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Smart Sensor in Water Flow Monitoring Model using Microcontroller and Raspberry PI

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Abstract− Water is the source of human, animal and plant life which can be said to be living things. However, the need for clean water in the world is increasing along with the growth in the number of living things in the world. The scarcity of clean water is often found due to the wasteful use of water by humans and dirty water due to waste generated by humans. Thus the technology in hardware and software midwives plays a very important role in overcoming water savings for the survival of living things in order to survive. We don't know the use of water that we usually use in a day directly. If we look at the water meter in our house we don't have a display of the cost of water usage and how much water we use in a day. Rapidly developing technology is able to overcome this problem by building a system for calculating the water flow rate and the application to display the cost of using water using a water flow sensor and making a display application that is a user interface so that it will make it easier for humans to run this system and make a smart system model using a method that is used as a user interface. old like the microcontroller and the technology that was developing raspberry pi.

Keywords: Water; Sensor; Monitoring; Microcontroller; Raspberry PI

1. INTRODUCTION

The rapid development of technology today is in line with the emergence of various methods of problem solving. one of the methods commonly used is the decision support system. decision support systems have very complex calculations in order to get more optimal results. the decisions obtained must be justified mathematically [1]. because the calculation is very complex, so it requires the help of tools in calculation and analysis. Besides that, humans also have physical limitations, so that tools are needed in jobs that are difficult for humans to do.

The rapid development of technology with the industrial revolution 4.0 which in the field of computing is expanding towards the Internet of Things (IoT) which involves several fields such as electronics so that it can cause a series of electronic applications to replace the human role as accuracy and accuracy and a job with sensors and control of a smartphone [2]. One of them is the changing role of the sensor to the smart sensor which was appointed in the making of the tool in this paper to detect water discharge with a waterflow sensor [3]. For this product itself is a series of applications that combine electronics, namely optical sensors, stepper motors and microcontrollers, all of which can be operated automatically through data input in a program that has been entered into the microcontroller and raspberry pi [4].

A microcontroller is an IC that works like a processor and memory inside [5]. This processor functions to process data to make new knowledge and memory function to store data which with Raspberry Pi can accommodate large-scale data or Big Data [6][7]. after storing in memory the user can make changes, delete and rewrite the data with new data by using a display that supports mobile devices as the interface and a certain software as an editor and compiler [8].

Hidayatullah [9] made a System Prototype on Water Quality Monitoring Telemetry in Microcontroller-Based Freshwater Fish Ponds and when the system was calibrated using standard water (aqua) a pH value was obtained of 6.88, then tested for the test solution (tap water, turmeric solution). and toothpaste). The system reading results are pH 7.0 for water, 8.7 for turmeric solution and 9.0 for toothpaste solution. So that the reading for the turbidity sensor is clear for plain water, cloudy for turmeric solution and cloudy for toothpaste solution. Meanwhile, Budiarjo [10] conducted an experiment with a microcontroller-based dam water level monitoring system so that the results obtained in his paper are that in hardware design, accuracy is needed in calculating the size of the voltage and current generated by the sensor, because the amount of voltage generated by the sensor will have an effect. on microcontroller performance.

However, in accordance with the development of raspberry pi technology, Bahri [11] has also done by building a web-based water quality and usage monitoring prototype using raspberry pi and explaining the results of testing the volume of the reservoir calculated using a measuring cup with a web server experiencing differences with the lowest error rate. of 0.10% and the highest error rate of 4.78%. while Gosavi [12] conducted water forecasing of smart sensors and stated that the work could be extended to foreasting data for larger data with customer satisfaction involving lower costs and better overall system performance.

Based on research before using sensors, they have a device that is also cheap so that many people use it to design electronic application tools, including one of which is to design a series of electronic applications for water discharge detection using a waterflow sensor and a stepper motor based on this microcontroller and assisted by raspberry pi. The waterflow sensor used in this electronic application is a water detector which will later be emitted through a timer, where the water will be produced and the component is given a source of electricity [13]. Which then this sensor will later function to determine the position in which the container will be filled with water. There is no water meter in a house to display the cost of water use, so to find out how much we have spent we still use the services of a water company employee

to notify it using a water bill. So that in this paper a tool is designed that can control the flow of water and display its financing by analogizing a container and a gallon as a testing medium for the working system of this tool so that it can be used as a smart sensor model.

