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Real-time monitoring and warning system in urban rivers

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Abstract

Urban rivers water quality is not suitable for use. The volume of river water in the city is fast full when it rains. Both of these problems need to be monitored. The purpose of monitored to give a warning to a community around the rivers. The rivers water quality determined base on the pH sensor, and turbidity sensor detection. The river water level is determined based on the results of ultrasonic sensor readings. The reading of three sensors is sent via GSM (General Service Mobile) communication network in SMS (Short Message Service) form. The reading also sent via internet data communication network to the server and displayed on web page form. This study indicates that all three sensors are able to detect pH, turbidity, and surface level of the river. The Sensors reading delivered via the GSM communication network, it provides real-time river water information. Whereas sensor readings sent via data communication networks provide river water information that is not real-time. Thus, sensor readings of water urban rivers better delivered via GSM on SMS form than via data communication on Web page form.

***Keywords**: monitoring, real-time, system, warning, water*

1. Introduction

The water an urban river has been polluted and used by people who live in the river bank. Likewise Way Kuripan River and Way Kuala River in Bandar Lampung. The effect of using water urban river, somebody can be affected itching and diarrhea [1]. Communities use polluted river water because they do not know accurate information about the water quality of Way Kuala and Way Kuripan Rivers. The public should know the river water quality standards they use. There is information on pH and classification of its use as needed. There is also information on river turbidity [2]. When people living on the banks of the river know information on river water quality, they are aware of the risks of using polluted rivers. A healthy water pH for river water users and living creatures is 6.5–8.5 [3].

Another problem in urban rivers is river water that quickly overflows during rain because urban land cannot absorb rainwater [4]. When it rains upstream the river also causes water in the downstream of the river to overflow and cause flooding. When river water overflowed the house in a residential area, the river was flooded. When the house is flooded, a lot of equipment in the house is damaged. Damage to the items in their homes should be avoided if the people living on the riverbank know information about the water level.

Previous research on river water monitoring systems has been carried out. Research on river water quality monitoring that has been carried out includes monitoring pH and turbidity [4-8]. The method used in this study is monitoring river water quality with a pH sensor and turbidity sensor. The sensor readings are processed by the microcontroller and displayed on the monitor. Other research has been conducted to monitor water quality using the wireless sensor method. Sensor readings are processed by the microcontroller and send them to the server via a wifi network. After the results of river water monitoring are on the server, the server processes it and classifies it. Classification is divided into several categories, namely safe, alert, and dangerous [9-13]. The classification results are displayed on the LCD screen.

Whereas research has been carried out on monitoring river water levels. The research was conducted with the output method in alarm in the form of sirens. The sensor readings are processed by the microcontroller, then the microcontroller determines the status of the river water level. If the status of the river water level is on the threshold, then the siren will ring for a

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while. However, if the river water level status is at a dangerous level, the siren will sound as long as the status is detected [14-18].

This research was conducted to provide real-time information about the quality and water level of the Way Kuripan River and Way Kuala. The system is built using the Arduino Uno board as a local processing, pH sensor, turbidity sensor, ultrasonic sensor, and Arduino GSM Shield. Other systems that support the output of this research are web pages, and sms. The system for monitoring river water quality includes monitoring pH, monitoring turbidity, and monitoring river water level. The new method of this research is the method of delivering output reading pH, turbidity, and ultrasonic sensors. The output delivery method used in this study is to use the mobile general service network (GSM). Through these network services the results of sensor readings are sent to the people who live along the river in the form of SMS and WEB pages. In addition, the new method in this study is monitoring three components, namely pH, turbidity, and river level in one system. In the previous study, this was separated, ultrasonic sensor-based monitoring stood alone, pH sensor based monitoring, and stand-alone turbidity.

2. Method

The object of this research is rivers in urban areas. River water in urban areas needs to be monitored for quality. Quality monitored includes three elements, namely pH, turbidity, and river level. Then the method used to carry out surveillance by applying the sensors ordered detects pH, turbidity, and river water level. The sensors used to detect these three elements are pH sensors, turbidity sensors, and ultrasonic sensors. The sensors are connected to Arduino Uno for sensor control. Arduino is connected to a mobile phone device via a GSM Shield device equipped with a SIM card. The network used is a GSM mobile network as a medium for sending the results of reading sensors. Control delivery is also available on Arduino Uno. The relationship of sensors, Arduino Uno, GSM Shield, mobile phone devices, is shown in Figure 1. The flow of information that starts from the sensor reaches the public through two advance media, namely SMS and Web pages.

