

# Innovation Technology for Disaster Management

Herman Yuliandoko, Subono, Sholeh Hadi Pramono, Ponco Siwindarto

**ABSTRACT**---The development of technology has been so rapid and the application of technology in our life become a necessity. The vocational education is one of the supporting factors for the application of technology in Indonesia. One example of the technology application of vocational education is the application of technology for disaster management using ZigBee technology. And ZigBee have good respond to collect data from sensor and sending to the coordinator with long distance from disaster location. This application is one of the solutions to disaster management problems in Indonesia. Because the mostly disaster management is done in conventional ways in Indonesia. In this research we make a design of ZigBee based flood disaster prototype and the outcome of this research is to know the effectiveness of the system to detect water level, water velocity and dissolved oxygen in the water. By using water condition data it can be determined whether there has been a flooding. This research very useful for the people to know early information of flooding dangerous so the people have time to prepare and save their life or property.

**Keywords**--- Technology, Disaster, ZigBee, Warning.

## I. INTRODUCTION

Indonesia's geographical and geological conditions are show vulnerability to disaster. Earthquakes, landslides, floods, windstorm and volcanic eruptions have a great opportunity to occur in Indonesia. So far we know that natural disaster always cause loss of property or life, it's also in Indonesia. It is needed a mechanism to manage and minimize the disaster effect to the people. Because it is impossible to prevent some of disaster occur in the world but we can minimize damage effect of the natural disaster. Therefore it is important to implement the disaster management to prevent impacts or consequences caused by disasters and minimize casualties, economic losses and damage [1].

In the current education curriculum, the importance of the contents of disaster is also introduced. MirzaDestandi in his research on the Urgency of Local Wisdom Based Curriculum Education in Indonesia explain the urgency of the local wisdom-based disaster education curriculum in

Indonesia. As a country which has enormous potential for disaster, Indonesia needs to implement a disaster curriculum in educational institutions so that students have the knowledge and insight about the disaster. This disaster education has a general goal to provide an overview and reference in the disaster preparedness learning process. Through education, students are expected to be able to think and act quickly, precisely, and accurately when facing disasters. The types of natural disasters faced in each region in Indonesia have differences because each region has different characteristics. Therefore the disaster curriculum must accommodate existing local wisdom, as an effort to provide the right education to deal with and deal with disasters[2].

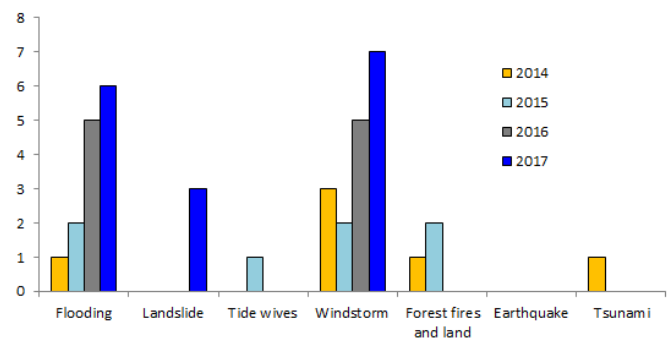


Fig. 1 Disaster Trend in Banyuwangi[3]

Today the implementation innovation technology in the management of natural disaster is very important and researchers have made any research in this area. One of that is the implementation of information technology and landslide management for BPBD (Regional Disaster Management Agency). In this research identified the need for the application of landslide disaster data management information technology and made the document software requirements specification (SRS). SRS is used as a reference in the design and development of information systems for landslide data management (SIK-Landslide) in the Regional Disaster Management Agency (BPBD). The method of this research is questionnaire and interview in the BPBD and another office which manages disaster data. The results of this study are to know the current conditions about technology, people, and the processes that exist within the BPBD organization, and make reference in designing and developing an information system for landslides (landslides)[4].

Revised Manuscript Received on May15, 2019.

