both the effectiveness of disaster response and the resilience of communities. This research emphasizes that EWS is not only a technological innovation but also a strategic tool for management and education in building sustainable disaster preparedness.

Keywords: early warning system, disaster management, crowdsourcing, disaster education, risk reduction, web platform, community participation

INTRODUCTION

Natural disasters are unpredictable events that can harm society in multiple ways, including economically, socially, and environmentally. (Akter et al., 2023; Fan et al., 2023; Krichen et al., 2024; Le et al., 2024). Some examples of natural disasters are earthquakes, tsunamis, floods, droughts, and typhoons. Natural disasters can cause immense damage to infrastructure, housing, and natural resources, resulting in loss of life and trauma to affected communities.

First, most current EWS focus primarily on technological aspects without adequately addressing management coordination mechanisms. Second, limited research has explored the educational potential of disaster warning systems as tools for enhancing community capacity. Third, there is a lack of integration between crowdsourcing

technology, management processes, and educational frameworks in disaster preparedness.

The background of research on early warning systems for natural disasters is related to the problems that occur today, namely, the numerous natural disasters that occur in various countries, including Indonesia. The causes of natural disasters can vary, including natural factors such as extreme weather or climate change, as well as human factors such as uncontrolled mining activities and the unbalanced use of natural resources.

To reduce losses incurred by natural disasters, a reliable and well-integrated early warning system is needed. Research on early warning systems for natural disasters can discuss various aspects related to their implementation, such as the technology used, warning systems, and organizational follow-up mechanisms for dealing with natural disasters.

Moving on from the above incident, PT Bengkel Web Indonesia built a mapping system as well as an Early warning system for natural disasters in the area that are directly in contact with the surrounding community, so that they can report events in real time which are directly sent to the Command Center PT Bengkel Web Indonesia is expected to assist organizations in mitigating disasters and minimizing losses generated through mapping disaster-prone locations.

The urgency of this research is underscored by the increasing frequency of disasters in Indonesia and the limited preparedness of local communities. Without a reliable, community-based, and integrated EWS, the risks of casualties, economic losses, and social disruption will remain high. Therefore, this study is expected to provide practical solutions for disaster governance, enhance community resilience, and contribute to national efforts in reducing disaster risk.

The purpose of this research is to design and implement a web-based EWS platform using crowdsourcing that integrates management and educational dimensions for disaster mapping. Specifically, the study aims to: (1) analyze the weaknesses of traditional disaster reporting systems, (2) develop a prototype of an integrated EWS, and (3) evaluate its effectiveness in terms of response time, coordination, and community engagement.

The benefits of this research are twofold. Theoretically, it contributes to the development of interdisciplinary studies in disaster management by combining IT, management, and education. Practically, it provides a model that governments, organizations, and communities can adopt to strengthen disaster preparedness and reduce risks. In the long term, the research supports the creation of resilient societies that can respond adaptively to disasters and sustain development goals.

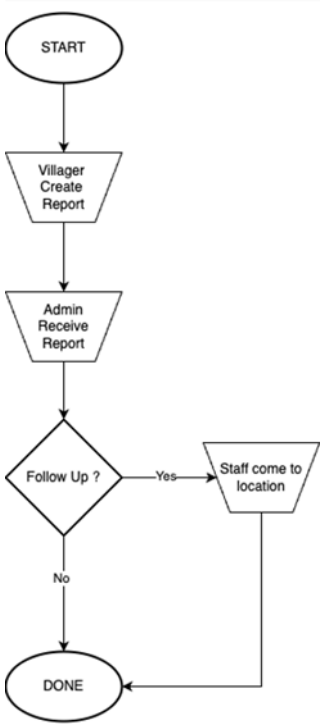
METHOD

In this study, the author employs a descriptive method, which involves describing a situation or problem based on facts and data collected during the research.

In preparing this report, the author employs the descriptive analysis research method, which involves collecting data through direct observation of field conditions, allowing for their consideration in decision-making.

