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Prototype Development of Water Turbidity Measuring Device with ARDUINO UNO and LCD LMB16A Display

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Abstract: ***A water turbidity measuring device has developed using Arduino Uno based phototransistor sensor. Working principle of the measuring device was fabricated with nephelometric method; the main sensor components consist of a phototransistor as a detector and LED as a light source which is designed in such a way with 90^o position (upright position). The measuring device utilizes scattered light by particles in the water. The intensity of light passing through the scattering particles is detected by the phototransistor system sensor (detector) which provide analog signal of voltage. The incoming voltage will be processed in the Arduino Uno and the result obtained are converted into NTU (Nephelometric Turbidity Units) and displayed on 2x16 LCD. Measurement limit of this device is obtaining turbidity levels between 0 NTU to 100 NTU.***

Keywords: level of water turbidity, Arduino Uno, Phototransistor Sensors, 2x16 LCD

1. Introduction

Water turbidity occurs because of organic and inorganic Total Suspended Solid content. The organic substances are made from weathered plants and animals, while inorganic substances are usually come from weathered rock and metal [1].

The market has available devices to determine the turbidity level of water, such as Turbiditymeter. The function of Turbiditymeter itself is used as a standard test device to determine the turbidity level of water. Turbiditymeter is actually easy to find, but because the price is considered relatively expensive, so that this device is only owned by certain parties [3].

From these considerations and reasons, researchers design and develop a prototype tooling equipment to measure turbidity level of water. Sensor used in measuring water turbidity is phototransistor and LED as the light source. Microcontroller used is Arduino Uno. The standard unit used to measure the turbidity level of water is NTU (Nephelometric Turbidity Units) where the results of this device will be displayed in 2x16 LMB16A LCD.

2. Research Method

The planning of developing prototype of turbidity measuring device has done in this research. The design process of this device begins with the general system design of the whole prototype. The design process is divided into several interconnected devices that are the hardware devices and the software. Once the tool is successfully created, it will be compared to a standard turbidity measurement device to measure the measurement ranges which can be measured by the device created.

a) General System Design

In general, the design process consists of two parts, namely hardware system and software system. In the design, this system is equipped with phototransistor sensor system as a signal provider, Arduino Uno as a signal processor, and 2x16 LMB16A LCD as output viewer from signal processor. To simplify the system is divided into 3 parts; Input – Process – Output. Phototransistor and LED Sensor System as input, Arduino Uno as process and 2x16 character LMB16A LCD display as output.

The principle of the measuring device made is built with nephelometric method which is the main sensor component consist of phototransistor as detector and LED as a light source, designed in such a way with 90^o position. The measuring device utilizes scattered light by particles in the water. The intensity of light passing through the scattering particles is detected by the phototransistor system sensor (detector) which provide analog signal of voltage. The incoming voltage will be processed in the Arduino Uno and the result obtained are converted into NTU (Nephelometric Turbidity Units) and displayed on 2x16 LCD.

b) Hardware Design

In the hardware design and planning process of the device, planning of making electronic circuits was done.

1) Turbidity Sensor System Design

The turbidity sensor system is made of a phototransistor detector and LED as a transmitter. Both components are arranged in such a way as to form an angle of 90^o. the series of sensor systems made are shown in Figure 2.1.

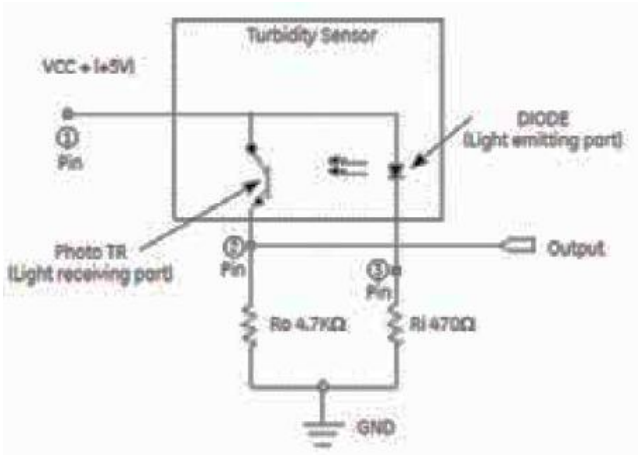

Figure 2.1 Turbidity Sensor System Series Scheme

The way this sensor system works is used to detect changes in the intensity of light passing between the phototransistor (detector) and LED. The more particle scattered in the water between the detector and the LED, the more turbid the water. Otherwise, the fewer the particle scattered, the clearer the water.

