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AQUAPONICS PH MONITORING SYSTEM USING ARDUINO UNO MICROCONTROLLER

Arief Ismanto
Program Studi Teknik Komputer,
Fakultas Teknik dan Ilmu Komputer, Universitas Teknokrat Indonesia
Email: arief_ismanto@teknokrat.ac.id

ABSTRACT

This application aims to design and implement a circuit that serves to monitor the level of pH levels in the water, water pH monitoring is very important to know the good bad water quality. The provision of clean water with poor quality can result in a bad impact on the health of plants and fish, namely the onset of various diseases. Changes in the pH of water can also cause changes in the smell, taste, and color of the water. With the development of technology, the existence of sensors and microcontrollers, it is easier to make automatic monitoring tools by using the Arduino Uno microcontroller. Measurement of water pH can be done using a pH meter, this method can only be done manually, then made a Microcontroller Arduino Uno R3-based water pH monitoring system to facilitate water pH control so that the process of treatment of plants and ponds becomes better. This temperature sensor works because of the temperature change around the sensor, the detection of non-electrical signals is converted into an electrical signal, usually in the form of electrical voltage, and the change will be displayed on the LCD screen. While the pH sensor measures the pH such as the activity of hydrogen ions surrounding a thin-walled glass bulb at the end. This probe produces a low voltage that is measured and displayed on the LCD screen.

Keyword:
Monitoring
Microcontroller
Temperature sensor
Mustard
Ph Sensor

1. INTRODUCING

The more technology develops, the more fields there are and need to be developed. One of them is information technology. This is a field that is closely related to the development of technology. Without information technology, perhaps the development that occurred would not be this advanced. Information technology in general is a study of the design, implementation, development, support, or management of computer-based information systems, especially in hardware applications (hardware) and software (computer software) [1]–[3].

Information Technology (IT) is a general term of technology to assist humans in creating, changing, storing, communicating and disseminating information[4], [5]. Information technology is a technology that has a function in processing data, processing data, obtaining, compiling, storing, changing data in all kinds of ways to get useful or quality information. In addition, the function of information technology is to solve a problem, open up creativity, increase effectiveness and efficiency in human activities[6]–[8].

A computer is an electronic device that manipulates information or data. It can store, retrieve, and process data. Computers are designed to run applications and provide a variety of solutions through integrated hardware and software components. It works with the help of programs and

represents decimal numbers through a series of binary digits. It also has a memory that stores data, programs, and processing results[8]–[10].

The rapid development of human populations in urban areas has an impact on the narrower of residential land. Another impact is the higher air temperature because plants as oxygen producers are rarely found. Most Indonesians assume that narrow land will not be utilized, especially as agricultural land.

With a variety of agricultural methods developed one of which is a method suitable for planting with the narrow land aquaponics system can be utilized to the maximum. This system is a combination of aquaculture with hydroponics that produces a symbiosis of mutualism or mutual benefit. Aquaculture is fish cultivation, while hydroponics is the cultivation of plants without soil which means the cultivation of plants that utilize water and without using soil as a planting medium or soilless. Aquaponics makes continuous use of water from the maintenance of fish to plants and is then returned to the fish pond. The basic core of this technological system is the optimum water supply for each commodity by utilizing a re-circulation system[11]–[13].

In general, aquaponics uses a recirculation system, meaning it reuses water that has been used in fish farming with biological and physical filters in the form of plants and their media. The recirculation used contains maintenance compartments and water treatment compartments. The use of filter materials, such as zeolite, clay, gravel, or sand as bacterial substrates that can overcome and regulate excess compounds - nitrogen compounds harmful to fish in aquaponics systems. Thus, the plant serves as a biofilter to absorb ammonia, nitrate, nitrite, and phosphorus that are harmful to fish, so clean water can then be streamed back into the fish tub. Typically, water treatment systems are composed of compartments, declarations, filtration compartments, oxygenation compartments, and sterilization compartments[14]–[16].

Arduino is an open-source single-board microcontroller, derived from the Wiring platform, designed to facilitate the use of electronics in a variety of fields. The hardware has an Atmel AVR processor and the software has its own programming language. Arduino is currently very popular all over the world. Many beginners learn to know robotics and electronics through Arduino because it is easy to learn. But not only beginners, hobbyists, or professionals also enjoy developing electronic applications using Arduino. The language used in Arduino is not a relatively difficult assembler, but a simplified C language with the help of Arduino libraries[17]–[20].

