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To cite this article: E S Soegoto *et al* 2021 *J. Phys.: Conf. Ser.* **1764** 012190

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# Internet of things for flood and landslide early warning

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**Abstract.** The purpose of this study is to improve the use of technology for the occurrence of a disaster as a form of anticipation in a disaster-prone area and tourist area. The method used in this research was a descriptive research method where the data obtained from events that occur in a particular region. The results of this study indicate that technological innovation is needed to monitor floods and landslides because based on the data from National Disaster Management Agency (BNPB) on the occurrence of disasters in Indonesia. There are still many areas that prone to natural disasters especially floods and landslides. The important role of the technology is to increase the level of confidence and security of tourists towards the potential for a disaster that occurs and can improve the tourism industry economy.

## 1. Introduction

Internet of things is a concept related to the internet connection on a device such as a cellphone, lamp, machine, and others. Therefore, the internet of things is all devices that are built on the internet that can communicate with each other and tell users something [1]. Natural disasters are events that are caused by a factor that can disrupt community activities and can also cause harm to the community. Some of them are floods and landslides including other natural disasters that often occur. Floods are natural disasters caused by stagnant or obstructed water flows that make the water inundated, the trigger factor is from nature itself or due to human behavior. Whereas landslides are natural disasters caused by shifting of the land. To anticipate a disaster, it is necessary to use the internet of things in early warning of floods and landslides.

There have been several studies on landslide mitigation that have been carried out previously, including research carried out by Noviardi and Dilson, wherein their study used the Internet of Things to



mitigate landslides. By utilizing the system to retrieve data then produce decisions and warnings and direct the community to the evacuation site electronically [1]. According to research conducted by Pune from University of India [2], the Internet of Things for landslide monitoring is a system created to alert local residents and provide information about the risks of the area to disaster occurrence to residents. Whereas previously conducted research on flood mitigation includes research carried out by universities from India, where research on IoT utilization for flood mitigation is a system for detecting water levels then collecting data for monitoring stations, then flood warnings will be displayed on LED display boards for public [3]. There is more research conducted by universities in India, where the difference is the delivery of information about flood warnings, namely through SMS messages to authorized users [4].

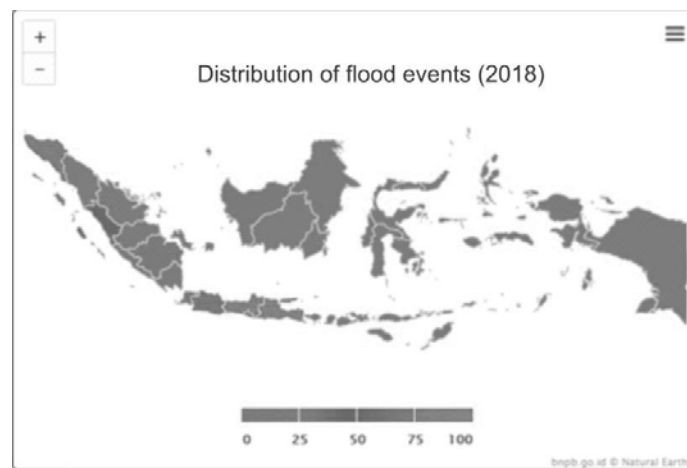
The purpose of this study is to improve the use of technology for the occurrence of a disaster as one form of anticipation in a particular area, especially in tourist areas. With the existence of this technology, it is expected to be used in improving the economy in the tourism industry in a region. In addition, it makes local people and tourists feel safer. This research method was a descriptive research method where data was obtained from events that occur in a region.

## 2. Method

This research used descriptive method with qualitative approach. The data were collected from the result of interview. The interviewee are the local people as users of the device. Respondents are local people who lived in riverhead and riverbank. The data analysis supported by literature study with deepen study on a number of floods and landslides in Indonesia.

