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Water Turbidity Detection Device Using Turbidity Sensor Based on Arduino Uno

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Abstract

A water turbidity detector using an Arduino Uno based turbidity sensor is a solution to measure water turbidity. The turbidity sensor functions to measure the level of water turbidity by detecting dissolved solid particles in it. The use of Arduino Uno as the main microcontroller, turbidity sensor to measure the level of turbidity and the results can be displayed clearly on the LCD. The main advantage of this tool is its ability to provide information about water turbidity. The integrated LED and Buzzer also provide notification if the water turbidity level has been set. In addition, the simplicity of use and integration between the turbidity sensor, Arduino Uno, LED, LCD, and buzzer on one microcontroller board provides convenience for users. The outputs of this system are LCD, LED and buzzer, and the entire input-output system is integrated by one Arduino Uno microcontroller board. This system is designed to assist users in detecting turbidity using a turbidity sensor. Based on testing, the success rate of this system is 93.27%.

Keywords: Turbidity Sensor, Arduino Uno, LED, Buzzer, LCD

Abstrak

Alat pendeteksi kekeruhan air menggunakan sensor turbidity berbasis Arduino Uno menjadi solusi untuk mengukur kekeruhan air. Sensor turbidity berfungsi untuk mengukur tingkat kekeruhan air dengan mendeteksi partikel padatan terlarut di dalamnya. Penggunaan Arduino Uno sebagai mikrokontroler utama, sensor turbidity untuk mengukur tingkat kekeruhan dan hasilnya dapat ditampilkan dengan jelas pada LCD. Kelebihan utama dari alat ini adalah kemampuannya dalam memberikan informasi tentang kekeruhan air. LED dan Buzzer yang terintegrasi juga memberikan notifikasi jika tingkat kekeruhan air yang telah ditetapkan. Selain itu, kesederhanaan dalam penggunaan dan integrasi antara sensor turbidity, arduino uno, LED, LCD, dan buzzer pada satu papan mikrokontroler memberikan kemudahan bagi pengguna. Luaran dari sistem ini berupa LCD, LED dan buzzer, serta keseluruhan sistem input-output terintegrasi oleh satu papan mikrokontroler arduino uno. Sistem ini dirancang untuk membantu pengguna dalam mendeteksi kekeruhan dengan menggunakan sensor turbidity. Berdasarkan pengujian, tingkat keberhasilan sistem ini adalah 93,27%.

Keywords: *Sensor Turbidity, Arduino Uno, LED, Buzzer, LCD*

1. Introduction

Water is one of the essential elements and primary needs of living beings on Earth [1]. Water is essential for daily activities such as cooking, washing, bathing, drinking, as well as other activities like industry and agriculture [2]. Along with the progress of time, local governments have established water management companies to provide services according to their responsibilities in district areas, where clean water sources are supplied by regional water utility companies [3]. Water that meets health standards and can be consumed after boiling is crucial to support basic human needs.

The turbidity level of water is related to the amount of suspended solid particles in the water. These particles originate from various sources such as soil, mud, organic matter, or microorganisms like bacteria [4]. In this regard, measuring water turbidity is used as an initial indicator of microbiological contamination or solid materials in the water [5]. In addition, water turbidity detection devices play an important role in maintaining water quality across various sectors, including the food and beverage processing industry, wastewater treatment, and other industrial applications [6]. These devices enable operators and managers to monitor and maintain water quality in accordance with standards and regulations set by the relevant authorities. High water turbidity levels can indicate issues such as soil erosion, chemical contamination, or human activities that can degrade water quality [7].

Based on the background of the problem, the author developed a "***Water Turbidity Detection Device Using Turbidity Sensor Based On Arduino Uno***". The working principle of this water turbidity detection device involves obtaining NTU (*Nephelometric Turbidity Unit*) values [8] using a turbidity sensor as input, which is then processed through Arduino Uno and displayed via an I2C LCD, buzzer, and LED. The water turbidity level is a crucial parameter in assessing water quality, and the turbidity detection device helps measure the level of turbidity.

