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Development of an Arduino-Based Water Quality Monitoring System Using Turbidity Sensor

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Abstract

Clean drinking water is essential for human health since dirty water can lead to serious diseases such as diarrhoea, cholera and typhoid and long-term diseases such as kidney damage, cancer and child development problems. Though hard water is less dangerous, it causes dry skin and kidney stones and saline water causes high blood pressure. The Water Quality Monitoring System exists as a solution against existing water safety issues. The system uses an Arduino Uno as the controller and a turbidity sensor for water clarity measurement. The sensor provides readings in Nephelometric Turbidity Units (NTU), classifying water quality as clean (0–5 NTU), slightly dirty (5–50 NTU), cloudy (50–100 NTU) or heavily contaminated (above 100 NTU). The system is efficient in detecting unsafe water by sensing high turbidity readings, enabling people to take measures before consumption. The device can be highly effective for household use, rural areas, schools and water quality problem areas. Moreover, its integration into water coolers in institutions can be an effective method of performing continuous water quality monitoring, maintaining public health and safety.

Keywords: Water quality monitoring, turbidity sensor, Arduino Uno, clean drinking water, water safety, NTU measurement, public health

INTRODUCTION

Nutrient-rich boiling water represents the essential foundation of human health as well as agricultural growth and development sustainability. Urbanization, industrial effluent discharges, agricultural runoff and poor waste management processes have been the cause of heavily polluting water quality in bodies of water all over the world [1-5]. The conventional method of water quality determination by manual sampling and laboratory analyses is generally costly, time-consuming and incapable of providing real-time continuous data. It is a delay in detection that could result in disastrous health and environmental crises, particularly in underdeveloped regions [6–10].

The development of smart self-sustained water monitoring systems became possible due to new emerging embedded systems technologies and wireless sensor network implementations and Internet of Things (IoT) connectivity. The systems support real-time acquisition processing and remote station reporting. There have been numerous studies aimed at the measurement of the said key parameter using smart sensors. Low-cost devices such as photodiodes and light-dependent resistors (LDRs) have been analyzed with encouraging findings for measuring the turbidity of water and therefore can be appropriately employed for scalability for deployment in both urban and rural settings [11-15].

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Literature has numerous studies employing different monitoring methods for water quality. We can categorize the suggested methods for water quality quantification. In their 2016 publication [3] Cloete et al created a system consisting of four nodes which include the sensing node and measurement node and wireless node and notice node. The wireless node transmits the data to the notice node through a wireless transmitter and receiver module. The wireless receiver module transmits data to the notice node which will instantly alert the user about the water conditions [16-20].

Since the IoT system is implemented on a large scale for collection of authentic data and there are multiple communication involved in a real-time monitoring system. Kamaludin et al. [4] proposed a water quality monitoring system based on an IoT-based system.

This paper proposes a new architecture of low-cost sensor-integrated water quality monitoring. The system not only offers real-time and continuous monitoring and data but also predictive data to ensure timely intervention in the environment and hence it is the right solution for the next era of water resource management.

METHOD

The central control function of our proposed system relies on an own built Arduino microcontroller. Once the microcontroller receives the code upload no additional PC system with keyboard commands and monitor will be required to activate the system. The system operates automatically through the uploaded code in the microcontroller. C language serves as the programming choice for this system [5]. Turbidity sensor functions as the water parameter measuring instrument within this system. Previous studies revealed that general users mainly need to measure water pH level together with water turbidity (cloudiness).

Such as smoke in the air, turbidity is a cloudiness or haziness of a liquid created by the suspended presence of very small particles in the liquid, usually not observable by the eye. Measurement of turbidity is an important quality assessment of water. Measurement of turbidity is an important quality assessment of water. Solution or suspended substance in water which scatter the light and make the water cloudy or turbid is responsible for turbidity. Sediment, primarily clay and silt, fragile organic and inorganic material, colored soluble organic matter, algae and other minute animals may all be components of the particulate matter [6].

DESCRIPTION ABOUT CIRCUIT

Arduino Uno

The Arduino Uno operates by implementing the ATmega328P microcontroller chip. The Arduino Uno stands as the most well-known member of Arduino boards for engineering embedded system projects along with electronics applications [21, 22]. Beginners find the device easy to handle while professionals still get all the functionality they need [7]. Through its collection of pins and ports Arduino Uno lets users manage connection and control of active LEDs and sensors and motors simultaneously. The device possesses several power pins which consist of 5V and 3.3V and GND (Ground) and VIN to gain power for controlling other systems.

