Model development of flood control system for sluice

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Abstract. Along with technological developments, the agricultural sector should also integrate it into agricultural systems. Problems with regulating water and monitoring the amount of water are often difficult and eventually lead to flooding. The aims of this research is to develop a model for a real time wireless flood control and monitoring system for sluice in “subak” area in Bali using the ultrasonic waves. This model development and integration is supported by the advance of electronics and information technology, have built a system which can automatically sense the water level at a sluice and then send these values to the control circuit through connecting cable. The ultrasonic module HC - SR04 is used as a distance sensor for detecting water level by measuring distance between sensor and water surfaces. This sensor placed above the sluice gate and gives electric input to the sluice drive electric motor. This model also equipped with LCD screen to displays the measurement data. Then depending on the measurements, the LCD screen show that the current status of water level in the sluice. The result of this research shows good agreement for the application of ultrasonic waves device for flood controlling and monitoring system for sluice.

1. Introduction

Flood disasters still occur regularly and continuously in Indonesia. Flood can be occurs due to the volume flowrate of water in the river exceeding the river body. A lot of impact caused by flooding not only material losses but also fatalities. In agricultural sector huge number of waters also gave big problem. Especially in Bali with “subak” system, problems with regulating water (Figure 1) and monitoring the amount of water are often difficult and eventually lead to flooding. The impact of flooding can be reduced if the community awared to face the coming of the flood [1, 2].

One way is to comunicate the information of the water level quickly to the community by using automation in technology [3]. With the rapid development of programming in the microcontroller, automatic control for storing water, distributing water in open channel and others watering systems can be done. Based on the description above, a transformation in the agricultural industry is urgent to do. Automatic tools will be built based on the Arduino Uno Microcontroller and the Atmega 328p board as the core of processing data. The Uno as the brain tool will control the sluice, aided by proximity sensors (HC-SR04) to support the measurement of water and a DC motor to control open-close the sluice.

Advanced sensor in automation proximity technology called ultrasonic sensor. For example, an automotive body vehicle receives environmental information especially distance with other object, converts it into a signal and performs an action like warning the driver. The emitter of ultrasonic part transmits a burst of ultrasound to the environment surrounding the sensor. The obstacle object reflects back to sensor receiver, the echo is received the sensor and generates an impulse [4, 5]. Developing a control tool for water in agriculture, environmental issue, irrigation system, monitoring of soil humidity, waste and reuse of waste nutrient for watering system with controlling the flow of hydroponic nutrients plants using proximity sensor HC-SR04 automatically [6-10].

Figure 1. Agricultural sluice.

The fidelity of the detection of obstacles and the measurement estimation between the obstacle and the user influence by the distance of object from the sensor, the motion of the object or the sensor, the temperature and pressure at working condition [11].
The objectives of this study were:

- Design, build, instrument, and control the model of sluice system.
- Experimentally evaluate the proximity/ultrasonic sensor characteristics.
- Compare the experimental results between ultrasonic measurement and manual measurement data.

In relational with this goal, the Arduino Uno uses as the brain of the appliance supported by proximity sensor (Ultrasonic HC-SR04) to detect the level of water. The DC motor gear which has low speed high torque with 108 rpm equipped by L298N motor driver module to control the way of rotation of DC motor. All of the data will be display on LCD.

2. Physical description

The concept of ultrasonic wave generated by the sensor are presented in Figure 2.

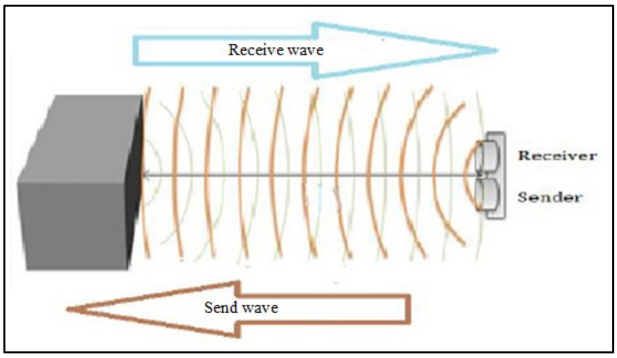

Figure 2. Concept of ultrasonic signal.

Electrical energy is converted into sound to transmit the pulse to the surround. The sound that is received back is transform into electricity. Thus, the lag of time between the sent and received soundwave signal is used to calculate the distance to the object.

3. Experimental apparatus and method

The acquisition, process and output of the study are shown in Figure 3.

