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Dissemination Application for Early Warning in a Community

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ABSTRACT

The development of sensor technology for early warning at an affordable price makes it possible to be implemented in the community. Therefore, an application is needed to send this early warning information to community members and warning response centers in real-time by considering the distance from the location of the incident. So, in this research, we proposed a dissemination application for early warning in a community (DissApps). The application was build using Code Igniter Framework, MySQL database, Mapquests, and Wablas API. This application can be used for disseminating emergency response situations such as thievery, a natural disaster such as earthquake, flood, forest fire.

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1. Introduction

This research is motivated by the massive applications of the Internet of Things such as sensors that help identify emergencies such as thievery, a natural disaster such as earthquakes, fires, etc. The survey conducted by [1] has divided the IoT application into 6 categories: smart home, smart cities, environmental monitoring, health care, smart business, security, and surveillance. One of the IoT implementations for environmental monitoring is a sensor to measure temperature, wind, rainfall, etc. Some ideas for implementing IoT that have begun to be developed are an intelligent hazard and natural disaster management, smart urban management, health management, etc [2]. Figure 1 gives an example of a fire sensor.

Figure 1 Fire Sensor Example

Researches related to the implementation of IoT for disaster mostly focuses on the implementation of tools such as flood early warning systems [3], anti-theft systems for homes [4], home security systems [5]. No research focuses on the design of structured dissemination applications in a community that involves the position or distance of community members to events.

1.1. Internet of Things

According to [6] the history of the development of Internet of Things (IoT) started in 1989 for internet and began to spread to online device control in 1990. The term IoT was known in 1997 through Radio Frequency Identification (RFID). RFID is massively used in the military in America starting from 2003 and supported by the internet protocol starting from 2008.

IoT relies on universal device addressing on devices, so they are easy to control and use for certain purposes. One of IoT implementations is in the case of early detection such as flood disasters [7] [8], fires [9], and or disorder such as theft [10] or robbery [11]. Figure 2 shows that IoT Framework can be installed on various sensor devices that have an IP address. The middle section describes the application bridge/rest API which can capture data that is sent from the device and stored in a database/cloud. The rest part shows that information will be processed from stored data. This information can be represented as a visual dashboard or alerts that are sent through certain media and can be used to forecast new sensor values to predict disaster [12].

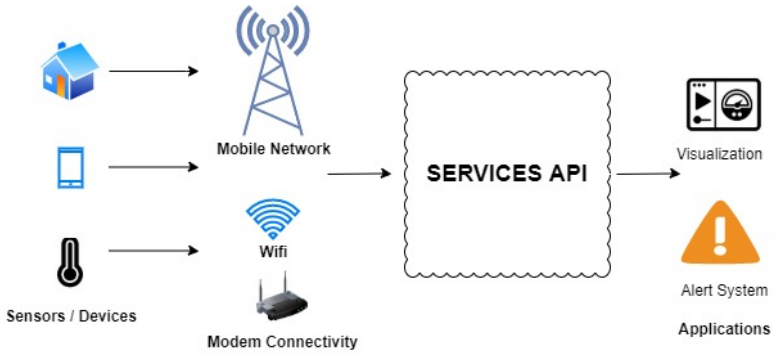

Figure 2 IoT Framework [13]

1.2. Dissemination

Information dissemination is an activity which broadcast the information to target group or individuals so that they obtain information, arise awareness, receive, and finally utilize the information. Generally, Dissemination is conducted by using one or more media such as the web, SMS, news on television, messages WhatsApp, etc. Information dissemination using web media can be web or web services. Web services are a form of a software system designed to support machine-to-machine interaction over a network [14] with XML or JSON data format. SMS gateway technology is also widely used by researchers to disseminate earthquake information.

SMS gateway technology is also widely used by researchers for the Dissemination of earthquake information and flood early warning [15]. WhatsApp technology can be used to disseminate early warning information because it has a variety of functionalities such as creating groups and attaching photos, documents, videos, locations, links, contacts, and data. Studied [16] and [17] have been confirmed that WhatsApp is useful as a supported tool for disseminating information during the disaster. Beside SMS and WhatsApp applications, maps application such as WebGIS also used to monitor early warning systems easily using visualization [18].