The board possesses 14 digital pins labeled from zero through thirteen which enable users to turn things on or off while select pins allow pulse width modulation for controlling functions like motor speed and LED brightness. Analytics obtained from temperature sensors or light sensors flow through the 6 analog pins marked A0 through A5. Through the USB port users can both load board code from their computer while receiving power supply to the system. Resetting the board is possible through the reset pin while advanced analog settings are controlled using the AREF connector. The TX/RX functionality of serial communication is accessed through pins 0 and 1 on the Arduino device [8].

Turbidity Sensor

The scattering of light occurs because turbidity in water exists due to floating particles in the water. Water turbidity represents the evaluation of light scattering which occurs because of particles suspended in water. The turbidity sensor operates through Nephelometric Turbidity Units (NTU) and distinguishes water quality based on readings below 5 NTU (clean) up to 50 NTU (slightly dirty) and 100 NTU (cloudy) and above 100 NTU (high contamination) [9].

16*2 LCD

The 16x2 LCD functions as a compact display unit which shows text across two separate lines with each containing 16 characters and finds broad application in Arduino-based projects for value display. The device operates with 5V power supply through a controller system called HD44780. A 16pin array on the display includes various pins for power supply and control operations using RS, RW and E signals and data transfer using D0 through D7 and backlight functions. Most Arduino projects utilize only four data pins (D4–D7) in 4-bit mode in order to save pins. A 10k potentiometer lets you establish the contrast adjustments. The standard communication establishes pin 12 for RS signal and pin 11 for E and pins 5 through 2 for data bits D7 to D4 while RW connects to GND and power goes to 5V and GND [10]. The circuit schematic has been placed in Figure 1.

RESULT AND DISSCUTION

The turbidity monitoring system employs the Arduino Uno board to gauge water clearness with a turbidity sensor and show the results through a 16x2 LCD display. The DFROBOT turbidity sensor operates at 5 volts level through an analog signal which reflects the water's particle concentration. The analog pin A0 of Arduino accepts the sensor signal. The VCC and GND pins of the sensor obtain power from Arduino's 5V and receive ground through GND. The LCD display which shows two lines of 16 characters receives power through Arduino with 5V and GND connections.

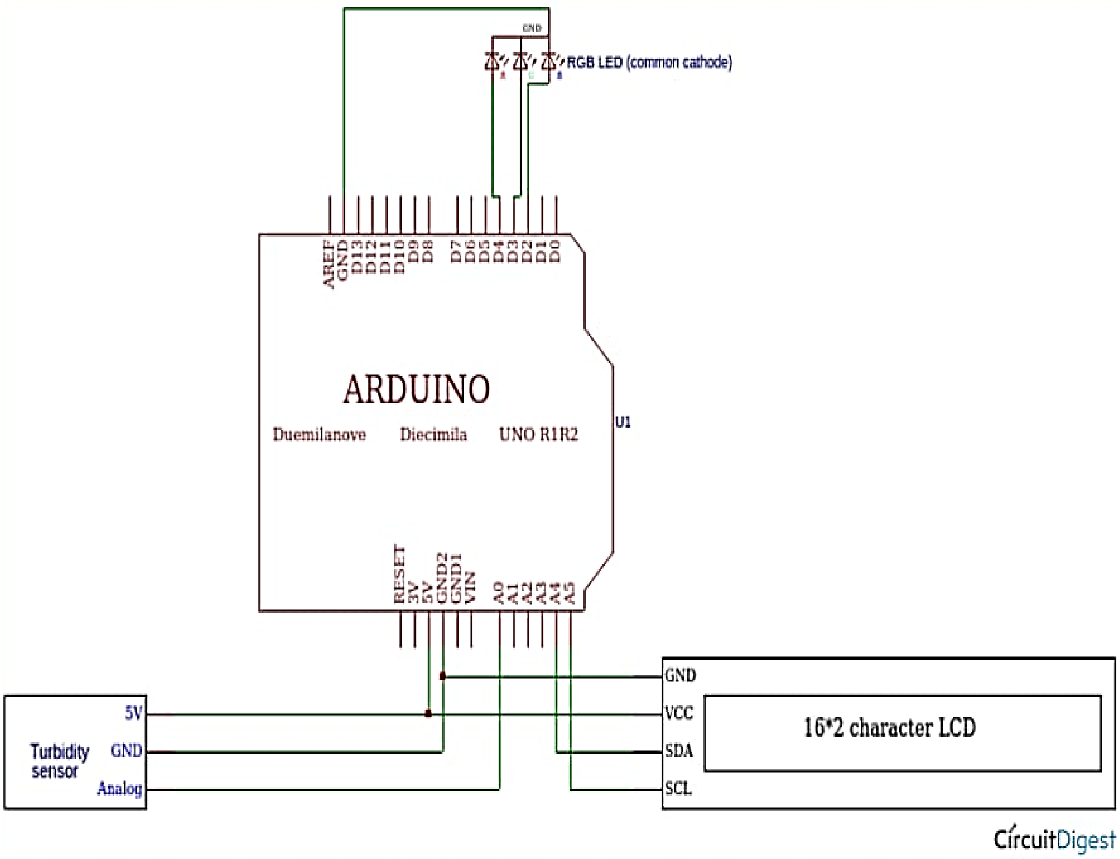

Figure 1. Circuit diagram.