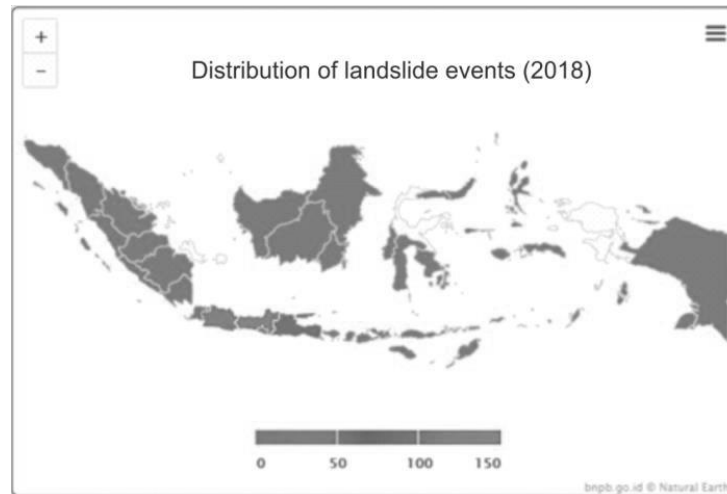
## 3. Results and Discussion

Natural disasters are harmful events that occurred. Floods and landslides are some of the most frequent disasters in Indonesia. The losses incurred include the loss of property, destruction of housing, and destroying the economy. The following is a Figure 1, which is the map of floods in Indonesia.



**Figure 1.** Flood disaster map

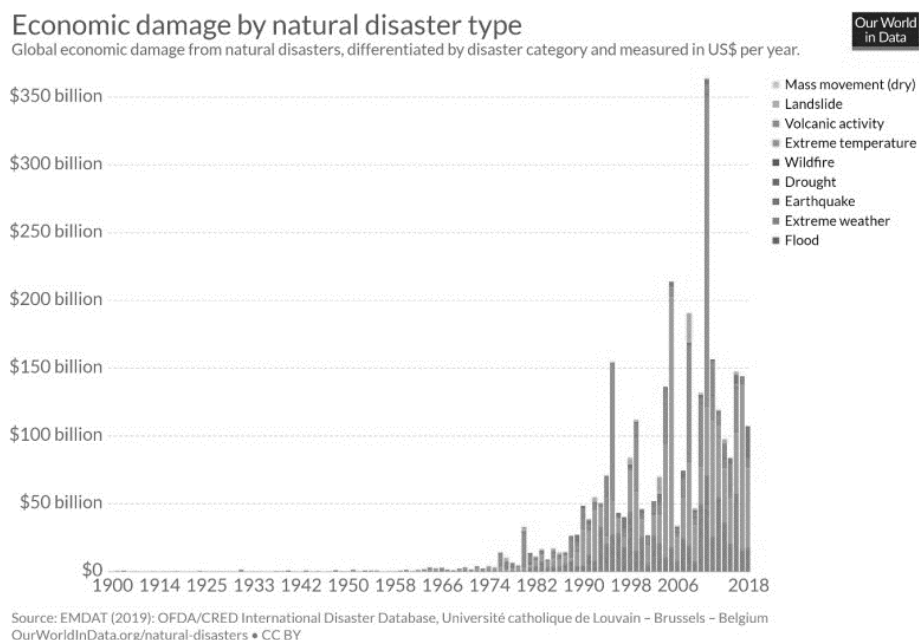
According to data from the National Disaster Management Agency (BNPB), in 2018 there were 382 floods spread in Indonesia with 42 dead and missing victims and 145 injured [5]. While the following Figure 2 shows the map of landslides in Indonesia (Figure 2).



**Figure 2.** Landslide disaster map

Source: bnpb.go.id

For landslides, according to data from the National Disaster Management Agency (BNPB), in 2018 there were 473 landslides spread in Indonesia with 167 dead and missing victims and 127 injured [5]. In addition to Indonesia, in the world, there have also been many natural disasters that have occurred, especially floods and landslides. From the occurrence of these disasters, of course causing losses, including economic losses. The following is Figure 3 of the impact of disasters on the economy.