Water pH monitoring is very important to know the good of poor water quality. The provision of clean water with poor quality can result in a bad impact on the health of plants and fish, namely the onset of various diseases. Changes in the pH of water can also cause changes in the smell, taste and color of the water. Based on the Regulation of the Minister of Health (PERMENKES) number 416 of 1990 on the requirements and supervision of water quality that good clean water quality standards have a pH level of 6.5 to 9.0.

The design and manufacture of automatic control systems on Arduino Uno-based aquaponics can provide good benefits, among others, as a solution to problems in water quality monitoring (PH) in aquaponics that are still done manually, as detection of acidity levels in water to know the pH of water that is suitable for the life of fish and plants in aquaponics.

2. RESEARCH METHODS

Tool design is an initial method in the manufacture of a tool that is very important because without a design the tool is made can not run optimally. To get maximum results, a good design is needed by paying attention to the nature and characteristics of each component used, so that component damage can be avoided. In the design, the stage consists of several stages, namely the design of block diagrams, flow charts or flow charts, tools, and materials, to the overall design of tools.

Planning requires rigor, tenacity, and accuracy because early planning will determine the end of a plan in the tool manufacturing process. If the initial plan is wrong then the end result will be wrong. The design process is very necessary for the process of making tools, especially the design of electronic devices. The process of designing tools is very important to start a job with the following objectives In order for the resulting tool to be in accordance with the expected, To choose the most appropriate components, To determine errors or error constraints that occur, minimize costs but with tools whose results are satisfactory.

A flowchart diagram is a type of flowchart or flowchart is a type of diagram that represents an algorithm, work flow or process, which displays steps in the form of graphical symbols, in the flowchart diagram below explains how the work and process tools work.

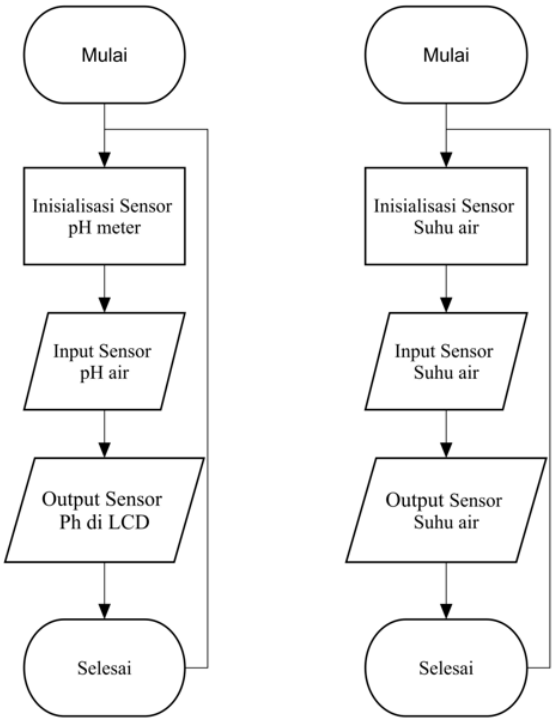

Figure 1. Flowchart pH meter sensor and Water Temperature Sensor

At the beginning of the system, the start will prepare all system components such as water pH sensor, LCD, and other supporting components connected in one component unit. The input comes from the water pH sensor component. Furthermore, the water pH sensor sends data in the form of water pH values and to Arduino to be displayed on the LCD.

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3. RESULTS AND ANALYSIS

3.1. Tools Design

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3.2. Overall Tool Planning

The design of the entire suite of tools consists of four important elements that are integrated into each other. These important elements are input circuits, controller circuits, output sets, and also integrated program software. A circuit consisting of electronic components either in the form

of inputs or outputs needed by microcontrollers in order to function properly. The entire suite of tools can be seen in the following image