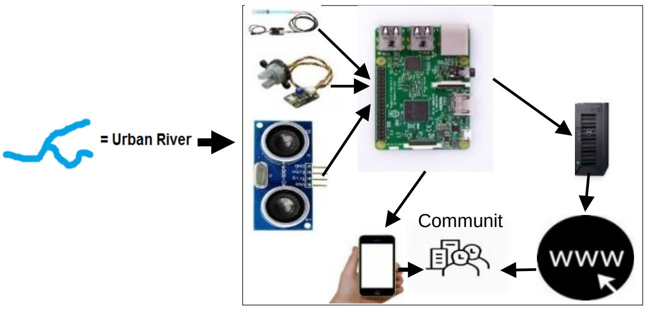

Figure 1. Information stream on monitoring and warning of urban river water

While the flow of this research is as shown in Figure 2. The first step starts from the analysis of the problems of river water in urban areas for people who live on the riverbank. The second step is analyzing the need for monitoring and warning the river water in the city. Design a series of component schemes for monitoring systems and river water warnings in urban areas. Assembly of components used, calibration and coding of commands for sensors and interface coding. Next synchronize components with interfaces. Then the data communication calibration is used to transfer river water information. Trials and implementation as well as testing system performance is the last stage before the activity concludes the research results.

In addition to talking about time, the real-time systems are also required to be able to provide appropriate response to input. In this system, the system is required to provide output in accordance with the reality. The example if the pH of water is actually nine, then the system is expected to give the same output, also for reading turbidity sensor elements and ultrasonic sensors. Therefore, the next thing that becomes an indicator of test standards that must be met in real-time monitoring system is the accuracy between the output systems with the real. The equation used to test the real-time system response time is as in (1).

$$Real - time\ Performance\ (Response\ Time) = \frac{Respon\ Time - Real - time}{60} \quad (1)$$

while to test the accuracy of the information sent it can be tested by the comparison of information in SMS and web display with the actual situation.

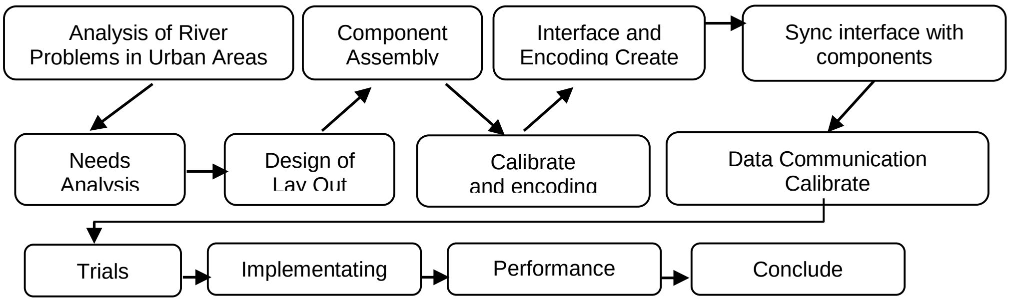

Figure 2. Flows and stages of research implementation

3. Results and Discussion

The result of this research is that a system capable of monitoring river water in cities includes three components, namely monitoring the pH of river water, turbidity of river water, and elevation of river water level. In addition, the results of this study are a system that is able to give a warning to the community around the river about the pH of river water, turbidity of river water, and about the water level of the river. The results of river water monitoring are displayed in the form of SMS output. The sensor readings listed in the form of SMS are pH of river water, river water height and turbidity. Sensor readings sent in the form of SMS are sent via the GSM network. This shipment is done by the GSM Shield which is installed on Arduino Uno. The results of sensor readings are also provided in the form of web pages. These results are sent by the system to web pages via the internet network. Sensor readings that appear on web pages have pH, turbidity, and river water level.

Sensor readings provided in both forms (Webpages and SMS) have different real-time properties. Tests conducted show differences in the timing of sensor readings delivered at local processing, on SMS, and on web pages. As shown in Figure 3, the first characteristic is that the ultrasonic sensor reading is very real-time than the other two sensors (turbidity sensor and pH sensor). Ultrasonic sensor readings delivered to local processing and texting from two rivers installed by ultrasonic sensors provide real-time reading results. While the ultrasonic sensor readings from two rivers that are delivered to web pages have less real-time characteristics. Both have a difference in the time of receipt of the results of the sensor reading ± 4 minutes. But the system is able to give a warning to the surrounding community to be aware of the overflow of river water.

