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Water Level Detection System using Virtual Instrumentation for Monitoring Flood

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Abstrak. Indonesia merupakan negara yang sering mengalami bencana, salah satunya adalah bencana banjir dimana setiap tahun pasti wilayah Indonesia mengalami kebanjiran. Oleh karena itu dibutuhkan suatu sistem instrumentasi yang mampu mendeteksi tingkat ketinggian air sebagai salah satu sistem pencegahan berupa sistem peringatan dan monitoring. Pada penelitian ini dibuat suatu rancangan pendeteksi ketinggian air pada suatu tempat dengan menggunakan Water level sensor berupa jenis funduino beserta buzzer module dihubungkan dengan arduino uno sebagai Master Control Unit (MCU) yang mengelola hasil pembacaan sensor menjadi data digital. Selanjutnya tampilan data berupa grafik dan numerik ditunjukkan pada display komputer (laptop) dengan menggunakan antarmuka pengguna grafis berbasis LabVIEW.

Kata Kunci: *Arduino, Water Level Sensor, LabVIEW, Banjir*

Abstract. Indonesia is a country that often experiences disasters, one of which is the flood disaster where every year the territory of Indonesia is definitely flooded. Therefore we need an instrumentation system capable of detecting water level as a prevention system in the form of a warning and monitoring system. In this research, a water level detection system was designed using a water level sensor called *funduino* and a buzzer module was connected to Arduino Uno as a Master Control Unit (MCU) which manages the sensor readings into digital data. Furthermore, the data displayed in the form of graphs and numerics were shown on a computer display using LabVIEW based on graphical user interface.

Keywords: *Arduino, Water Level Sensor, LabVIEW, Flooded*

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INTRODUCTION

Indonesia is a country that has two seasons, namely the rainy and dry seasons. The rainy season that occurs ranges from October to March, while the dry season ranges from April to September. During the rainy season, the total volume has abundant amount of water, it will cause river water overflows and is unable to accommodate the excess volume of water. This condition is caused by the volume from body of water such as a river or lake that overflows or breaks a dam so that the water comes out of its natural limits. Floods often result in destructing to houses, roads, plants and other buildings [1]. If flood does not overcome using a good management of disaster mitigation system, this situation will cause the victim or casualties[2]. The previous studies said that ultrasonic sensors can be applied to measure the distance of water level. However, in this paper using a water level sensor to detect the water level, and buzeer modul is used as alarm system to give a signal that the water is full in tank. The system works when water reached the sensor and it would be detected.

Many experiments have been carried out using LabVIEW and Arduino, such as automated monitoring of the water level using LabVIEW to overcome water supply shortages.[3] The next research was implementation of the IoT based on system for the large-area management of the water distribution system using LabVIEW[4]. After that LabVIEW is used as user-friendly, computer-controlled instrumentation and data analysis technique that can revolutionize the way measurements are made, allowing theoretical predictions, simulations, and actual experimental results compared by almost instantaneously[5].

The proposed measurement system in this paper was designed by connecting the a water level sensor called *funduino* and a buzzer module was connected to Arduino Uno as a Master Control Unit (MCU) which manages the sensor readings into digital data. Furthermore, the data displayed in the form of graphs and numerics were shown on a computer display using LabVIEW based on graphical user interface. Then the data is processed and displayed on the front panel in LabVIEW as the results of monitoring the flood.

METHODOLOGY

In designing this virtual instrumentation system consists of several steps, namely the General Design of the System, Hardware, Software which contains an algorithm to carry out the measurement data acquisition process. The system design framework generally consists of several blocks that are interrelated and integrated with each other, so that they can work together to achieve goals. The system circuit diagram can be seen in Figure 1. In accordance with the flow of the circuit diagram the system consists of the Input, Process and Output sections. The input section consists of a water level sensor and a buzzer module, the process part consists of the Arduino Uno module, the GUI uses LabVIEW and the Output section consists of the computer as display monitoring.