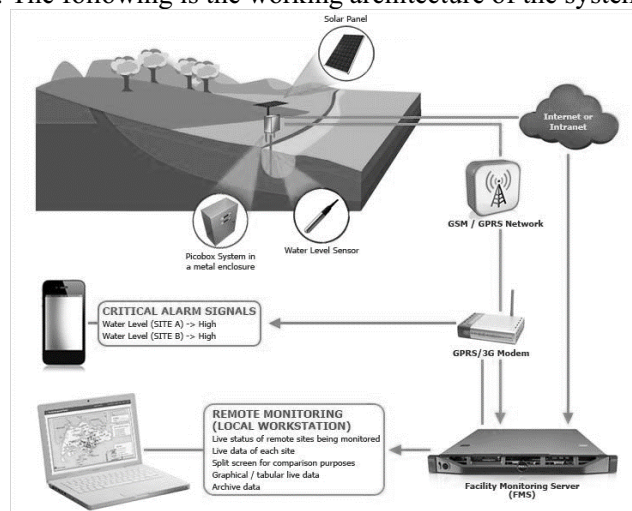


**Figure 3.** Economic damage by a natural disaster

For floods that occurred in 2018 the total losses were amounting to 17.44 billion US \$, and for the biggest losses occurred in 2011, which amounted to 70.76 billion US \$. Whereas for landslides that occurred in 2018 the total loss amounted to 878.04 million US\$, and for the biggest losses occurred in 2010, which amounted to 1.28 billion US\$ [6].

From the data obtained, it is proven that there are many areas prone to floods and landslides. Floods and landslides are very influential for the community, especially on the economic aspects. One of those affected is the economy in the tourism business. As one of them happened in Indonesia, precisely what happened in Lombok, West Nusa Tenggara, where there was a landslide that hit the Tiu Kelep waterfall tourist spot [7]. Previously, it was triggered by an earthquake that occurred, then followed by a landslide. Around 35 foreign and domestic tourists were victims and 2 others died. From this incident, it can make tourists worried and also can make the income of tourism places down due to the decline in tourists that occurred due to the disaster. In addition to landslides, floods also hit one of the tourist attractions, namely in Petra, Jordan [8]. Where the flood was triggered by heavy rains that occurred in the area. The flood that occurred in Petra reached a height of 4 meters. Many residents and tourists who were victims of the floods that occurred in Petra, as well as many losses caused by the occurrence of the flood. Therefore based on the data and events, a system is needed that can monitor and provide early warnings for floods and landslides, as a form of anticipation so as not to cause anything undesirable.

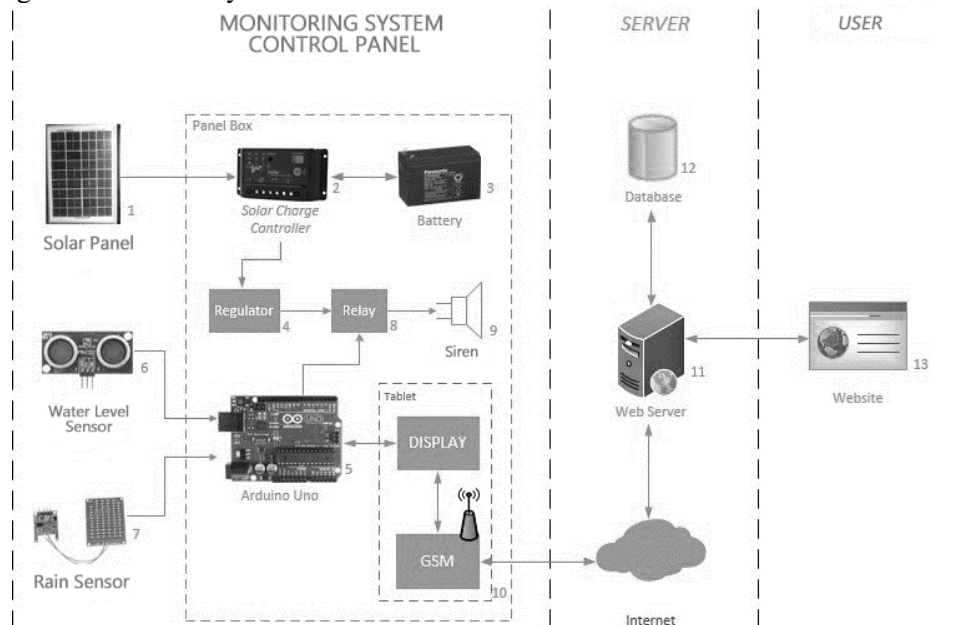
So the results of this study are the establishment of an Internet of Things based system to monitor the condition of water flow in a river, sedimentation and rainfall in an area then the data is sent to the server for processing, and can give warnings to the local residents so that citizens can anticipate in the event of a disaster. The following is the working architecture of the system (See Figure 4).