**Herman Yuliandoko**, Informatic Engineering Dept. State Polytechnic of Banyuwangi, Banyuwangi East Java-Indonesia

**Subono**, Informatic Engineering Dept. State Polytechnic of Banyuwangi, Banyuwangi East Java-Indonesia Vivien AriefWardhany, Informatic Engineering Dept. State Polytechnic of Banyuwangi, Banyuwangi East Java-Indonesia

**SholehHadiPramono**, Electrical Engineering Dept. Brawijaya University, Malang East Java-Indonesia

**PoncoSiwindarto**, Electrical Engineering Dept. Brawijaya University, Malang East Java-Indonesia

The research on Design and Development of Wireless Sensor Network (WSN) Prototype for Early Warning of Floods, make a prototype of implementation of innovation technology in the disaster management. The main idea of this is how to control water level by using sensor and inform to the people if there is flooding indication. Through this system the flooding condition can inform quickly to the people so that the people can prepare and save their property or life [5]. Wireless technology become major network choosing which implemented in the rural area and this technology also suitable to be used for networking system on disaster area. There are many tools use wireless technology due to flexibility and mobility aspect and this is also used in the ZigBee technology. ZigBee base technology is one of wireless technology which it can use to be wireless communication in the disaster locations. ZigBee use 802.15.4 IEEE standard for communication system. This tool also have advantages in the low energy consumption and easy to manage [6]. Low energy consumption make this tool can be implemented on rural area with only use a battery for long time.

## II. MATERIAL AND METHODS

In this research provide one of innovation technology for disaster management. It is very use full for Indonesia which has many obstacles with disaster management.

### A. Design System

This research provides an innovation technology for disaster management with ZigBee as nodes which send data information of water level, water velocity and dissolved oxygen. The design diagram as below Figure 1.

In this system use 3 kind of sensor with different function, water velocity sensor, water level sensor and dissolved oxygen. The measurement of water parameter will be detected by sensor and the result send through ZigBee to the another ZigBee until ZigBee coordinator. ZigBee coordinator will forward all data to the server or PC. The main idea of this system is to send data of water condition such water level, water velocity and dissolved oxygen from river location to the main office through wireless network by using ZigBee.

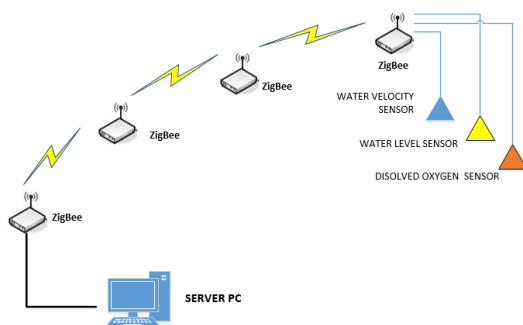


Fig. 2 Design System

### B. ZigBee and Sensors

To detect flooding was used some of sensors with different function and characteristic. There are there main

sensors, first water level sensor by using ultrasonic sensor, second water velocity sensor and third dissolved oxygen.

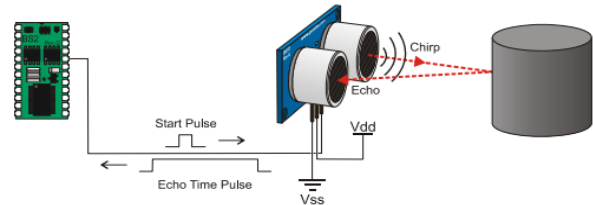


Fig. 3 Ultrasonic working theory [7]

Ultrasonic sensors detect the water level based on delay time between ultrasonic wave transmitted and received. This sensor transmit ultrasonic wave for 200µs with wave speed is 344 m/s. After ultrasonic wave touch and object the transmission wave will reflected to the sensor.

The water velocity sensor is working to detect water flow by using Hall Effect mechanism as below figure.



Fig. 4 Water flow sensor, arduino and circuit diagram [8]



Fig. 5 ZigBee and Arduino [9]

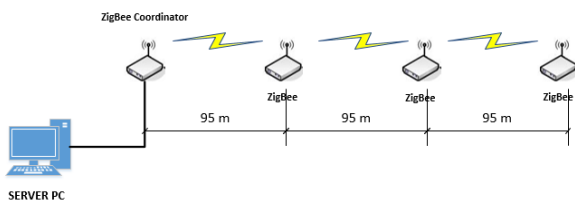
### C. Experiment

An experiment system is a very important thing to do because with the test the weaknesses of the system being built will be known. The experiment was conducted using two environmental conditions, first condition in the ZigBee signal without obstacle or free loss space and the second condition of experiment of the ZigBee signal in the many obstacles. For free loss space testing is carried out in open areas while experiments with many barriers are carried out in buildings with fixed inter-node distances. In this research we make to experiment method as below condition:

**Table 1. Table of Experiment Parameters**

No	Parameter Condition	Experiment 1	Experiment 2
1	Environment condition	Free loss space	Many Obstacle
2	Node (ZigBee) quantity	4 Unit	4 Unit
3	Distance between nodes	95 meter	70 meter
4	Packet data	60 packet/minute	60 packet/minute

*Experiment 1*



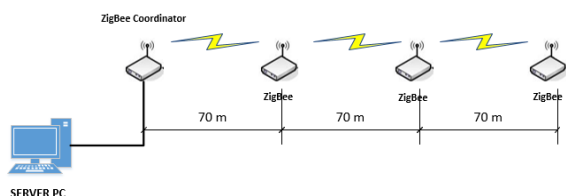
**Fig. 6 Distance on Experiment 1 with free loss space**

**Table 2. Table of Experiment 1 Result**

NODE	PACKET	PACKET LOST	RSSI	TIME	AVERAGE/kbps
1 - CO	60	0	-96	60 second	2.05kbps
1-2-CO	60	0	-90	60 second	2,0 kbps
1-2-3-CO	60	0	-90	60 second	2.0 kbps

Above table show that there are not packet loss and data sensor can be received in the good condition.

*Experiment 2*



**Fig. 7 Distance on Experiment 2 with many obstacle**

**Table 2. Table of Experiment 2 Result**

NODE	PACKET	PACKET LOST	RSSI	TIME	AVERAGE/kbps
1 - CO	60	0	-90	60 second	2.05kbps
1-2-CO	60	5	-78	60 second	2,0 kbps
1-2-3-CO	60	15	-70	60 second	1.80 kbps

In this experiment found that obstacle very significant to influence the packet loss and signal strength. That is similar

with a research in performance evaluation of ZigBee in indoor and outdoor environment by MujahisTabassum. Their research was showing that obstacle can reduce 15%-20% signal strength [10].

### III. CONCLUSION

This research has shown several things that can be taken as a conclusion:

1. This research shows that ZigBee can be used to send flood data well, this is indicated by the small amount of packet loss and the speed of data that is still in the good category.
2. The application of this system will be very beneficial for disaster management because it uses simple and low energy devices.
3. Packet loss is strongly influenced by environmental conditions so the application of this system will also be more optimal in free loss space area.
4. Further testing is needed in the real environment to get more accurate data

### REFERENCES

1. R. Dalante, M. Garschagen and F. T. a. R. Shaw, "Introduction: Disaster Risk Reduction in Indonesia: Progress, Chalanges, and Issues," Springer International Publishing AG 2017, Kendari, 2017.
2. M. Desfandi, "Urgensi Kurikulum Pendidikan Kebencanaan Berbasis Kearifan Lokal di Indonesia," *Sosio Didaktika*, vol. 1, pp. 191-198, 2014.
3. BNPB District Banyuwangi, "Rekap Bencana 2014, 2015, 2016, 2017," BNPB (National Board for Disaster Management) Banyuwangi District, Banyuwangi, 2017.
4. W. H. Nur, Sukristiyanti, D. Mulyadi and d. F. Firmansyah, "Penerapan Teknologi Informasi dan Pengelolaan Bencana Longsor Untuk BPBD," in *Prosiding Pemaparan Hasil Penelitian Pusat Penelitian Geoteknologi LIPI*, Bandung, 2012.
5. B. H. Nugroho, Jusak and P. Susanto, "Rancang Bangun Prototype Aplikasi Wireless Sensor Network Untuk Peringatan Dini Terhadap Banjir," *Journal of Control and Network Systems (JCONES)*, vol. 3, pp. 18-25, 2014.
6. F. Arkan and Zaini, "Aplikasi Teknologi ZigBee Pada Sistem Detektor Kebakaran Pada Rumah Susun," *Jurnal Teknik Elektro ITP*, vol. 3, pp. 11 - 18, 2014.
7. Parallax, PING Ultrasonic Distance Sensor, 2013.
8. R. Hosamani and R. Bagade, "Arduino Based Water Billing System for Domestic Purpose," *Internatinal Journal of Modern Trends in Engineering and Research*, vol. 2, no. 6, 2015.
9. h. yulianidoko, "OSF (Open Science Framework)," [Online]. Available: <https://osf.io/yga3e/>. [Accessed 4 January 2019].
10. M. Tabassum and K. Zen, "Performance evaluation of ZigBee in indoor and outdoor environment," in *2015 9th International Conference on IT in Asia (CITA)*, Kota Samarahan, Malaysia, 2015.