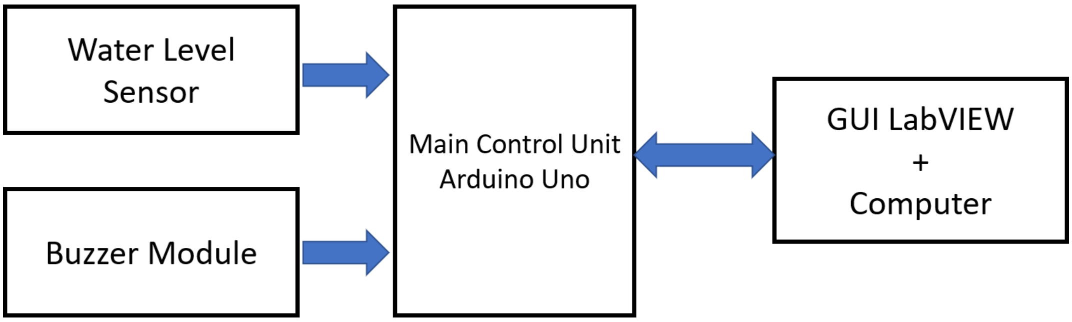

Figure 1. Flowchart Diagram Of Water Level Detection

RESULTS AND DISCUSSION

Hardware Design

Arduino Uno R3

Arduino Uno is a circuit board based on the ATmega328 microcontroller. This IC (integrated circuit) has 14 digital inputs / outputs (6 outputs for pulse width modulation (PWM), 6 analog inputs, a 16 MHz ceramic crystal resonator, universal serial bus (USB) connection, adapter socket, ICSP header pins, and buttons reset. This is what needed to support the microcontroller so that it is easily connected with a USB power cable or AC adapter power supply cable to DC or also battery [2].

Water Level Sensor (Funduino)

This sensor is designed to detect water that can be used widely, namely detecting rainfall levels, water levels. This sensor works with the digital I/O pin of the Arduino or can use it with an analog pin to detect the amount of contact induced by water between the ground and the sensor trace. This sensor can measure the water level by going through a series of parallels, it can also measure water droplets / water size. It is easy to convert the water size into an analog signal and output, the value is directly used in the program function to achieve the water level alarm function. The characteristics of this module have low power consumption and high sensitivity.

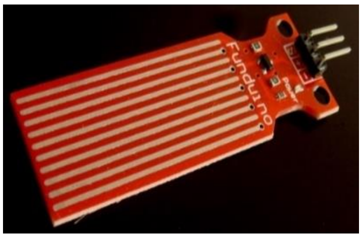

Figure 2. Water Level Sensor

Buzzer Module

A buzzer is an audio signal device, which may be mechanical, electromechanical, or piezoelectric. Use of the buffer as an alarm device, timer and confirm user input such as mouse clicks or key stokes. Buzzer is an integrated structure electronic transducer, DC power supply, widely used in computers, printers, copiers, alarm, electronic toys, automotive electronic equipment, telephones, timer and other electronic products for sound devices. Active buzzer 5V rated power can be directly connected to continuous sound, this section is dedicated sensor expansion module and board in combination, can complete a simple circuit design, to "plug and play"

Figure 3. Buzzer Module

LabVIEW

LabVIEW is a graphical programming language for instrumentation, data acquisition, automation and control as well as communication. This software is a developer as well as the programming language C / C ++, FORTRAN or BASIC. LabVIEW program is designed to be machine independent so it can be transferred between operating systems. LabVIEW also has many tools for handling mathematical functions, graphical data visualization and input data objects that are commonly found in data analysis and data acquisition applications [6]. In this research uses LabVIEW 2017 of student version that obtained from www.ni.com. The first step, we can create account there. After that you can get free for student.

The system works when the water level sensor and buzzer module are connected to the Vcc pin with a 5V power supply and the black wire connected to the GND pin on the Arduino. Output of Water Level Sensor, namely the blue wire connected to Analog pin A5, while the green buzzer wire is connected to digital pin 13 on the Arduino. The USB port is connected to the Personal Computer to transmit the results from Arduino to LabVIEW and then perform data retrieval.

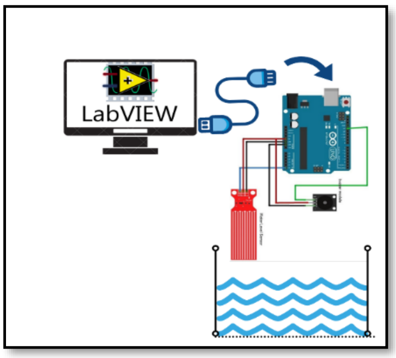

Figure 4. Block Diagram Proposed Design System

Software System Design

Figure 5 Block Circuit Diagram in LabVIEW software used for programming is LabVIEW and the programming package in VI Package Manager (VIPM), namely Maker-Hub. It is usually used for communication with Arduino, at the time of creating the program. The first step to build the program is by uploading the firmware to Arduino from the LINX Maker hub package on the LabVIEW tools then if the serial port has been read on the Maker Hub, that means the program can work properly. If it does not work or the serial port has not been read, it is preferred to download the NI-VISA Driver first for running the program on LabVIEW when it is connected to Arduino and the serial port has been read on LabVIEW. Analog output The output from the water level sensor is displayed on the LabVIEW front panel in the form of a voltage value and displayed on the tank.