**Figure 4.** System work architecture

The system work architecture consists of a level Water Sensor that has the function to check the condition of the water level, where the installation is in the river flow. The second is GPS sensor is to determine the position (coordinates), height and slope. The place is to install it in several locations in the river and areas prone to landslides. The next is Rainfall sensors to check rainfall levels. The solar panel is for monitoring units. It is placed with a water level sensor unit and rainfall sensor. 3G modem for data communication, from the monitoring unit to the server. The server is to process data from monitoring cameras to be information for the government and society. The alarm is to give danger signs to people around the river or landslide-prone areas. Mobile phone application (based on Android) has the function to connect to the server, and receive warning information that there will be floods and landslides, and give a warning to the user of the application.

The following shows how the system works:



**Figure 5.** Monitoring system control panel

The workings of the system are as follows:

1. Sensor unit

Detecting the level of water flow and rainfall, so that it can provide accurate data, for predictions and prevention of flooding and the presence of more water content in the soil under certain slope conditions that have the potential to landslide.

2. Server Unit

Receive data, process data, save and display to the website for further purposes.

3. Mobile Application

Connect with an integrated disaster alert server, so that when there is up-to-date information on the potential for flooding or landslides, applications that have been installed on the mobile phone will receive alerts to alert and alert users. The following devices are used:

### 3.1 Hardware

1. Arduino Uno

Arduino Uno is an ATmega328 based microcontroller board. Uno has 14 digital input/output pins (of which 6 can be used as PWM output), 6 analog inputs, 16 MHz ceramic resonators, USB connection, a power jack, ICSP header, and reset button.

2. Water Altitude Sensor

A water level sensor is an ultrasonic sensor that can detect the distance of an object by emitting ultrasonic waves with a frequency of 40 kHz and then detecting the reflection.

3. Rain Sensor (RSFP2)

This sensor is capable of detecting rain with the digital output which is a current sourcing TTL. There is an LED indicator that indicates rain or not.

4. Solar Panel

Solar panels convert solar energy into electricity. Silicon cells that are irradiated by the sun or the sun,

make photons that produce electricity. A solar panel produces approximately 0.5 Volt voltage.

#### 5. BMP280 sensor

Used to detect atmospheric pressure. There are many correlations between atmospheric pressure and rainfall in an area, especially in the event of a cyclone or hurricane if the pressure is very low the area developed by rain will be immediately felt beforehand. This helps detect possible flooding in response to rainfall.

#### 3.2 Software

##### 1. Arduino IDE

The Arduino software that will be used is the driver and IDE. IDE is created for beginners and even those who don't have a basic programming language at all because they use C++ language that has been made easier through the library.

##### 2. Android Studio

Android Studio is an Integrated Development Environment - Integrated Development Environment (IDE) for Android application development, based on IntelliJ IDEA.

##### 3. Code igniter

CodeIgniter is a framework used to create a web-based application that is compiled using the PHP language. In the CI there are several types of classes in the form of libraries and helpers. Both functions to help programmers (programmers) in developing their applications.

##### 4. Firebase Realtime Database

The Firebase Realtime Database is a database that is hosted in the cloud. Data is stored as JSON and synchronized in real-time to each connected client.

## 4. Conclusion

Technology is growing rapidly with the existence of technology that can help all human activities, especially helping humans in predicting the occurrence of a disaster as a form of anticipation and warning in disaster-prone areas. By utilizing technology as a detection of the occurrence of a disaster, it can reduce the fear of residents in disaster-prone areas as well as tourists in the tourist area. Especially for tourist areas, can increase the level of trust of tourists to a tourist place, so that it can advance the economy in the field of tourism business.

## Acknowledgment

We expressed thanks to the Research and Community Service (LPPM) of Universitas Komputer Indonesia that have motivated the authors to continue to develop the knowledge and support in this research.

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