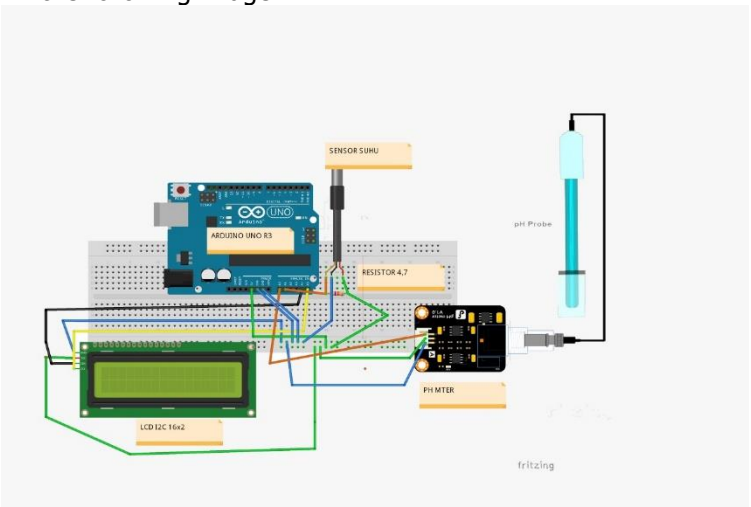

Figure 2. Overall Tool Planning

3.3. Design of Temperature Sensor

The DS18B20 Temperature Sensor is a Temperature sensor that uses a one-wire interface, so it uses only a small cable in its installation. Uniquely this sensor can be made parallel with one input. This means that we can use the DS18B20 sensor more than one but the sensor output is only connected to one Arduino PIN. This reason makes this sensor widely used, especially since this sensor has a type of waterproof, so this sensor we can make as a measuring device and control of water heaters. The function of this resistor is as a pullup of the data path and is necessary to help ensure the data transfer process remains stable and good.

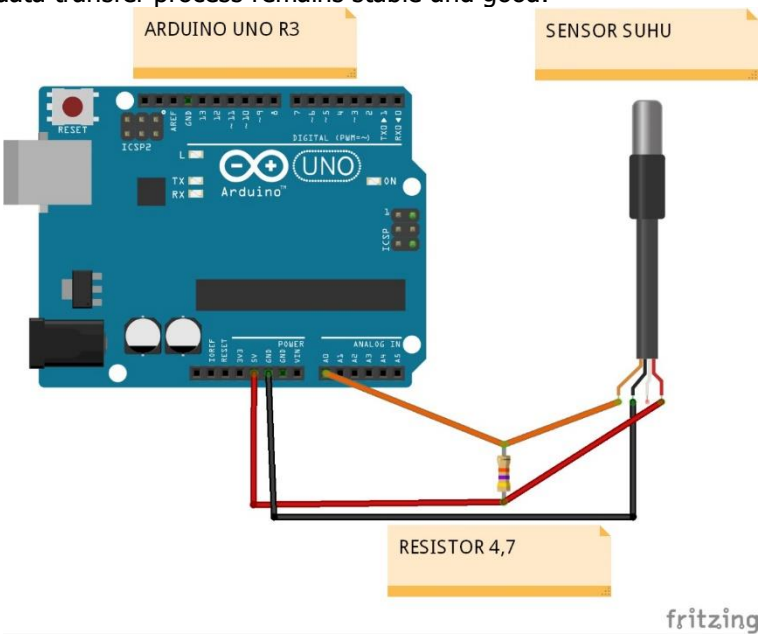

Figure 3. Design of Temperature Sensor

3.4. Ph Meter Design

A PH meter is an electronic device that serves to measure the pH (degree of acidity or numbness) of a liquid (there are special electrodes that serve to measure the pH of semi-solid materials). A pH meter consists of an electrode (measuring probe) connected to an electronic device that measures and displays a pH value. This tool is very useful for measuring the clarity of the water in the aquarium.

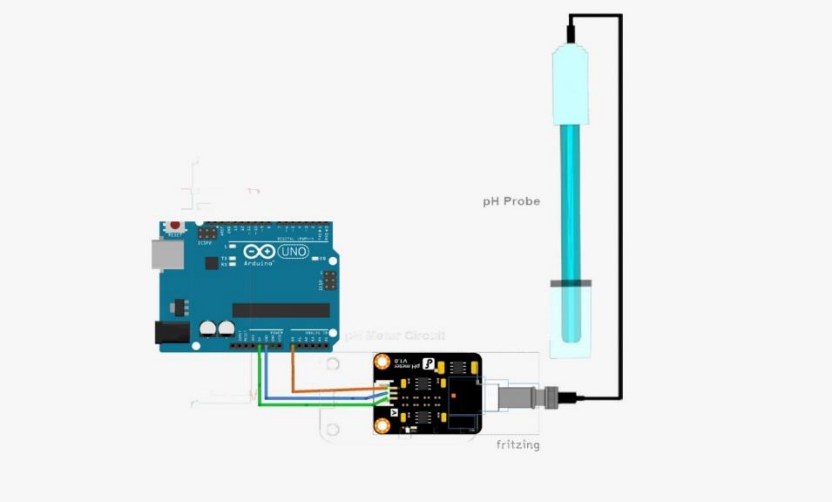

Figure 3. Ph Meter Design

3.5. LCD Design

The liquid Crystal Display (LCD) module is a versatile display module because it can be used to display various displays in the form of letters, numbers, and other characters and can display a variety of writings and other short messages. In the design of this tool, LCD is used to display the time when the pump is OFF and when the pump is OFF in real-time.