However, the use of WhatsApp in [19] still needs humans to send the information manually. So, in this study, we provide a contribution to develop a dissemination application using WhatsApp media which can automatically disseminate early warning information by considering the distance near the event location.

2. Materials and Method

2.1. Waterfall models

Waterfall model is one of software development model which breakdown the project activities into linear and sequential. Each process is needed to be completed before moving on to the next phase. The phase of each process as follows [20]:

1. Requirement Analysis and Specification Phase.
2. Design Phase.
3. Implementation and Unit Testing.
4. Integration and System Testing.
5. Operation and Maintenance Phase.

2.2. Unified Modeling Languages

Unified Modeling Languages (UML) is The UML is a collection of diagrams for specifying various aspects such as requirements and design of software systems [21]. UML is known as a state-of-the-art modeling to build software using an object-oriented approach. UML consists of some diagrams such as Use Case, Activity, Class Diagram, etc.

2.3. System Architecture and Method

Figure 3 shows DissApps system architecture which contains three parts of systems. The first part of this application is a sensor installed in the house of each community member, the second is database and web server, and the last is Wablas API.

Each community member's home may have more than one sensor, such as smoked detectors, motion detectors, etc. Usually, each sensor has one IP address and get a unique id from DissApps application when being registered by the administrator and is associated with one of a member's home address.

At the time when those sensors detect a hazard condition, it will send warning messages through the API to the application database by using REST API. Afterward, the cron job of DissApps application will read the alert and disseminate the warning message using Wablas API. That information will be sent to the owner of the incident house, the other members' community, and the community servant/warning center such as fire and police department which has the nearest address to the location of the incident. Each member community that received the alert message must respond and go to the area of the event as soon as possible.

The interesting point of this applications is if there is no response message received by DissApps application after 30 seconds, the message recipient area will be expanded until the message has been responded with the command "**Executed**" or "**Solved**" as shown in Figure 8 and Figure 14. The administrator also can be seen the location of the incident in maps via DissApps application real-time, which can be seen in Figure 13.

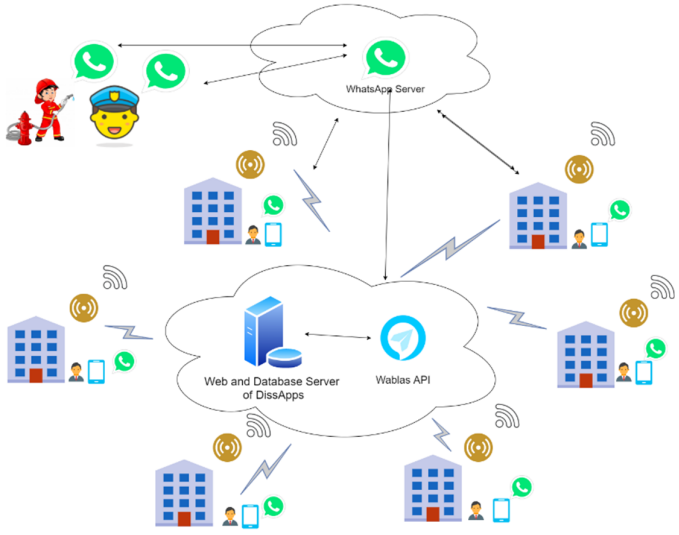

Figure 3 Architecture of DissApps

The method to implement this research can be seen in Figure 4. It can be seen that our study is focused on implementing Dissemination from triggered sensors

and try to spread the information from nearest the incident location and spread out periodically until the incident is solved.