2. RESEARCH METHODOLOGY

2.1 Circuit Block Diagram Design

Block diagram of electronic regulatory units which is very important to easily find out the working principle and functions of the parts that support the operation of a tool. Block diagram design also aims to facilitate the realization of making a tool so that it can work as expected [14]. Broadly speaking, the block diagram of the water flow regulation using a waterflow sensor based on the AT 16 microcontroller is shown in Figure 1 below.

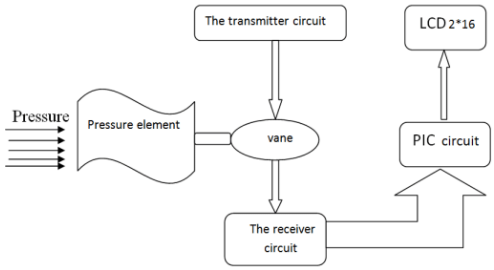

Figure 1. Block Diagram Design

The power supply functions as a source of voltage for the entire system so that the system can work. AT 16 is the control center of the entire circuit. Where the microcontroller will check the signal sent by the sensor, then control the DC motor. The sensor functions to find out the object / box that will be filled with sugar as well as the position for filling. The motor driver functions to control the rotation of the motor on the waterflow, so that the rotation of the waterflow motor which functions to open / close the water channel can be controlled by a microcontroller. The DC motor functions to control the opening and closing process.

2.2 Power Supply Circuit Design

This circuit serves to supply voltage to all existing circuits. The PSA circuit made consists of two outputs, namely 5 volts and 12 volts, the 5 volt output is used to supply voltage to the entire circuit, while the 12 volt output is used to supply voltage to the DC motor, the power supply circuit is shown in Figure 2 below [15]:

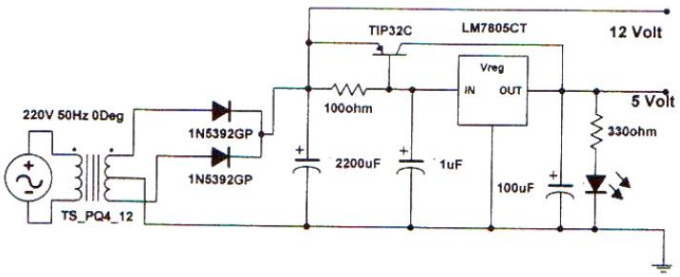

Figure 2. Power Supplay Design

The CT transformer is a stepdown transformer which functions to reduce the voltage from 220 volts AC to 12 volts AC. Then the 12 volts AC will be delivered using two diodes, then the 12 volts DC will be leveled by a 2200 µf capacitor. A 5 volt voltage regulator (LM7805ct) is used so that the resulting output remains 5 volts even though there is a change in the input voltage. The LED is only an indicator when the PSA is turned on. The PNP TIP 32 transistor here functions to supply current if there is a shortage of current in the rod, so that the voltage regulator (LM7805CT) will not heat up when the circuit requires a large enough current. The 12 volt DC voltage is taken directly from the output of 2 rectifier diodes.

2.3 Microcontroller Circuit Design

The µC AT16 circuit on this tool functions as the control center of the entire system. This AT16 microcontroller circuit will wait for the signal to be sent from the existing sensors. The awaited signal is a high signal. So in normal circumstances, each sensor will continuously send a low signal. When a high signal is sent from one of the sensors, the AT16 microcontroller circuit will see which sensor is sending the high signal, then the AT16 microcontroller circuit instructs the motor to rotate shut and open the bar according to the sensor that sends the signal [16]. The AT16 microcontroller circuit is shown in Figure 3 below:

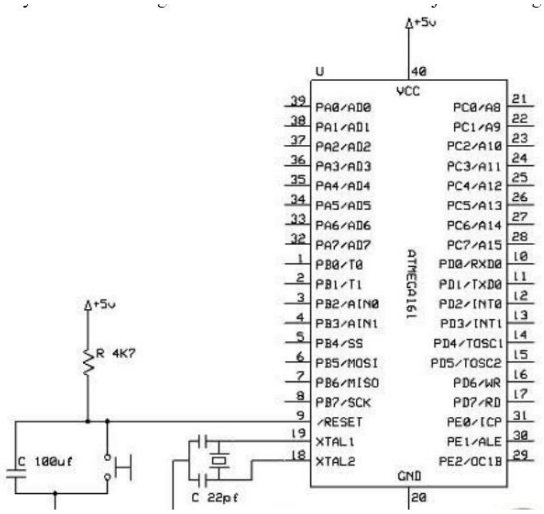

Figure 3. Microcontroller Design

This microcontroller has 32 I / o ports, namely port 0, port 1, port 2, port 3. Pins 32 to 39 are port 0 which is an 8 bit I / O channel / bus. Pins 1 to 8 are port 1. Pins 21 to 28 are port 2. And Pins 10 to 17 are ports 3 Pin 40 is connected to a 5 volt voltage source. And pin 20 is connected to the groud. This microcontroller circuit uses a 12 MHz crystal component as its clock source. This crystal value will affect the speed of the microcontroller in executing a certain command.

Pin 9 is connected to a 10 μf capacitor connected to the positive and a 10 ohm resistor connected to the groud. These two components function so that the program on the microcontroller is run to the rod. These two components function so that the program on the microcontroller is run a few moments after the active power. The length of time between the active power on the microcontroller IC and the program activation is equal to the multiplication between the capacator and the resistor. If calculated, the length of time is:

$$T = R \times C = 10\ K\Omega \times 10\ \mu f = 1\ M\ Second$$

So 1 millisecond after the active power on the IC then the active program In this design, port 0, namely P0.0 to P0.3 will be connected to the DC motor driver circuit p0.4 and p0.5 will be connected to the relay circuit and port 2, ie p2.09 to p2.3 will be connected to the parallel port input.

Pin 17 which is P3.7 with a transistor and an LED. This is done only to test whether the minimum circuit of the AT16 microcontroller is working or not. By providing a simple program on the microcontroller, it can be seen whether the minimum circuit is working properly or not. If the LED connected to Pin 17 has worked according to the command given, then the minimum circuit is ready for use. However, after the whole circuit is put together, the LED connected to pin 17 is not used anymore.

2.4 Raspberry pi design

Raspberry pi design cannot be separated from the existence of a circuit which can be illustrated in the figure 4.

Figure 4. Perancangan Raspberry pi

Raspberry pi can be said to be a mini computer where in the circuit there is a brain like a CPU with the difference between models A and B located in the storage module used. Model A uses 256MB of storage and model B's storage is 512MB. In addition, model B is equipped with Ethernet ports (for LAN) which are not found in model A. The Raspberry Pi design is based on the Broadcom BCM2835 SoC (system-on-a-chip), which has embedded an ARM1176JZF-S processor with 700 MHz, VideoCore IV GPU, and 256MB of RAM (model B). Data storage is not designed to use hard

disks or solid-state drives, but relies on an SD type storage card to run the system and as a long-term storage medium [17].

2.5 Design In Detail

The design in detail discusses the power supply circuit, sensor circuit, processing circuit, relay drive circuit (driver), the working principle of the whole circuit, the basic logic of the program, program modules and system testing. To be able to see the working principle of the water flow control detector automatically can be seen in Figure 5.

