Design Simulation on the Management of Water Pumps for Flood Control using Web Server and Arduino

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***Abstract* - The water level in the pump house that already exists in urban areas are not monitored well and caused flood. Water pump management in the pump house is very useful in speeding up the handling when the water level is already high in order to not caused flooding. Pump house itself is a container while the volume of water that is located in urban areas are piped to the river or sea. The existence of automatic application makes the water level in the pump house can be directly handled as the Web Server that is connected to the Arduino microcontroller which would give the order for the water pump switch on automatically. There is an application as a backup when not working automatically with the help of an operator to run it. The status of the water level is divided into 3 status normal status, standby status and highest status is the warning status. There is also an alarm as a warning that sounds when the status of the water level is at Alert status. The data of water level, the water status, the status of the pump and tool status can also be monitored in real-time through Web Server application.**

Index Terms - Pump House Management, Flood Warning System, Water Altitude Status, Remote control, Arduino.

I. INTRODUCTION

In the modern era, and advanced many new innovations that help the human work. Innovation is usually associated with the discovery of new and renewal that requires technology which helps man to implement his idea into a masterpiece. With the increasingly sophisticated technology, the authors will design a management simulation water pump in the pump house.

This study is based on Tempo's website on 20 December 2014 [1] noted that of the many natural disasters that occurred in Indonesia, floods are the most frequent natural disaster occurs. Flood itself often occur in Indonesia, especially in big cities like Jakarta and Surabaya. Torrential rain that will result in the capacity of water in rivers flowing into the pump house will overflow. As a result of the overflow of water inside the pump house will disrupt community activities around the pump house.

The author conducted a field survey by visiting some of the pump house located on East Surabaya. Information obtained from the survey of the field is in every house there is a person who is assigned pump keeping the pump house. But the guard has another job and if deemed no rain then the guard will leave the pump housing so that the water level cannot be monitored. At the time of site surveys also found that guard sleeping during working hours and so cannot know the status of the water level. Especially at this time, predictions are often less accurate rainfall where rain often fell abruptly. Measurement of water level in the pump house is also measured manually by looking at the water level limit. At each house, water pump is turned on manually via a button on the machine.

With the information obtained, the researcher will design a management system that will overcome the water pump water level in the pump house. This was done by means of water pump activates automatically when the water level reaches a certain status. Water pump automatic deactivation can occur when the water has reached normal height. Measurement of water level in this simulation using a sensor that is connected to the Arduino microcontroller [2] that will connect to the server and the water pump.

Making the simulation uses two pieces of container that the first container is assumed as the pump house and the second container as rivers with strong currents or water catchment areas. In short the process that occurs in this simulation is the removal of water at a certain status which is at the primary container to the second container to avoid the main container overflowing.

The aim of this research is to create a simulation of the pump house management system based on the situation in Surabaya. Therefore this simulation can be reflect and implement to a real pump house, to help to mitigate the flooding impact and control the flood based on the water level.

II. RESEARCH METHODS

A. *Methodology*

Simulations were designed in this study is to manage the water pump. This simulation uses two pieces of container that simulated a pump house and rivers with strong currents or water catchment areas. The water level is measured by the ultrasonic sensor that will divide into 3 pieces status. The third status is the status Normal, standby status and the last is the Alert status. Alert status is the top point of the water levels that were located closest to the Ultrasonic Sensor. The simulation also a water pump that will move the water that is on the main container to be moved to the second container. There are two water pumps that will work when the water level shows the Ready state and Alert status. The first water pump will turn on when the water level status is in standby status. While the second water pump will turn on when the water level reaches the status Alert status.

All of the running system is controlled at the server. The server contained within the PHP programming language command automation in the activation and deactivation of the water pump [3]. As there is a manual backup activation and deactivation of pump water through applications that can be accessed by Operator. If the altitude reaches Alert status and the standby status Ultrasonic Sensors connected to the Arduino sends the data to the server. The operator can know the status of the level after Server obtain elevation data from the Arduino [4]. All data on the status of the water level, the status of pump performance and the status of the device will be stored in the server. There is an alarm that will sound continuously when the water level is at Alert status

B. *System Design*

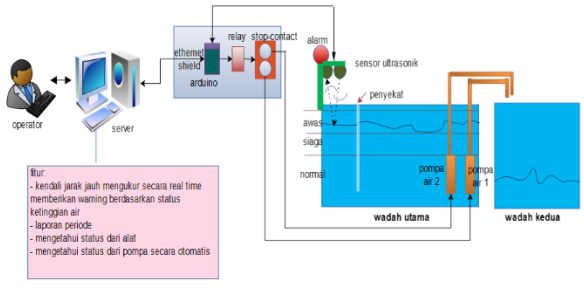

Fig. 1 System Design Water Pump Management Simulation.