Table 1. Water quality based on turbidity sensor readings.

Water sample	Turbidity (NTU)	Water quality description
Mud Water	264	Highly Polluted
Tap Water	30	Slightly Polluted / Not Safe for Drinking
RO Water	1	Very Clean / Safe for Drinking

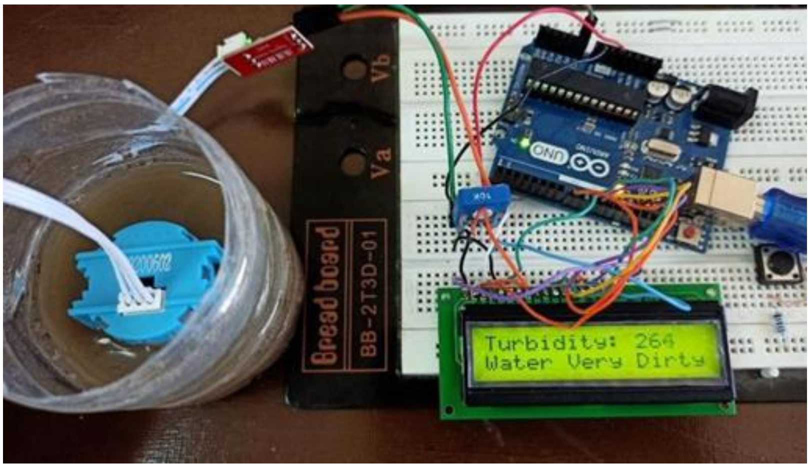

Figure 2. Testing turbidity sensor with dirty water.

A 4-bit operation requires connection of only 4 data pins (D4–D7) between Arduino digital pins 5, 4, 3 and 2. The RS and E control pins are attached to pins 12 and 11 and the RW pin receives a short circuit connection. Monitors the LCD contrast through a V0 pin on the display using a middle pin of a 10k potentiometer. Through the Analog input of the Arduino turbidity sensor readings are converted into Nephelometric Turbidity Units (NTU) values that indicate water quality based on a range of 0–5 NTU for clean water up to over 100 NTU for highly polluted water. This value along with the turbidity value is then printed on the LCD in real-time. This is a very basic setup with which one can easily monitor water clarity with low-cost and easily available components. Results of turbidity sensor are shown in Figure 2. Real life testing results are shown in Table 1.

To ensure that the system satisfies goals, prototype testing was carried out. Figure 2 demonstrates our prototype or the global system where sensor was putted together in glass container, prototyping is also done to demonstrate and evaluate the design's functionality and find problems early in the development process. The system was tested under different conditions and with different qualities of water. The figure demonstrates how the system identified various impurities added to the water, including vinegar, detergent powder, mud, salt and hot water and how these impurities affected some of the sensor. The results of the testing were successful and in accordance with the research objectives. As mentioned the sensor readings are shown on an LCD screen on the device prototype.

CONCLUSION

This work effectively illustrates the design and construction of a low-cost, portable and real-time water quality monitoring system using an Arduino Uno and turbidity sensor. The system can detect the change in water clarity and show the reading of turbidity on a 16x2 LCD display in Nephelometric Turbidity Units (NTU), classifying water quality into different grades from clean to highly polluted. The hardware setup, utilizing low and easily available electronic components, provides the ease and affordability of the design, appropriate for deployment in resource-constrained environments.

Through testing short-term and long-term operation tests for 6, 12 and 24 hours the prototype was demonstrated to consistently detect and respond to various water contaminants like mud, vinegar, salt, detergent and hot water. Multiple prototyping and sensor calibration guaranteed the stability and accuracy of the system. The compactness and portability of the design are also facilitated by the implementation of a light microcontroller configuration, while the logic used effectively translates sensor readings to detect possible contamination.

In conclusion the implemented system meets the principal objectives of providing a cost-effective, robust solution for real-time turbidity monitoring. It offers a platform for future development, for example, wireless data transfer and integration with IoT platforms, in order to facilitate remote and scalable monitoring of water quality.