2. Method

The research and development method, known as Research & Development (R&D), explains that the research method is used to produce a specific product and test the effectiveness of that product [9]. The stages of Research & Development used in this study is presented in **Figure 1**.

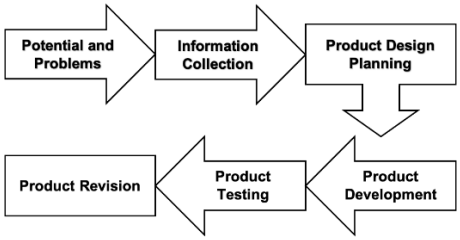

Figure 1. R&D Development Research Scheme

The Research and Development (R&D) method is used to develop and test the Water Turbidity Detection Device Using an Arduino Uno-Based Turbidity Sensor **[10] [11]**. This research process includes the stages of needs analysis, device design using a turbidity sensor, hardware and software development, and testing to ensure the device's accuracy and reliability **[12]**. The results of this research are expected to produce a prototype that can be used to monitor water quality in real-time, thereby supporting efforts to improve water resource management.

2.1 Design Overview

In designing the water turbidity detection device using an Arduino Uno-based turbidity sensor with outputs in the form of an LCD, buzzer, and LED, the design of the device to be developed is illustrated in **Figure 2**.

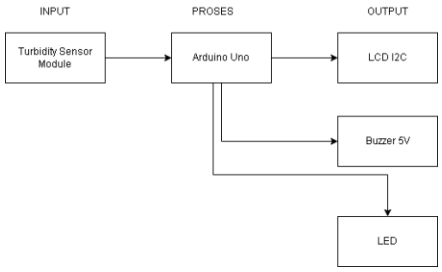

Figure 2. Block diagram of Input, process, Output model

The water turbidity detection device using an Arduino Uno-based turbidity sensor consists of 3 main blocks. The input block uses a turbidity sensor that functions to measure water quality by detecting its turbidity level. The process block uses the Arduino Uno microcontroller, which plays a crucial role in processing the data provided by the input device and converting it into the desired information to be displayed on the output devices. The output block of the device utilizes an LED, buzzer, and LCD.

2.2 Hardware Architecture Design

In the design of the water turbidity detection device using an Arduino Uno-based turbidity sensor, the schematic and layout of the product circuit are created using Fritzing software [10]. The product design is presented in **Figure 3**.

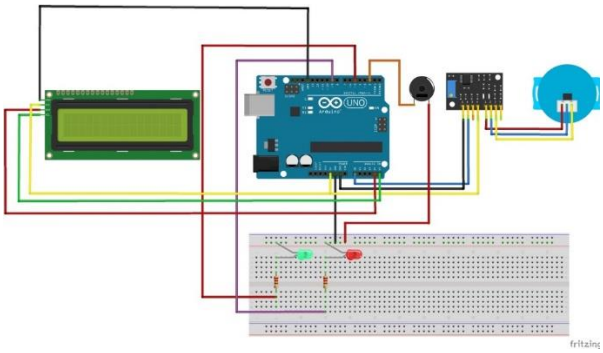

Figure 3. Schematic of The Entire System Circuit

2.3 Flowchart

The development of a water turbidity detection tool using a turbidity sensor based on Arduino Uno is carried out to monitor water quality in real-time. This system receives input from the turbidity sensor, which detects the turbidity level of the water. The data from the sensor is processed by the Arduino Uno to determine the water's condition. As output, this tool has three indicators: an LED to visually display the turbidity level, an LCD to display the turbidity value numerically, and a buzzer to provide a warning if the turbidity exceeds a certain threshold. This system is designed to improve the efficiency of water quality monitoring in a practical and accurate manner. Below is the flowchart showing the development of the Water Turbidity Detection Device Using Turbidity Sensor Based on Arduino Uno in **Figure 4.**

