Implementation of wireless sensor network (WSN) on garbage transport warning information system using GSM module

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Abstract. The waste transport transportation system currently running is still using a scheduling system that prioritizes scheduled routes or locations. From the current system, it can be seen that there are still places that have accumulation of garbage. Therefore, a waste warning information system is needed that can provide information on the accumulation of garbage that must be transported immediately. Based on these problems, the purpose of this article is to discuss the creation of a prototype of a waste transport warning system by applying the Wireless Sensor Network (WSN) system using GSM communication media. The client system prototype is built using an ultrasonic sensor that is used as a full garbage detector, Arduino Uno microcontroller, GSM module. Whereas in the information system server system warning waste transport uses the mySQL, PHP and Gammu databases. From the test results it is found that the client system has been able to send garbage data in full condition to the information system server. And the server has been able to display the results of sending data in the form of web pages. Next from the waste transport warning information system page, the operator can send the full location data of the garbage to be immediately transported to the transporting officer in the form of an SMS.

1. Introduction

Environmental cleanliness cannot be separated from the freeing of waste in our environment. Garbage is a source of disease if left to overlap for a long time. And not only that, waste that is left to accumulate too long will also result in flooding if accompanied by flooding. Talking about the accumulation of garbage has occurred in many urban areas. And even the accumulation of garbage will sometimes exceed the load. For urban areas, garbage collection is always carried out by government agencies such as city cleaning services and some of them are carried out by private parties. Scheduled waste transportation system is one of the solutions carried out by the government and the private sector. This is done to facilitate transportation in balancing schedules from one place to another. However, if the garbage disposal is greater than the amount of transport, it will have an impact on the accumulation of waste that is too long. Therefore, a new system is needed that can anticipate the accumulation of waste that is too long by prioritizing the transport of waste from the location of the garbage collection that is full so that the waste does not overlap too long. In this article discusses the full waste warning information system design using the wireless sensor network (WSN) model by implementing a GSM communication system between client and server. With the full waste warning information system, it will help the relevant agencies to prioritize the transportation of waste.
in the area. In addition, the existence of this system can help people from sources of pollution that smell of sources of disease and causes of flooding.

The current development of sensor technology has brought users to remote sensor data transmission systems using computer network technology. Remote data transmission technology over a wireless network is also called the Wireless Sensor Network. Wireless Sensor Network (WSN) is a sensor device that can communicate wirelessly to an information system station to make it easier for objects to be detected and remotely processed. [1]. Wireless sensor networks usually have many nodes that are interconnected and communicate with other nodes using digital encoding and encryption methods [2]. The use of wireless sensor network technology has covered the use of military, environmental, health, industrial and residential applications [3].

The purpose of all Wireless Sensor Network (WSN) applications is the processing of data that has been sent remotely to be processed at the data processing center station in the form of a server. The data processing server consists of information system applications. An information system is a system that collects data and is processed according to agreed rules so that it becomes a decision [4][5][6].

One of the Wireless Sensor Network communication systems that can be run is to use communication technology remotely using a GSM module (Global System for Mobile Communications). As one of the standard cellular communication systems that are open and have one of its services is SMS (Short Message Service). Some applications that use application data transmission techniques based on embedded systems such as data transmission systems from fire and smoke sensors to the fire information system station using GSM module communication [7][8], and a gas leak information system using SMS Gateway communication [9]. And also one of the applications on flood disaster is a GSM-based information system in sending flood location data and flood height [10][11].

Discussing the application in the field of environment, waste is one of the objectives of application development which will be discussed in this article. Especially is the development of the implementation of the Wireless Sensor Network (WSN) in the waste management information system. The system developed is an integration between the Wireless Sensor Network model, GSM Communication and Information Systems.

2. Methods
The prototype method for creating information systems for waste transport warning based on wireless sensor network (WSN) is made in several stages, namely system analysis and system design. Where in the system analysis aims to make a system description that will be made starting from garbage detection to the operator receiving information from the system. While the system design aims to provide an overview of the block diagram of the entire system in the form of components used by the system.

2.1. System analysis
The system analysis that is built can be described can be seen in Figure 1 with the following description begins with the sensor placed in the full trash from location A and Location B will send a signal or data to the client system based on GSM transmitter and the client system sends data via SMS to Receiver modem on the Information System Server. From the computer the operator can see the full location data of the trash data through a web browser. To send information to the transportation officer, the operator makes an SMS sending action through the information system that is accessed by him.
2.2. System Design
For the design of a prototype system of waste transport warning information systems based on Wireless Sensor Network (WSN), a block diagram is needed that explains the components contained in each block of the client system and server system as shown in Figure 2. Starting with a client system that has an ultrasonic sensor as input block, the Arduino Uno microcontroller as the processing block and the output block consist of a GSM transmitter module. Whereas on the server system there is an input block in the form of a GSM receiver module and a computer as an information processing system block.

On a computer server there are several components that run information system applications warning garbage transport. In Figure 3 can be seen the component architecture contained in the server that is Apache Web server, MySQL as the database, PHP engine as the backend program interpreter and Gammu as the SMS recipient application from the client system. From the Apache web server, the operator can access the system. While Gammu is in charge of receiving SMS from the client system and sending the SMS from the information system to the garbage transport officer.
3. Results and discussions

Based on system analysis and system design, this study produced a prototype as shown in Figure 4. Overall the system shows that the client prototype can send information to the server and information to the garbage transport officer using the SMS Gateway. At the time of simulation the server uses a laptop that is connected to the modem as the sender to the garbage picker and receives an SMS from the client system.

The client system prototype is built as shown in Figure 5. That the client system uses an ultrasonic sensor placed above the simulation construction of the trash. The ultrasonic sensor is connected to the Arduino Microcontroller. Data that has been processed by the microcontroller is sent to the GSM modem module to the transport warning information system server.
The results of sending the full garbage condition data are received by the server and displayed on the information system interface for garbage transport warnings in the form of web pages as shown in Figure 6. On the web page there are four columns namely date and time received by data, location, garbage status and shipping form SMS to the garbage officer.

![Figure 6](image1.png)

**Figure 6.** Results of an information system interface warning of web-based waste transportation

The form of SMS sent through the web page from the information system warning the transport of waste by the operator to the waste transport transportation officer has an editor such as "Please immediately transport the waste to Location A because the garbage is in full condition (Operator System)" as shown in Figure 7.

![Figure 7](image2.png)

**Figure 7.** SMS editorial results received by garbage officers

### 4. Conclusions
Based on the results of the proposed system analysis for information systems for waste transport warnings described in general concept form. Furthermore, from the general concept form, it was developed into a system design in the form of a block diagram for client systems and server systems, accompanied by a supporting component server architecture, then produced a prototype information system for waste transport warning systems using the concept of the Wireless Sensor Network (WSN) system. From the test results it is found that the client system has been able to send garbage data in full condition to the information system server. And the server has been able to display the results of sending data in the form of web pages. Next from the waste transport warning information system page, the operator can send the full location data of the garbage to be immediately transported to the transporting officer in the form of an SMS.

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