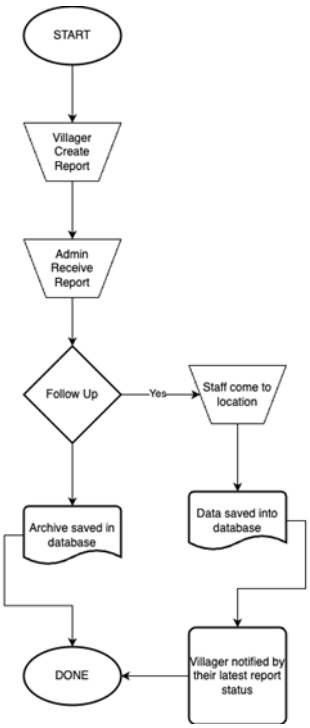
1. System Analysis

The old system of manual natural disaster reporting had weaknesses in terms of efficiency, accuracy, and responsibility needed when dealing with disaster emergencies. Therefore, many governments and organizations have turned to more modern, technology-based natural disaster reporting systems to improve the quality of disaster response and management.



Picture 1. Old System Flowchart

An early warning system built to reduce the risk of natural disasters by empowering the community as reporters who can directly send disaster reports to the command center. Additionally, this system can map important locations, including disaster-prone areas and vital points of interest. The proposed system will provide the facilities and functions required by system users. The design will be modeled using Unified Modeling Language (UML).

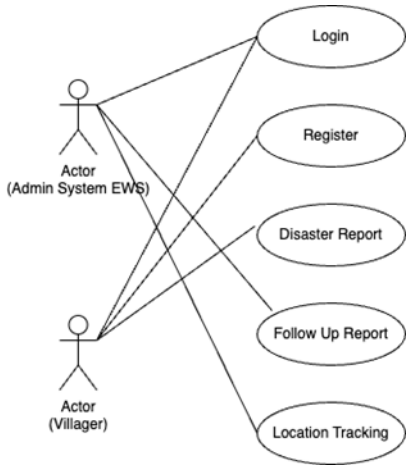


Picture 2. Flowchart system to be built

2. Use Case Diagram

A use case diagram is a graphical representation of one or more actors, use cases, and interactions that introduce a system. Use Case Diagrams do not delve into detail about system usage, but rather provide a brief overview of the relationships between use cases, actors, and systems.

The use case diagram is an illustration of the interaction scenario between the user and the System. Use case diagrams illustrate the relationship between actors and activities that can be performed against the application. Based on the results of the needs analysis conducted by the Usecase Researcher, the diagram of the system to be created is as follows:

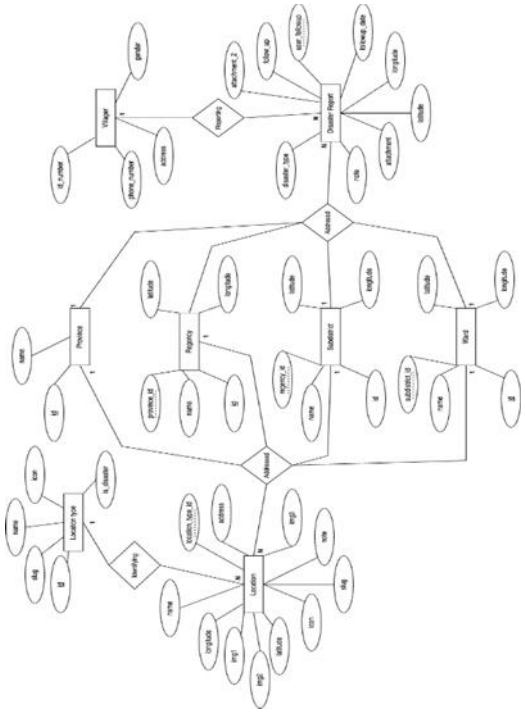


Picture 3. Use Case Diagram EWS

The use case figure above explains what the system to be built does and who will interact with the system according to what has been determined by the system.