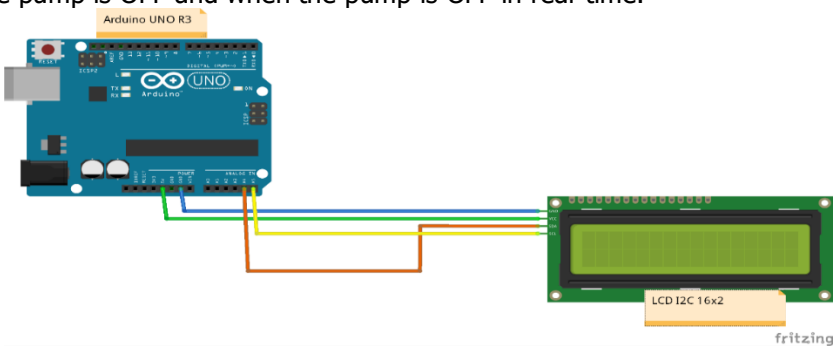

Figure 3. LCD Design

3.6. Water pH Sensor Testing

Testing this water pH sensor is a process of calculating the pH of water that only relies on this sensor. The water pH sensor uses analog signals as its transmission. The range of this analog signal consists of 10 bits with a range of 0-1023. Please note that the value issued by the sensor is an ADC (Analog to Digital Converter) value that will be further processed. This test is done to prove whether the sensor can work properly or not.

Table 1. Water pH Sensor Testing

Day to Day Experiment	Sensor Ph Grade
1	6.49
2	6.62
3	6.42
4	6.69
5	6.39
6	5.98
7	6.15

3.7. Water Temperature Sensor Testing

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Table 2. Water Temperature Sensor Testing

Day to Day Experiment	Sensor Ph Grade
1	23.25 °C
2	24.00 °C
3	24.06 °C
4	23,06 °C
5	25,08 °C
6	24,10 °C
7	24,14 °C

3.8. LCD Testing

At this stage is a testing of Arduino microcontroller communication with 16x2 LCD, on this tool 16x2 LCD is used as a monitor to find out the working conditions of the monitoring system more easily. Here are the LCD test results.

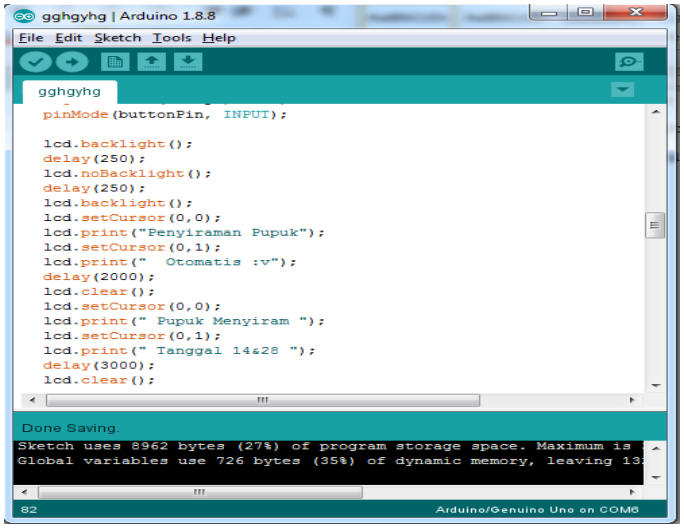

Figure 3. LCD Testing

4. CONCLUSION

Based on the discussion and results of the study, it was obtained some conclusions as follows By looking at the results of the reading of the water pH sensor, then farmers can determine that the water is in good condition or not for mustard plants. The result of the water pH sensor reading has a difference that is not so far from the pH meter which is 5.5 to 6.5. The water temperature sensor readings are already working well and will send data to the Arduino to be displayed on the LCD screen. The yield of plants in aquaponics is very good because it uses fertilizer from fish manure in aquaponics.

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