The next characteristic is the results of turbidity sensor readings delivered to local processing, to SMS, and to web pages that do not have significant differences in real-time properties. However, overall the results of turbidity sensor readings sent to the three outputs are of less real-time nature. The time of receipt of turbidity sensor readings with turbidity events has a difference of ±28 minutes. But because turbidity can also be detected in plain view specifically for river water that has a depth of ≥1 meter, the surrounding community can also determine the feasibility of river water used. The system is able to provide information on turbidity of river water as a warning about the level of turbidity of river water for people who use river water.

The last real-time characteristic is the result of reading a pH sensor that is sent to local processing, to SMS, and to Web pages having very less real-time properties. The difference between the occurrence of contamination and the results of the river water pollution reading is ± 37 minutes. In addition, the results of reading a pH sensor sent to a webpage have more non-real-time properties. This is because the pH sensor used has a slow reading response, so the information sent to local processing, to SMS, and to web pages has a large delay.

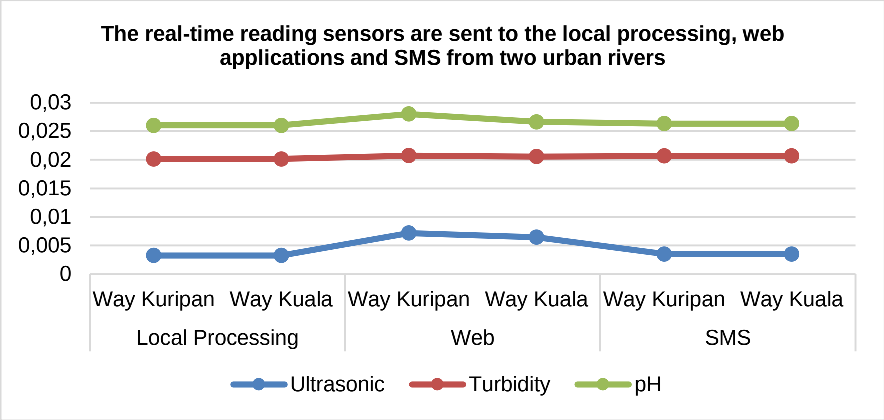

Figure 3. Real-time characteristic of monitoring and warning urban river system

Another result of this research is that the real-time results of the third reading of sensors sent to local processing are more real-time than the results of the third reading of sensors sent to SMS and Web pages because of network influence. The influence of the network in question is the ability of the network to transfer the results of the third reading of the sensor to a Web page. Seen in Figure 3, the results of the third reading of the sensor to the web page (using internet networks) have the largest delay time than local processing without network and SMS using GSM networks. The results showed that the sensors used to measure physical things such as shorter distance response times than the sensors used measure the biological elements. In accordance with the research of Miguel F Acevedo, it was claimed that sensors that measured physical things having shorter response times than biometric and chemical measuring sensors [19-20].

The difference response time for local and web processing According to research by Xuefeng Liu, Jing Zhu, Jianhua Mao, Xiaoming Shao, and Longlong Lu, the long time difference was caused by the protocol used. As a result of their research, the web sensor protocol using German company SensorBus is 52 minutes, the result is the difference between the real time and the output time of sensor readings on the web an average of 40 seconds [21]. Whereas in this study do not use the 52 north protocol, but use web services that support sensor communication with web applications.

According to Aiman Zakwan Jidin, Lim Mei Sze, and Norfadzlia Mohd Yusof who examined home security and web-based automation systems, a web service was needed that was able to reset periodically to ensure sensor readings appeared on web pages in real-time [22]. In addition, according to several experiments conducted by the author, that there was an influence of the web-browser used on the difference in the time of receiving data from the sensor. Another opinion from P Veerakumar that examined energy monitoring with a web page-based user interface, even though the output time on the web page was slow, but actually the reading data was already in the database system in real-time [23]. The thing that causes a large time difference between the acceptance of the database system and sensor readings of web page views is influenced by many factors, one of which is the service available on the web page itself.

Another factor shows that general service general (GSM) network service also influences the system output time on the web pages, as revealed by Muhammad Ilyas Afridi, et. al about the GSM-based Distribution System that the delay time was 6%-10% [24]. Especially the data communication on Web Service applications had the delay time of 6%-10% which was still in the fair category [25]. According to S. Ranjith et al. who examined GPS and GSM communication as a dangerous zone warning for anglers, finding the same thing that the sensor communication and GUI or storage had an average delay time of 6-10% [26].

4. Conclusion

This monitoring and warning system can provide real time warnings. The three sensors have different real-time characteristics in giving the reading results. The sensor that is very real-time in delivering readings is an ultrasonic sensor. While turbidity sensors and pH sensors both have characteristics that are less real-time. In addition, sending information from sensor readings to web pages is less real-time, while sensor readings delivered to local processing and SMS have real-time characteristics.

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