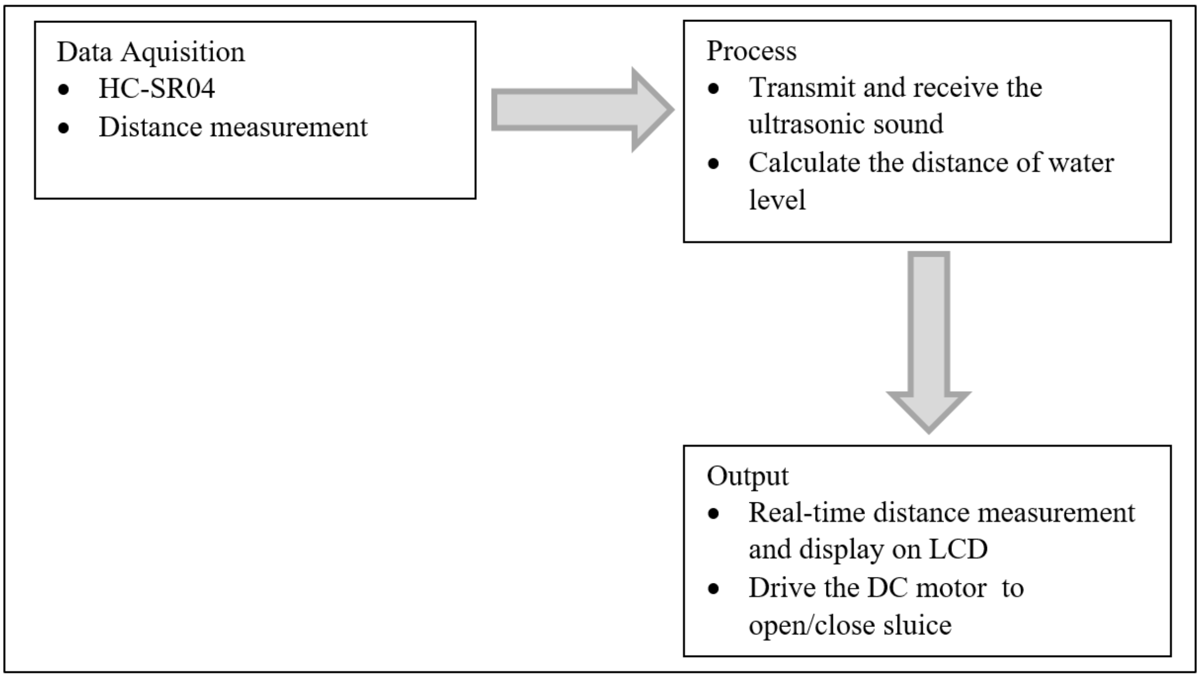

Figure 3. Methodology of study.

The major component and the logical flow of systems shown in Figure 4 below:

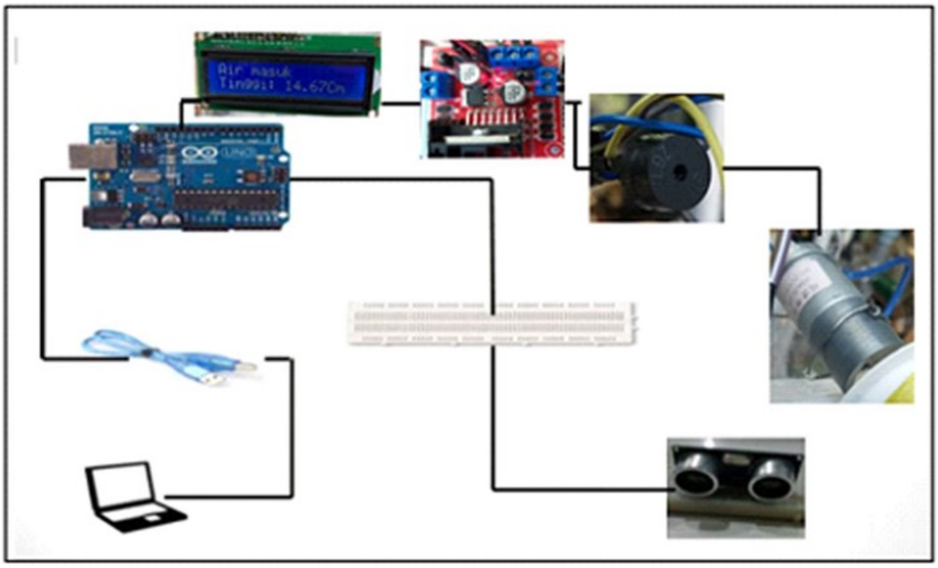

Figure 4. Experimental setup.