From the figure 1, can be explained as follows: There is an operator that takes action when there is a warning as the water level reached and the alert status Alert status. Operators can also monitor the performance status of the water pump in the pump house, the problem in the transmission apparatus or the connection to the device is disconnected. Operators are also able to provide a monthly report as the report period for the boss.

Working system of simulations that are Server which serves as the manager of all orders[5]. The server will turn on and turn off automatically when the water pump Ultrasonic Sensor connected to an Arduino Uno transmit data water level status. Ultrasonic Sensor serves as a water level gauge that sends and receives sound waves reflected back. Ultrasonic sensor uses an ultrasonic waves which have a longitudinal characteristic and usually works in a frequency above 20 KHz. Ultrasonic waves have a characteristic to create a particle motion with the same medium aptitude toward the same longitudinal direction, thus can create the medium aptitude became strain and stress [7]. The ultrasonic wave can move through the air with the speed 344 Meters/second. Ultrasonic sensor work with sending ultrasonic waves to an object and catch the waves back, differentiate time between each waves can determine the distance between the sensor and the object. For further information about how the sensor can determine the distance can be formulated as follows:

$$S = \frac{tIn \times V}{2} \qquad (1)$$

Where:

- *S* is the distance between object (meter)
- *V* is the speed of ultrasonic waves through an object (Km/s)
- *tIn* is the time differentiate in seconds between sending and receive of the ultrasonic waves.

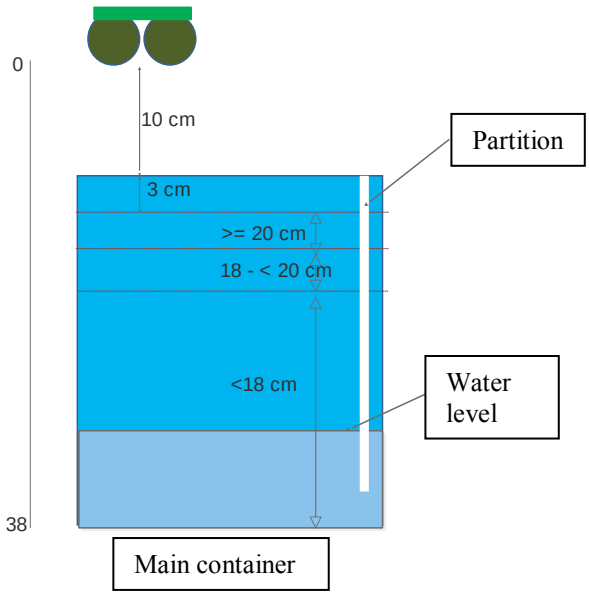

Fig. 2. Water Elevation Modeling.

From the Figure 2: Water elevation modeling, is important aspect how the sensor can measure and determine the status of water level. Suppose height of the container is 28 cm. Sensors placed on the container at a distance of 10 cm. There are three status contained in the simulation. Alert status has the shortest distance to the sensor but the calculation of

height values greater Alert status is equal to 20 cm. Standby status altitude value is 18 to less than 20 cm. while the value for the status Normal height is smaller than 18 cm.

There are two actors in this simulation which is operator and supervisor. The task of operator is able to see the status of the water level of the server so that the operator know the latest status of the water level at each pump house. As a backup operator can activate the water pump through the application. When the status of the altitude alert pump1 turned on, when the Alert status pompa1 and pump2 turned on in order to discharge faster performance when using two pumps. Operators can also shut off the water pump first and second through the application after seeing the status of the water level is at Normal status. Operators can also view the status of the water pump performance, status tool connected or not connected. Automation of life or death of a water pump also works after the server gets the data about water levels.

Supervisor task can only see the report period in the Server so it can determine the time when the water level reaches some status. The report also contains the status of the tool and status of the performance of the water pump in the pump house. These report will help the supervisor in decision making process thus can help to determine whenever those area need another pump or the strategy how they operate the pump.

III. Implementation and Discussion

A. Implementation

The Implementation tools used in this simulations using several parts assembled into one. Some sections are:

1. The series of Arduino
2. The series Ethernet Shield
3. The circuit Relay Board and Stop-Contact
4. The series of Ultrasonic Sensors
5. The circuit Pump

Furthermore to give some illustration of the simulation design can be present in Figure 3 and 4 respectively.