3. ERD

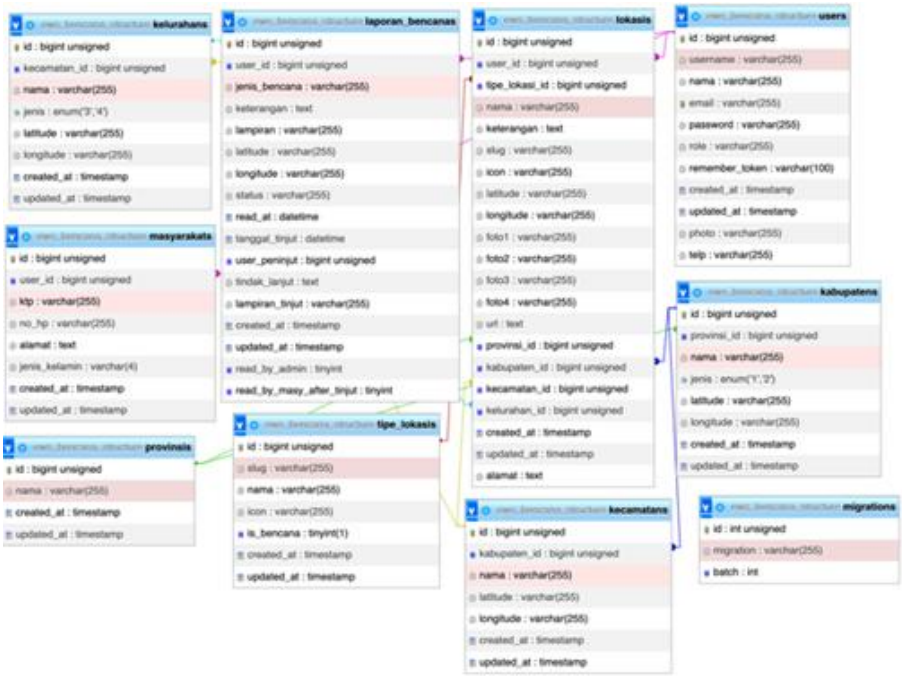
ERD To load the Early Warning System application for natural disasters & mapping disaster-prone locations shown in the picture below:



Picture 4. ERD EWS

ERD The above describes the relationship between interrelated entities, such as disaster reports related to disaster location types, location entities related to location types, and location entity relationships ranging from provinces, districts, and sub-districts.

4. Table Relationships

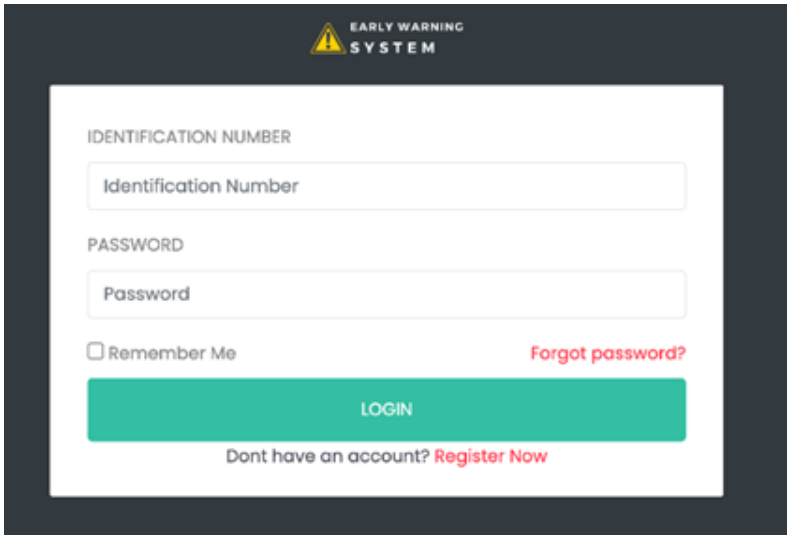


Picture 5. Table Relationships

RESULTS AND DISCUSSION

The results achieved in developing the early warning system application for mapping disaster distribution are the existence of a system that can be used to report the occurrence of a natural disaster to people in the vicinity who experience such disasters. It is hoped that by collecting this disaster report, it can be used as a disaster risk mitigation tool. The early warning system application, which is designed for natural disaster mapping, is currently limited to a local scope. Therefore, before using this system on a laptop or computer, a web server must be installed, a MySQL database imported from this system, and the web server activated.

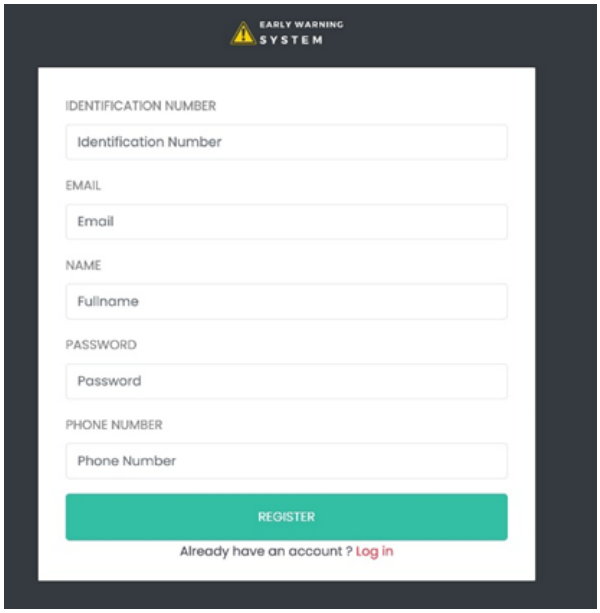
1. Community Login Page



Picture 6. Community Login Page

Admins or officers access this page to log in to the system.