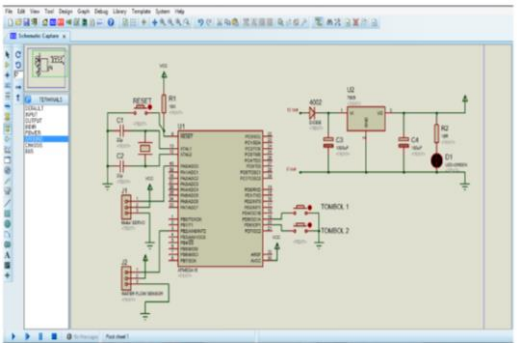

Figure 5. Overall Circuit

1. Waterflow sensor will regulate the movement of the water rotation and then count the counter
2. Aisci Regulator reduces the voltage to 5 volts in order to adjust the power supply that starts from 9-12 volts to become stable, namely 5 volts.
3. Capacitor serves to block voltage noise.
4. Header as a cable connector.
5. Servo motor connecting gallon valve opening and closing.
6. USB to serial converter, which functions as a communication between the microcontroller and raspberry pi.
7. Black Housing, which functions as a connector that is used to make it easier to dismantle pairs of circuits.

3. RESULT AND DISCUSSION

The results and discussion aims to find out whether the tool works in accordance with the predetermined plan, this test is also to find out the work of the tools and test programs in implementing the tools and programs that have been previously made.

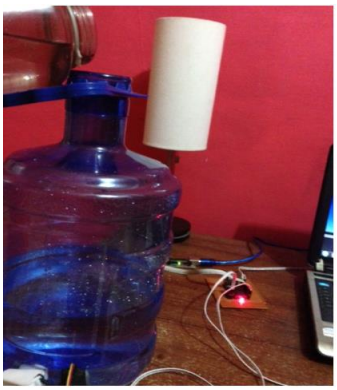

Figure 6. Testing the tool when filling water

Figure 6 shows the water filling process is carried out to test a pre-designed device to calculate the water discharge. In addition, the servo motor has been moved using the interrupt command and then the servo opens 70% to open the faucet according to the program and for the water flow sensor counts 590 turns for 1 liter of water..

Figure 7. The tool works at the time of testing

Figure 7 shows the process is working so that the design needs to be explained that to carry out the testing of the tool it is necessary to pay attention to how many serial ports in COM are used, port testing is carried out using the Hterm application [4]. Before doing the compiler program, first select what type of microcontroller to use, in testing the tool the author uses atmega 16 and then opens the file, select the software made in the form of a hex number then click the auto program and the process will run automatically in data transfer to the microcontroller.

Figure 8. Overall Tools at the time of testing

Above is a whole tool that looks to use a waterflow sensor as a water discharge reader, a gallon tap opening sevo motor, a vcb board as a support for circuits such as ICs, ground buttons, Aisci Regulator reduces the voltage to 5 volts to adjust to the power supply starting from 9-12 volts to be stable which is 5 volts. Capacitor serves to block voltage noise. Header as a cable connector. Servo motor connecting gallon valve opening and closing. USB to serial Converter, which functions as a communication between the microcontroller. Black Housing, which functions as a connector used to make it easier to dismantle pairs of circuits.

(a) (b) (c)

Figure 9. Smart Sensor

(a) Waterflow sensor during testing, (b) Servo motor when testing, (c) Microcontroller reads program data

Based on Figure 9, it can be seen that it consists of what kinds of circuits are used, including the microcontroller controlling this tool in processing the programming data transferred by Avr Vision, Aisci Regulator reduces the voltage to 5 volts to adjust the power supply starting from 9-12 volts to be stable, namely 5 volts. Capacitor serves to block voltage noise. The header as a connector for the Black Housing cable, which functions as a connector used to make it easier to dismantle the series.

Figure 10. Downloader transfers data to IC with Raspberry Pi

Downloader that uses USB to serial to convert data and as communication between the microcontroller and Microsoft Visual Studio 2010 so that the program coding is converted into hex data, namely machine programming language code read by the microcontroller.

4. CONCLUSION

A device that can detect water discharge and display the cost of water use has been built using a smart water flow sensor, which is part of the hardware circuit for this tool to detect and display a display of water usage costs. In a simulated application in a small scope of water, the program created can be used as artificial intelligence for microcontrollers and raspberry pi in calculating smart sensor rotation and servo motor movement.

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