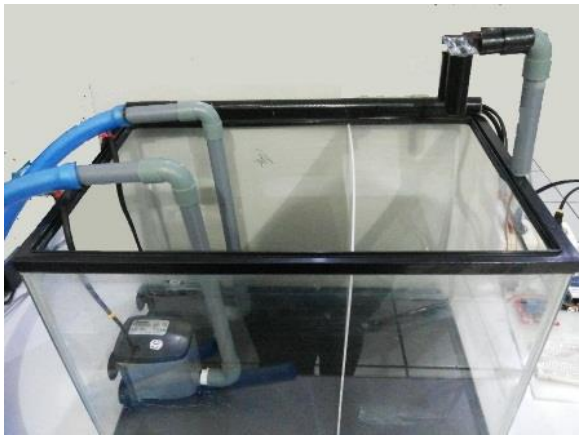

Fig. 3. Water pump and sensor in aquarium

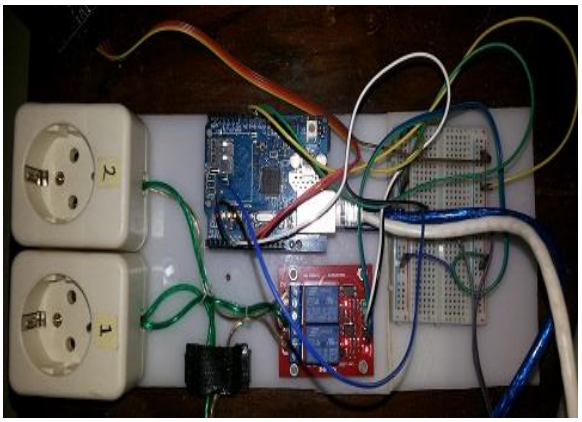

Fig. 4 Circuit design using arduino and relay board

Figure 3, can be explained as follows: In this series of water pumps will be placed in the aquarium to function as the transfer of water from the main container to be moved to another container. In the simulation takes two pieces of aquarium pump is placed next. At the aquarium pump added water pipes and water hoses to the water removal process.

Furthermore, from figure 4, can be described as follows: In this series there are two Relay Board as a water pump switch. At Relay are NC (Normally Close), Com (Command) and NO (Normally Open) [6]. NC normally as Active Low while NO to Active High. Installation in this circuit, the Relay1 and Com on Relay2 combined. Relay1 NC and NC Relay2 not connected to anything. NO Relay1 connected with Stop-Contact1 while NO Relay2 connected with Stop-Contact2.

Pin contained in Relay consists of 4 ie VCC pin, pin Gnd (Ground), pin IN1 and IN2 pin. The fourth pin located on the Relay will be connected with the female-male jumper cable to pin contained in Arduino. In the manufacture of circuit simulation at the VCC pin Relay connected with Arduino 5V pin. Pin relay and Gnd pin connected to the Arduino. Relay in1 pin is connected to pin 6 in Arduino. Relay for In2 pin connected to bread board that has been interconnected with the pin to 5 Arduino and positive pin so that the workings Buzzer as In2 Relay.

Lastly, the implementation of the system in the form of display on each page which is an application for running the simulation. There is the home page, the page manual pump operation, pump status page, water level status page, status tool, report page and the login page that can be accessed by the operator. While pages that can be accessed by only the login page supervisor and supervisor period reports page. The screenshot of the web system can be shown on figure 5.

Fig. 5. Web interface for water level monitoring

On this page there is the status of the water level will be updated continuously shows the value of the water level, time and status of water. Data value of the water level, time and status of water levels that appear on this page as much as 20 data. Data status information will change the color of the water level when the water level is at Alert status (red) and standby status (yellow). To be able to run automatically obliged click the article the automatic mode so that the process can be run automatically.

B. Discussion

The conclusion that can be drawn from this simulation is as follows:

1. this simulation can help to manage the pump automation in pump house to prevent the flooding
2. Data related to the water level, time, duration and water status is automatically saved thus can help in determining the prediction of the flood period.
3. Automation and manual control can help the operator to operate or to stabilize the water level quickly.
4. This simulation can be a solution for automation in pump house without any operator.

From the simulation result shown a good response, but for the implementation maybe still need a lot thing to consider, especially the facilities like stable internet connection and a computer in each pump house will be another issue. Obviously this simulation model can be expanded to various situation and may have different result in each implementation.

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