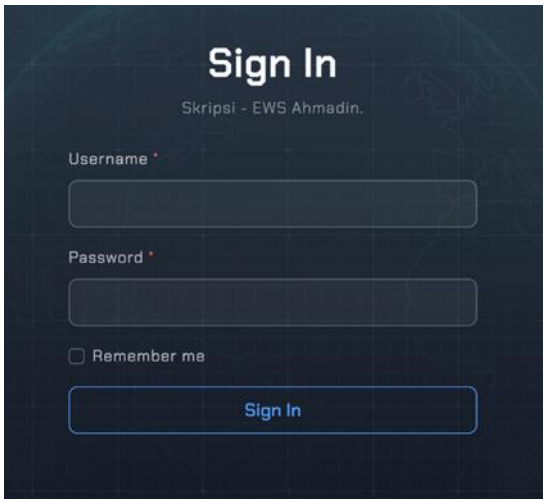
2. Community Registration Page



Picture 7. Community Registration Page

Community Registration page that displays a form for filling in the ID card number, email address, name, and password, which must be completed when creating an account in this system.

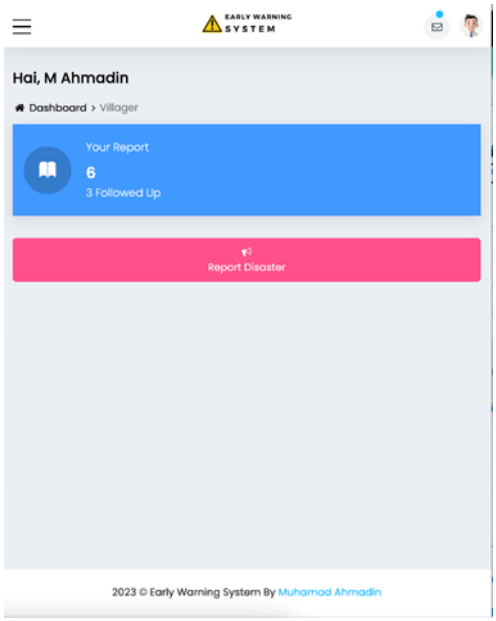
3. Admin Login Page



Picture 8. Admin Login Page

Admins or officers access this page to log in to the system.

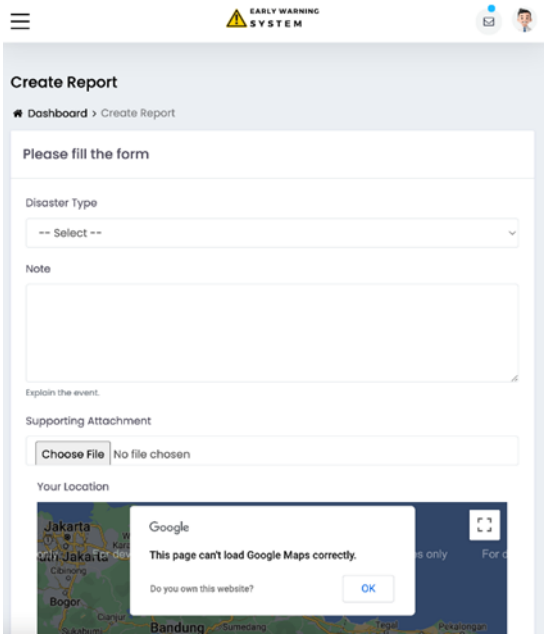
4. Community Dashboard Page



Picture 9. Community Dashboard Page

This page displays the total number of community reports and calculates the number of reports that have been followed up on.