2) Sensor System to Arduino Uno Design

In pin 2 the output of turbidity sensor system goes into the pin A0 of Arduino Uno, pin 1 of sensor is connected to a voltage of 5 volts and pin 2 of sensor system is connected to ground. Sensor system to Arduino Uno design scheme can be seen in Figure 2.2.

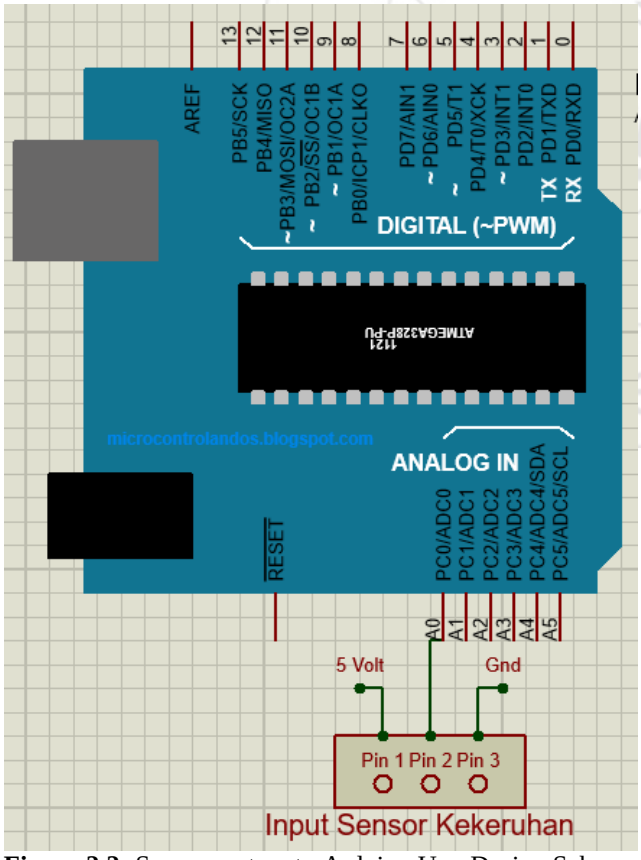

Figure 2.2: Sensor system to Arduino Uno Design Scheme

c) Software Design

Pada perancangan dan pembuatan software yang dibuat yaitu untuk mengolah data sinyal dari sensor ke arduino. Sinyal analog dari sistem sensor masuk ke pin analog input arduino berupa nilai ADC dan dikonversi menjadi nilai tegangan. Setelah mendapatkan nilai representatif dari tegangan kemudian dikonversi ke satuan NTU dan ditampilkan ke LCD 2x16 berupa data decimal. Perancangan dan pembuatan program menggunakan *software* IDE yaitu aplikasi untuk memprogram arduino dengan bahasa pemrograman C++.

3. Results and Discussions

After the design process is completed, then device characterization and data retrieval were done. Based on the result of data processing and device characterization, a relationship between voltage values and water turbidity from the standard device.

Figure 3.1: Prototype of Water Turbidity Measuring Device

In the device testing, obtained a relationship between the output sensor voltage with water turbidity level that can be seen in Figure 3.2.

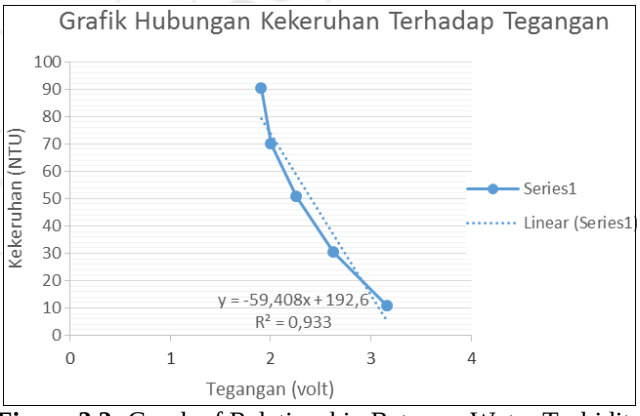

Figure 3.2: Graph of Relationship Between Water Turbidity and Voltage

From the graph above can be seen, the more further down the voltage value, the higher the value of the NTU; which means the clearer the water, the higher the voltage. Otherwise, the more turbid the water, the smaller the voltage. From the result of the characterization, it can be concluded that the device designed is working well. The measurement ranges of this device is between 0 NTU to 100 NTU.

4. Conclusion

Based on the results of characterization and discussion above then obtained the following conclusions:

1) The smaller the voltage value, the higher the water turbidity level, so it can be concluded that the device designed is working well.
2) The measurement ranges of this water turbidity measuring device is between 0 NTU to 100 NTU.

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