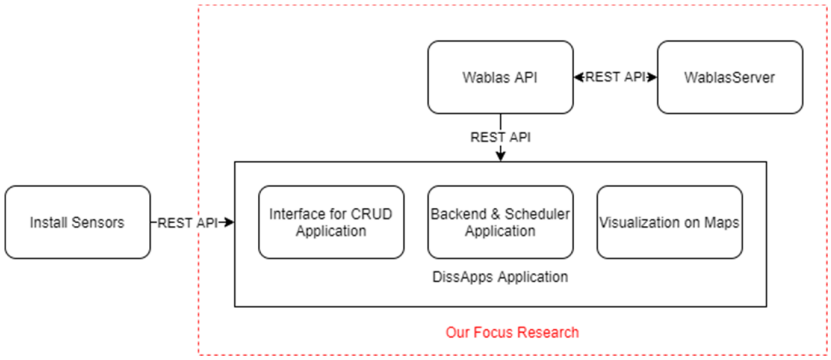

Figure 4 Method

3. Results and Discussion

The relational table of DissApps application can be seen in Figure 5. The community_member table will record the data of community members which is registered by the admin. Moreover, the warning_type table will record the types of warnings that can be registered by the admin to the application. Also, the warning_center_type table will record the relation between warning_type and warning_center. The kinds of sensors are recorded in the sensor table, and the list of sensors at each community member location is stored in the sensor_location table.

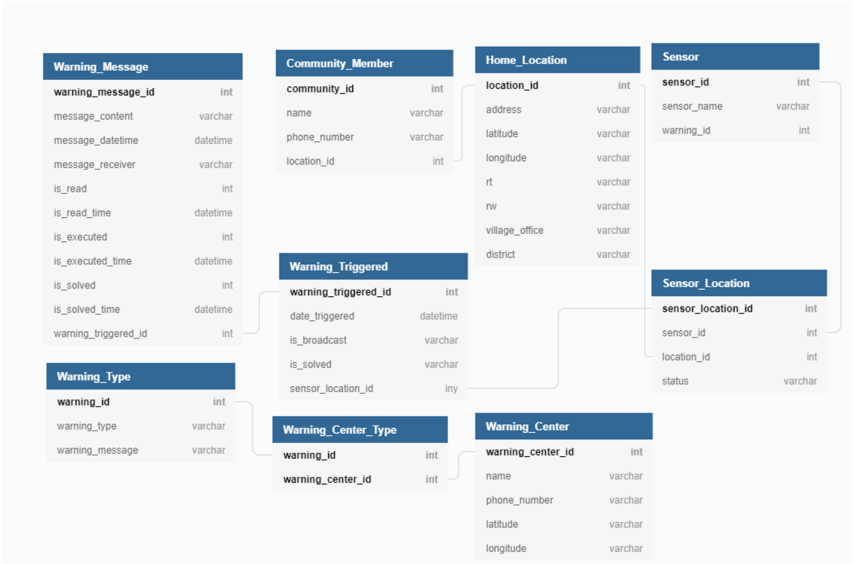

Figure 5 Relational Table

The use case diagram of DissApps application can be seen in Figure 6. The actor of this application is an admin who has several application functionalities: data sensor management, community, and community location management, data warning management, and early warning notification on the map.

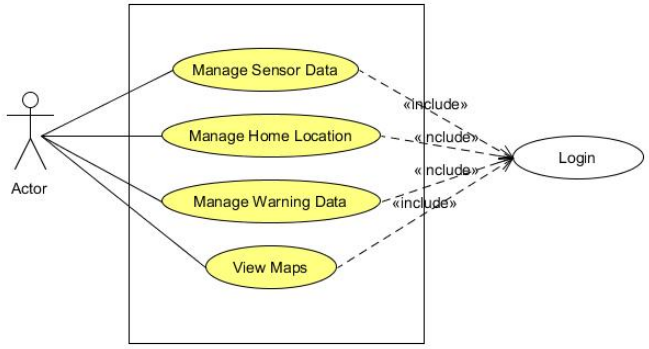

Figure 6 Use Case Diagram

The class diagram of DissApps application can be seen in Figure 7. The class diagram contains a list of class abstractions that are implemented in this application. Class diagrams illustrate the relationships between classes.