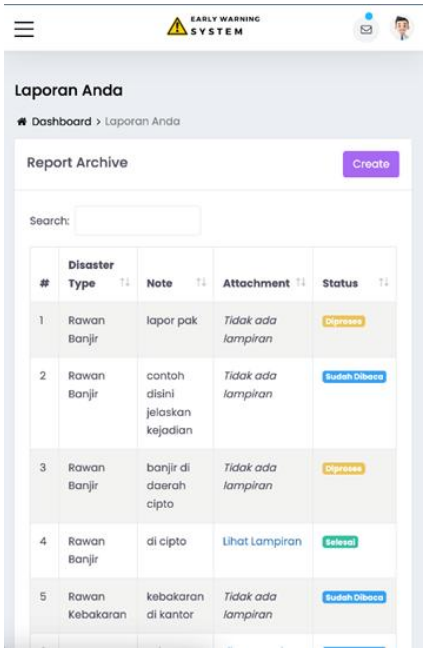
5. Create Disaster Report Page



Picture 10. Create Disaster Report page

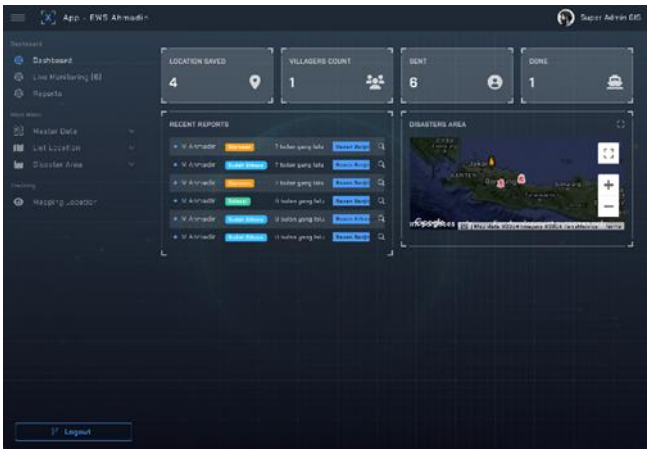
This page serves as a reporting platform for the community, offering a choice of disaster types and report information fields. The reporter's coordinates are also detected and recorded in the system.

6. My Reports page



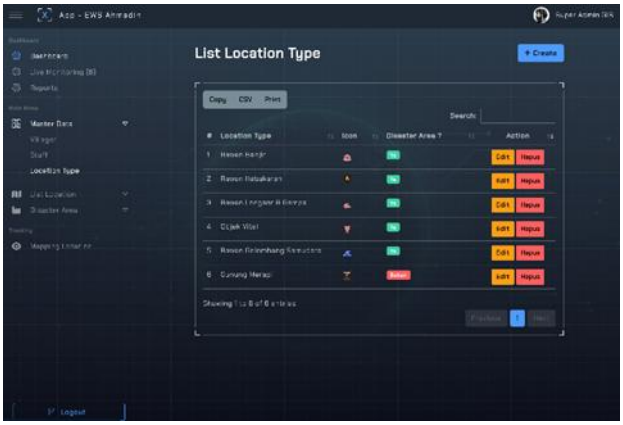
Picture 11. My Reports page

7. Admin Dashboard Page



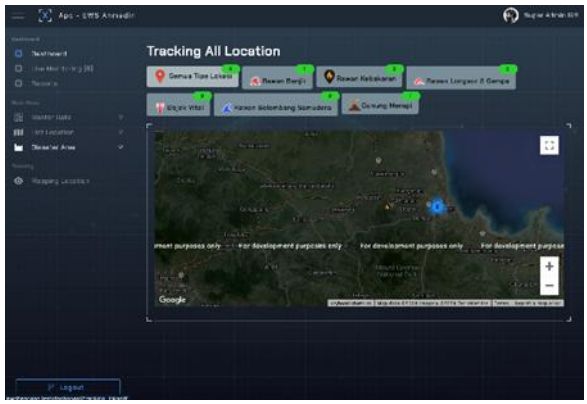
Picture 12. Admin Dashboard Page

8. Location Type Page



Picture 13. Location Type Page

9. Tracking Disaster-Prone Locations



Picture 14. Vulnerable Location Tracking Page

CONCLUSION

Based on the description in the previous chapters, the author can draw the following conclusions: 1) This research has succeeded in developing an early warning system application that the community can use to report natural disaster events. 2) This system can provide mapping of disaster-prone locations that the community can utilize to mitigate the risk of natural disasters. 3) This application contributes to the field of management by supporting decision-making processes, organizational coordination, and disaster risk governance. 4) This application contributes to the field of education by serving as a medium for disaster literacy, training, and integration into disaster risk reduction curricula. Future research directions include expanding to broader geographical areas to test scalability, developing offline functionality for areas with limited internet connectivity, and integrating with IoT sensors for automated disaster detection and long-term impact assessment on community resilience.