4. Results

A model of an actual sluice system built in laboratory scale. It is equipped with an ultrasonic sensor, DC motor gear which has low speed high torque with 108 rpm equipped by L298N motor driver module to control the way of rotation of DC motor, a buzzer to warn the over flow on sluice. The height of water level data sent to the LCD display and recorded through serial data logging of Arduino. A program using C programing languages which created on computer, uploaded to processor using USB cable. The model of agricultural sluice in this investigation shown in Figure 5.

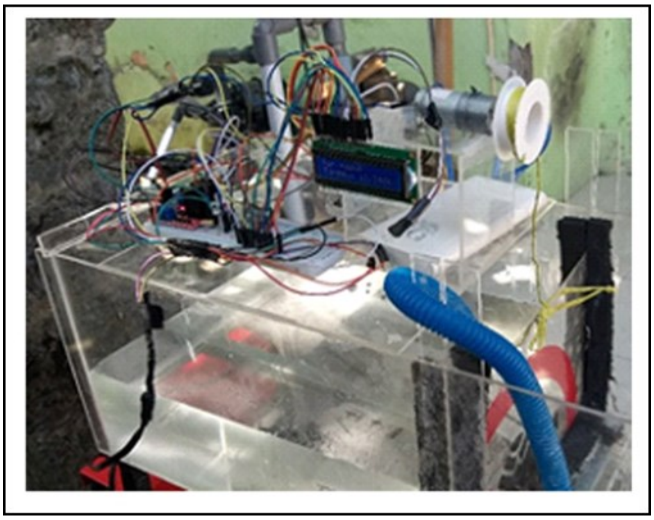

Figure 5. Laboratory model of sluice.

The test investigation on sensor measurement carried out in this study was to measure the change in distance (water level to the sensor position) when given a reference water level for measurement in three different sensor position at the water channel.

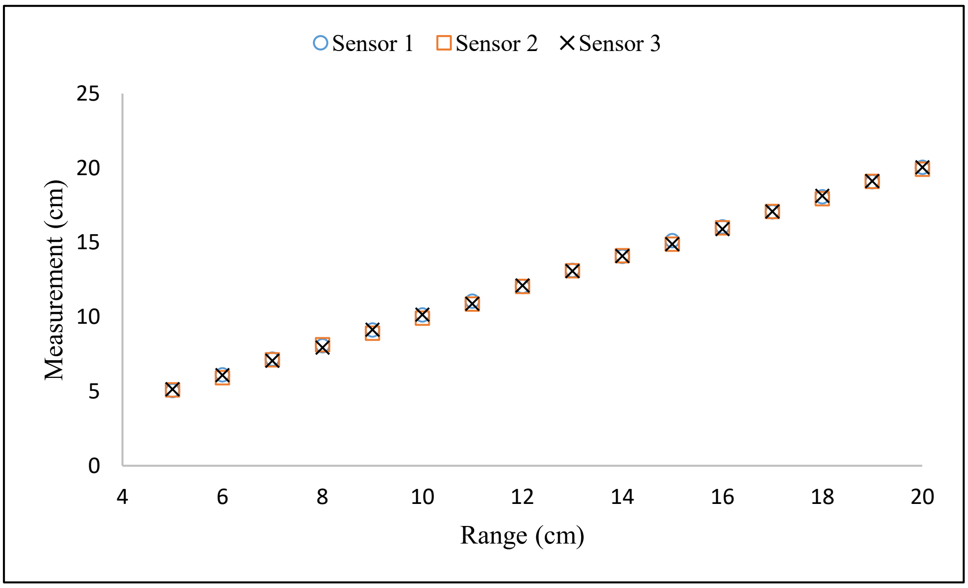

Figure 6. Comparison measurement between three sensors HC-SR04.

The result shows in Figure 6 that the comparing measurement between distances displayed and recorded by the ultrasonic sensor and the real distance shown on the bar (x axis) slightly difference with error about under 2%.

5. Conclusions
This work implemented and built a prototype of a new agricultural sluice for modeling agricultural sluice on laboratory scale. The experiment apparatus model, consist of three ultrasonic sensors. The experiment is able to give positive correlation. The validation test shows great agreement between ultrasonic sensor HC-SR04 and measurement bar with error under 2%. This meant that the ultrasonic sensor was efficient to calculate the measurement of water level in agricultural application.

6. References
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