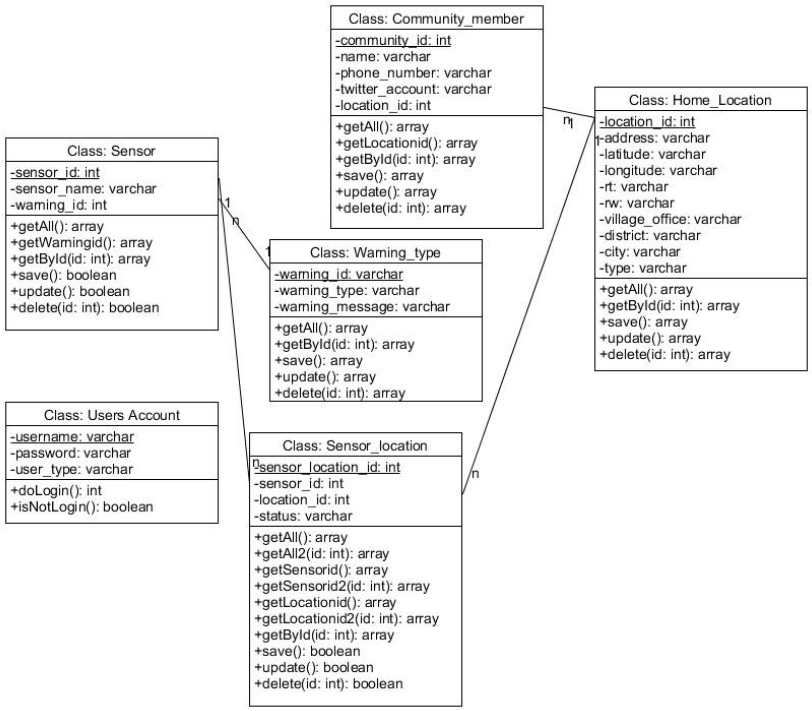

Figure 7 Class Diagram

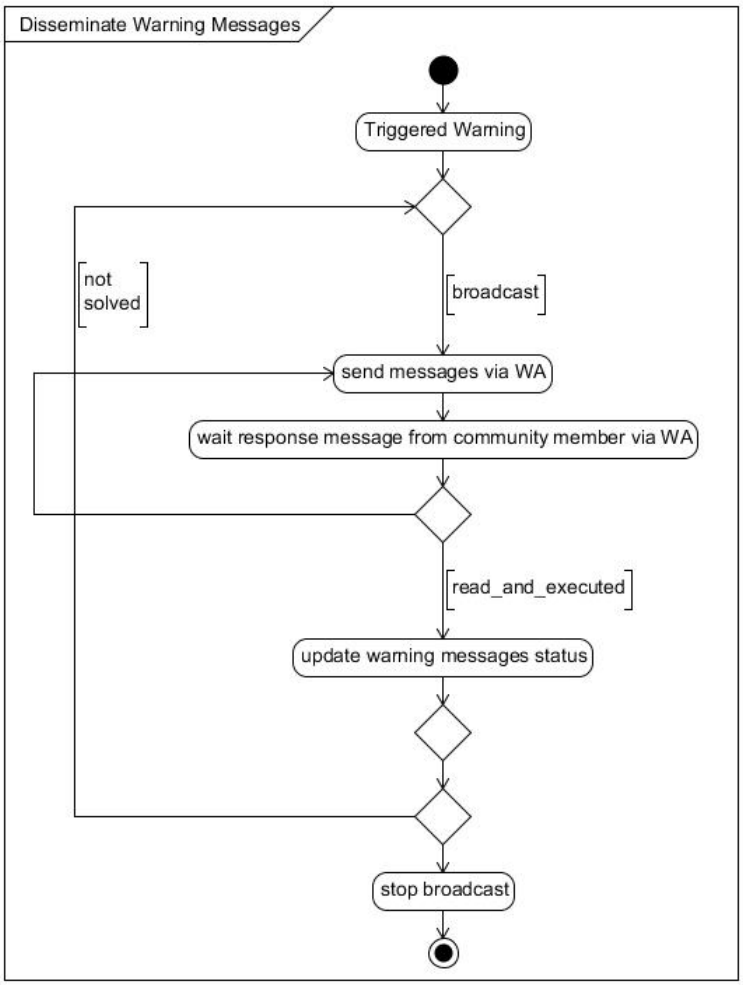

Figure 8 Activity Diagram of Dissemination Process

Figure 9 displays the number of warning centers, the number of warning types, the number of sensors, and the number of home communities. The sidebar contains a menu for sensor and warning data management, while in the upper right shows notification of new and unsolved warning data. Figure 10 shows warning types menu which can be used to input new warning types. For adding, updating, and deleting sensors for each member community location, admin can use the list home menu like Figure 11. Before adding the sensor to the community member location, all sensors needed to be registered by admin by using sensor location menus like Figure 12. All warning notification can be seen on maps like Figure 13.

Figure 14 shows the display of messages sent when the theft sensor is triggered like this "The theft sensor at the address of GBA 2 Block F4 No. 2 05/09 Cipagalo Bojongsoang Bandung Regency has been triggered. Please help to check conditions at the location (Warning Center)". If the recipient receives the message following the message by sending the message "Executed", then the recipient of the message only needs to respond the message by giving a warning code sent by the system, #COMX#WIDY (where X is the ID of the community member and Y is the ID of the warning message). If the case is finished or solved, the recipient can reply message with "Solved". Those messages will trigger the status of an early warning to be solved and no longer appear in the admin notification and the process

of sending broadcast messages to community members and the warning center will be stopped.