REFERENCES

1. World Health Organization, "Water shortage in the Philippines threatens sustainable development and health," Mar. 22, 2019. [Online]. Available: https://www.who.int/philippines/news/feature-stories/detail/water-shortage-in-the-philippines-threatens-sustainable-development-and-health
2. J. Manikandan and R. Haritha, "Smart Water Quality Monitoring with IoT Wireless Sensor Networks," International Journal of Engineering Research & Technology (IJERT), vol. 7, no. 4, pp. 245–248, Apr. 2018.
3. N. A. Cloete, R. Malekian, and L. Nair, "Design of smart sensors for real-time water quality monitoring," IEEE Access, vol. 4, pp. 3975–3990, 2016, doi: 10.1109/ACCESS.2016.2592958.
4. A. Kamaludin and M. Ismail, "IoT-based system for water quality monitoring," International Journal of Advanced Computer Science and Applications (IJACSA), vol. 8, no. 10, pp. 123–128, 2017. [Online]. Available: https://doi.org/10.14569/IJACSA.2017.081017
5. M. Banzi and M. Shiloh, Getting Started with Arduino, 3rd ed. Sebastopol, CA, USA: Maker Media, Inc., 2014.
6. United States Environmental Protection Agency, "Turbidity: Water quality standards criteria summaries," 2021. [Online]. Available: https://www.epa.gov/
7. Arduino, "Arduino Uno Rev3," [Online]. Available: https://store.arduino.cc/products/arduino-uno-rev3
8. Arduino, "Arduino Uno Rev34," [Online]. Available: https://store.arduino.cc/products/arduino-uno-rev3
9. DFRobot, "Gravity: Analog Turbidity Sensor For Arduino," [Online]. Available: https://wiki.dfrobot.com/Gravity__Analog_Turbidity_Sensor_SKU_SEN0189_
10. Electronics Hub, "Interfacing 16x2 LCD with Arduino," 2021. [Online]. Available: https://www.electronicshub.org/interfacing-16x2-lcd-with-arduino-uno/
11. Rajesh, "Measuring turbidity of water to determine water quality using Arduino and turbidity sensor," Circuit Digest, Mar. 9, 2024. [Online]. Available: https://circuitdigest.com/microcontroller-projects/measuring-turbidity-of-water-to-determine-water-quality-using-arduino-turbidity-sensor
12. P. Rajalakshmi and S. Banu, "Design and Implementation of a Wireless Sensor Network for Water Quality Monitoring in India," International Journal of Computer Applications, vol. 1, no. 22, pp. 6–12, 2010.
13. H. B. Mahale, A. G. Kothari, and A. B. Bagade, "Smart Water Quality Monitoring System," International Research Journal of Engineering and Technology (IRJET), vol. 3, no. 5, pp. 2395–0056, 2016.
14. P. Harshini and M. K. Kavitha, "IoT Based Water Quality Monitoring System Using Arduino," International Journal of Engineering Research & Technology (IJERT), vol. 7, no. 4, Apr. 2018.
15. S. A. Nadaf and A. M. Walke, "Water Quality Monitoring System Based on IoT," International Journal of Innovative Research in Computer and Communication Engineering, vol. 5, no. 4, Apr. 2017.
16. T. Raut and D. Gade, "A Review Paper on Water Quality Monitoring System Using IoT," International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), vol. 4, no. 3, pp. 870–874, 2018.

17. S. Tripathi and N. Jain, "Development of Low Cost Water Quality Monitoring System Using IoT and Arduino," in Proc. 2nd Int. Conf. on Smart Electronics and Communication (ICOSEC), Trichy, India, 2021, pp. 680–684.
18. A. Kaur and R. Kumar, "Water Quality Monitoring System Based on IoT Using Arduino," International Journal of Advanced Research in Computer Science, vol. 9, no. 2, pp. 567–571, 2018.
19. S. Sharma and D. Sinha, "Design of a Water Quality Monitoring System Using Arduino," in Proc. 4th Int. Conf. on Internet of Things: Smart Innovation and Usages (IoT-SIU), Ghaziabad, India, 2019, pp. 1–6, doi: 10.1109/IoT-SIU.2019.8777510.
20. [20] A. K. Gupta, A. A. Farooqui, and A. Vyas, "Smart Water Quality Monitoring System Using IoT and Machine Learning," International Journal of Computer Applications, vol. 180, no. 48, pp. 1–5, 2018.
21. Rajratna A. Naranje, Kalyan J. Kale, Pranav Kumar P. Chavan, Omkar A. Shirke, Kiran N. Wakchaure, and Naveen Kumar, “Doodle Bot: An Advanced Robot to Draw Complex Geometrical Shapes,” in Proc. 2024 4th Int. Conf. Innovative Practices in Technology and Management (ICIPTM), doi: 10.1109/ICIPTM59628.2024.10563881.
22. R. A. Naranje, K. J. Kale, P. P. Chavan, V. Kumar, and N. Kumar, “Development of 5 Axis Robotic Manipulator for Material Handling and Sorting,” Adv. Transdiscipl. Eng., vol. 58, pp. 547–553, 2024, doi: 10.3233/ATDE240672.