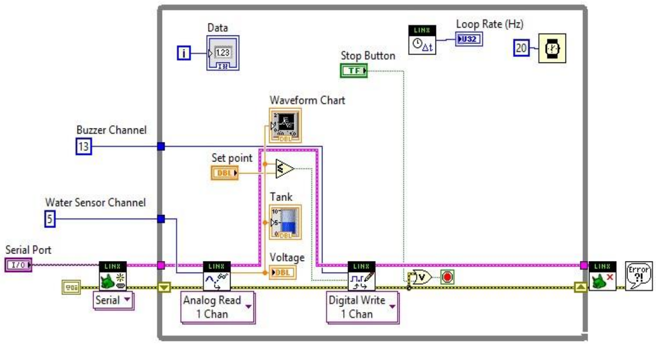

Figure 5. Block Circuit Diagram of LabVIEW

IMPLEMENTATION

Based on the results of implementation that the prototype had been successfully created using hardware contains of water level sensor and buzzer to connect the Arduino uno. The output from this sensor is s signal analog of Voltage sent by Arduino to LabVIEW for displaying. Then the data are processed and displayed on the front panel in LabVIEW as the results of monitoring the flood. We can see figure 5 displays of monitoring of front panel of LabVIEW. It seems simple but it is very friendly for user for monitoring the condition such as tank, dam, river, lake and so on.

The advantages of this system have water level sensor which are low power consumption and high sensitivity compared ultrasonic sensor that needs high power, low accuracy, not operate moving parts and temperature correction is required.[7]. According to the studies said that the best instrumentation system which can measure fast, non-destructively and environmentally-friendly[8]. From figure 6 can be seen the menu such as serial port shows that when com 3 is active, the system will work. And the loop rate has the function to obtain sampling the data. Then set poin has the function as the menu to adjust a limitation of voltage. We can see figure 6 design system that will become a virtual instrumentation of measurement.

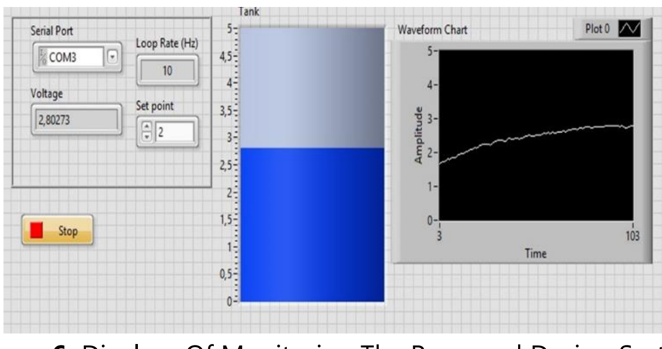

Figure 6. Displays Of Monitoring The Proposed Design System

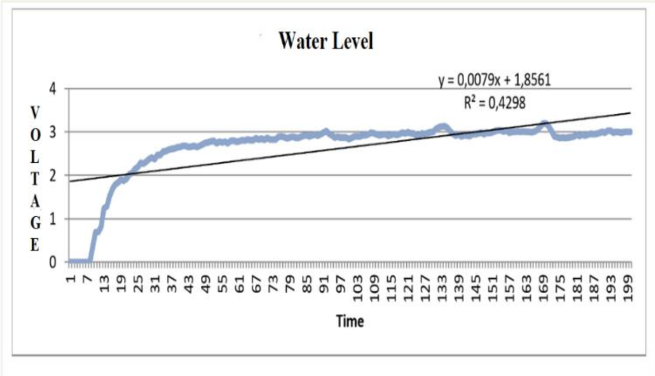

Figure 7. Graph Of Voltage Versus Volume Of Water Level

Figure 7 shows the value of voltage from sensor when water level reaches the sensor surface. The data obtained of the voltage value and the water level sensor when control panel is set the value set point 2, namely the maximum value of the sensor. So that the system will run to read the system and turn on the buzzer as the signal alarm of the system. When loop rate is set 10, it is mean the system will measure 10 data of voltage value every one second. When the volume of water increases and covers the sensor, the value of the voltage increases too. The graph of water level can be seen from the figure 7 that the output voltage shows linearity of system R2 = 0.4298, which means voltage value having small linearity. The reason happened because the instrumentation system design did not placed the sensor at good position when water would hit the sensor. This problem was different from paper by title system prediction salt content using hyperspectral imaging[9] which has high regression more or less 9.8 for prediction because in measurement needs calibration and comparation with other standard instruments.

CONCLUSION

According to data from the results of the design and testing water level detection system that has been carried out, it can be concluded that virtual instrumentation detection with water level Sensor and Buzzer module had worked well to detect water level but it was still having small linearity. The Arduino and LabVIEW program had been running according to the design, and it was able to control the entire work circuit and as an interface with LabVIEW. LabVIEW which used as a Graphical User Interface (GUI) was in accordance with the block diagram designed to be able to display voltage value and water level with graphs. Overall, water level detection system has worked quite well in accordance with the design that has been built. The next work will consider calibration and comparation several sensor for obtaining the objective measurement.

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