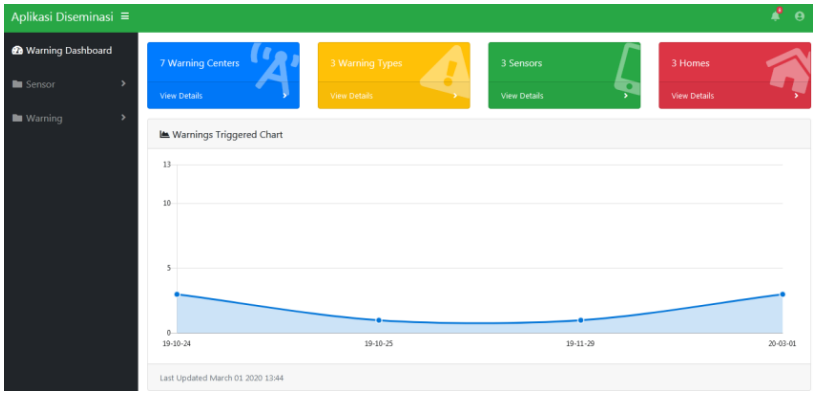

Figure 9 Warning Frequencies for Each Date

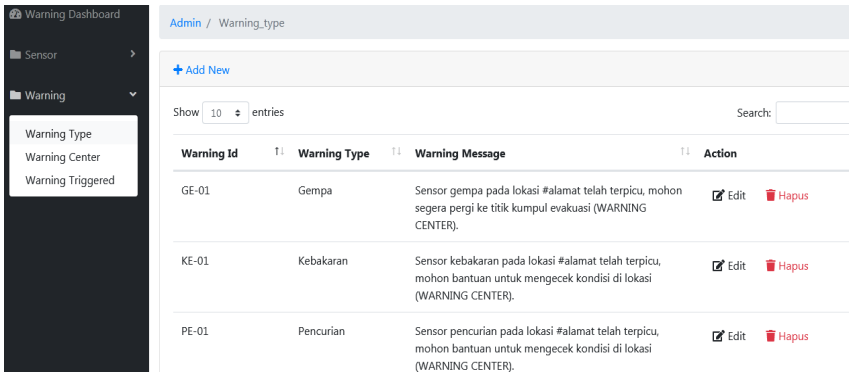

Figure 10 Warning Message for Each Type of warning

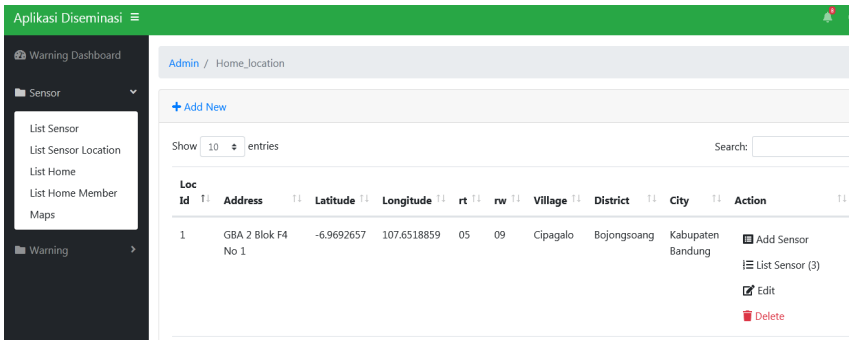

Figure 11 List of Registered Home and The Number of Sensor for Each Home

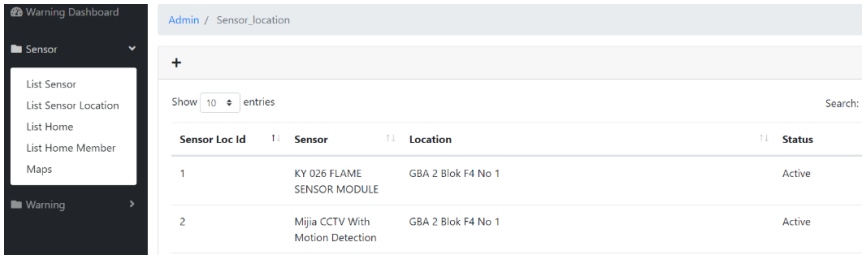

Figure 12 List of sensors available

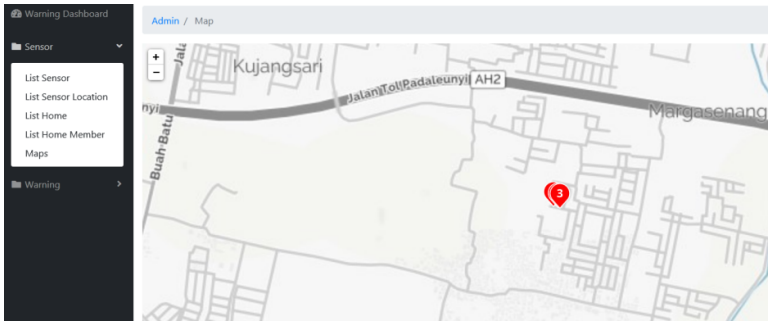

Figure 13 Warning notification on the map

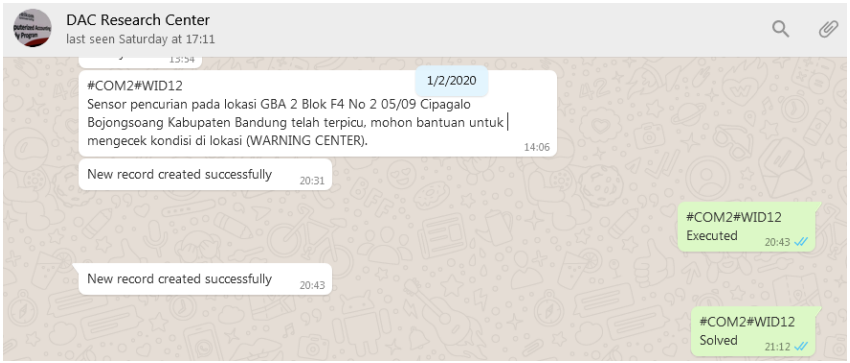

Figure 14 Warning Message and The Examples Response from Community Members

4. Conclusions

This research succeeded in making a prototype to disseminate early warnings by considering the distance of the location of the incident with the area of the closest community members. Dissemination of information will be automatically expanded if the event has not been handled or no one even has been executed. The response to the event is quite easy by the only reply to the message. The application was build using Code Igniter Framework, MySQL database, Mapquests, and Wablas API. This application can be used for disseminating emergency response situations such as thievery, a natural disaster such as earthquakes, etc.

The positive impact of this research is with this dissemination method; it can be used to disseminate all disaster warning information that can be triggered from all IoT devices which connected to the internet and registered to this application.

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