REFERENCES

Akter, M., Cumming, D., & Ji, S. (2023). Natural disasters and market manipulation. *Journal of Banking and Finance, 153,* 106883. https://doi.org/10.1016/j.jbankfin.2023.106883

Aryansa, R., Hendra Brata, A., & Tolle, H. (2019). Pengembangan aplikasi mobile social crowdsourcing dan early warning bencana alam dengan menggunakan push notification. *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer (J-PTIIK), 3*(5). http://j-ptiik.ub.ac.id

Asmara, J. (2019). Rancang bangun sistem informasi desa berbasis website (Studi kasus Desa Netpala). *Jurnal Pendidikan Teknologi Informasi (JUKANTI), 2*(1), 1–7.

Budiyanto, D. T. S. M. A. M. (n.d.). Pemanfaatan analisis spasial untuk pemetaan risiko bencana alam tsunami menggunakan pengolahan data spasial sistem informasi geografis.

Dewaweb.com. (2022, Juni 10). *Apa itu Laravel? Pengertian, fitur dan kelebihannya.* Diakses 10 Juli 2023, dari https://www.dewaweb.com/blog/apa-itu-laravel/

Desa, P., Sigap, W., Tanggap, D., Melalui, B., Early, A., Sistem, W., Kebencanaan, P., Desa, D., & Tabanan, B. (2022). Pendampingan early warning sistem pada Desa Baturiti dalam mendukung desa tujuan wisata sigap dan tanggap bencana. *Jurnal*, 3(1).

Fan, R., Zeng, W., Ming, Z., Zhang, W., Huang, R., & Liu, J. (2023). Risk reliability assessment of transmission lines under multiple natural disasters in modern power systems. *Energies, 16*(18), 6548. https://doi.org/10.3390/en16186548

Krichen, M., Abdalzaher, M. S., Elwekeil, M., & Fouda, M. M. (2024). Managing natural disasters: An analysis of technological advancements, opportunities, and challenges. *Internet of Things and Cyber-Physical Systems, 4,* 100118. https://doi.org/10.1016/j.iotcps.2023.09.002

Le, H., Nguyen, T., Gregoriou, A., & Healy, J. (2024). Natural disasters and corporate innovation. *European Journal of Finance, 30*(2), 115–141. https://doi.org/10.1080/1351847X.2023.2199938

Mukti, Y. I., & Puspita, D. (2019). Web-based disaster early warning system for Pagar Alam City. *Conference SENATIK STT Adisutjipto Yogyakarta, 5,* 302. https://doi.org/10.28989/senatik.v5i0.302

Mustiadi, I., & Listyalina, L. (n.d.). Pendekatan multidisiplin ilmu dalam manajemen bencana: Aplikasi landslide early warning system untuk pengurangan risiko bencana.

Purwanti, F. (n.d.). Mitigasi siaga bencana gerakan tanah dengan perangkat early warning system (EWS) daerah Bukit Manyaran Permai Kecamatan Gunung Pati Semarang Jawa Tengah.

Sumardiono, A., Alimudin, E., Zaenurrohman, Z., & Susanti, H. (2022). Rancang bangun monitoring early warning system bencana banjir berdasarkan ketinggian aliran sungai menggunakan modem SIM900 dan Internet of Things. *Infotekmesin, 13*(1), 112–117. https://doi.org/10.35970/infotekmesin.v13i1.1019

Sutedi, A. (n.d.). Rancang bangun aplikasi pengidentifikasi bencana dan lokasi aman bencana berbasis media sosial. *Jurnal Algoritma Sekolah Tinggi Teknologi Garut.* http://jurnal.sttgarut.ac.id/

Yunianto, M., Aji Purnomo, F., Palgunadi Yohanes, S., Koesuma, S., Hartono, R., & Maulana, N. (2016). Smart EWS: Sebelas Maret early warning sistem aplikasi deteksi dini bencana banjir Sungai Bengawan Solo berbasis Android. *Prosiding Seminar Nasional Geografi UMS.*