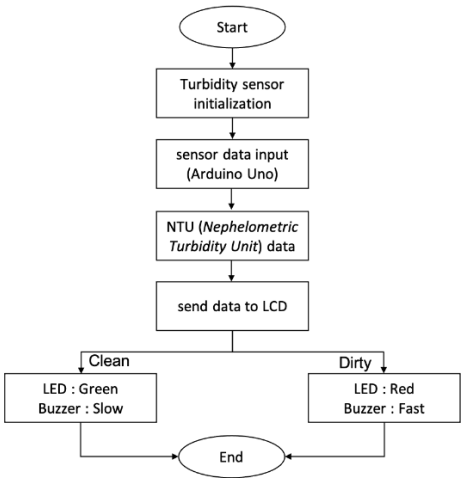

Figure 4. Flowchart Water Turbidity Detection Device Using Turbidity Sensor Based On Arduino Uno

3. Results and Discussion

The Water Turbidity Detection System Using a Turbidity Sensor Based on Arduino Uno is developed to detect water turbidity levels in real-time and provide output in the form of visual, numerical indicators, and sound alerts. This tool receives data from the turbidity sensor as the main input, which is then processed by the Arduino Uno to determine the turbidity level. The data processing results in three types of output: an LED as a visual indicator of turbidity levels, an LCD to display the turbidity value numerically, and a buzzer that sounds when the turbidity exceeds a certain threshold.

A turbidity sensor is a device that detects water turbidity by measuring the turbidity level in NTU units. Testing is conducted to ensure the sensor functions properly, starting by connecting the sensor to the Arduino Uno microcontroller board. If the sensor is connected, the serial monitor will display the NTU (*Nephelometric Turbidity Unit*) value, whereas if it is not connected, the message "Failed to read from Turbidity Sensor" will appear. The test is carried out using clean water and turbid water samples, as follows.

Figure 5. Test Results of the Clean Water Turbidity Sensor Measurement System

Figure 6. Test Results of Turbidity Sensor Measurement System for Turbid Water

The test results will demonstrate how the turbidity sensor reads water turbidity levels with various particle concentrations. Additionally, the responses of the LED, LCD, and buzzer to the data processed by the Arduino Uno will be analyzed to assess the system's accuracy and reliability. This discussion will reveal to what extent the device meets the design objectives as a practical and efficient water quality monitoring tool. The complete test table for water using the turbidity sensor and TDS meter is presented **Table 1.**

Table 1. Results of Water Testing with a Water Turbidity Detector Using an Arduino Uno-Based Turbidity Sensor

Num	Water Testing	Turbidity Value	TDS Meter	Error
1	Drinking water	5	3	0.6%
2	Milk water	47	50	6%
3	Tea water	48	52	7.6%
4	Coffee water	185	195	5.1%
5	Ground water	101	112	9.8%
6	Soap water	44	50	12%
7	Oil water	156	161	3.1%
8	Syrup water	56	61	8.1%
9	Orange water	33	36	8.3%
10	Sea water	125	134	6.7%

Based on the results of testing and analysis, the water turbidity detection device using the Arduino Uno-based turbidity sensor has successfully functioned as designed. The turbidity sensor can accurately detect water turbidity levels, and the data generated is processed by the Arduino Uno to produce outputs: an LED as a visual indicator, an LCD to display turbidity values numerically, and a buzzer as an alert when turbidity exceeds the set threshold. Therefore, this device can serve as a practical and efficient solution for real-time water quality monitoring. These results are expected to serve as a foundation for further development to enhance the system's reliability and flexibility.

Table 1 presents the results of water testing using the Water Turbidity Detection Device based on the Arduino Uno and the TDS meter. Based on the data from the water testing table, the average error rate is 6.73%, indicating a product success rate of 93.27%.

4. Conclusion

Based on the observations and testing results, it can be concluded that the Arduino Uno-based water turbidity detection device has been successfully designed and implemented. The development of this device involved using the Arduino Uno as the main microcontroller, a turbidity sensor to detect water turbidity levels, a buzzer and LED as warning indicators, and an LCD to display the turbidity levels in real-time. The results from all tests indicate that the

device has adequate accuracy and a quick response to changes in water turbidity levels. The device's error rate was recorded at 6.73%, while its success rate reached 93.27%. These results demonstrate that the device is effective, reliable, and ready to be used as a practical and efficient water quality monitoring tool.

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