Design and Fabrication of Water Quality Monitoring System

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Abstract— A universal resource given by nature, fresh water is crucial for industries, agriculture, and human life on earth. This study employs water monitoring sensors to illustrate real-time water monitoring. The system was developed on Arduino UNO board as the microcontroller which was programmed by the Arduino IDE software (version 1.8.18). Three sensors turbidity, temperature and pH were used to examine the water quality. The collected data of the sensors can be viewed on the LCD screen. Therefore, this Water Quality Monitoring System can detect early pollution and can be used in various aspects in human health.

Keywords — Arduino UNO, Arduino IDE, pH sensor, Temperature sensor, Turbidity sensor, NTU (Nephelometric Turbidity Units)

I. INTRODUCTION

Nearly 70% of the human body is made up of water. [7]. In this 21st century, even now in some parts of the world, polluted water is taken for drinking. People are suffering from several diseases like cholera, typhoid, dysentery, polio, meningitis and guinea worm disease through this polluted water [10,11]. A Smart Water Quality Monitoring System is employed to gather key parameters of water which includes turbidity (in NTU), pH, and temperature. The system is developed on the Arduino UNO board which is programmed using Arduino IDE software(version1.8.18). Computer code can be altered and coordinated with a physical board using this free and open-source software. Using the Arduino IDE software (version 1.8.18) with the C++ programming language, the Arduino UNO microcontroller was programmed. To install each sensor module in the board, a specific library was installed and coding was done to enable specific sensor function [8,9]. This system includes three water monitoring sensors that are temperature sensor, pH sensor and turbidity sensor. A temperature sensor is basically a device that gathers the data on temperature and translates that data into human specific reading form. A thermometer, which measures the temperature of solids, liquids, and gases, is the most common and essential type of temperature sensor. Since it is not very precise, this kind of temperature instrument can be found in public and typically used for non-scientific usages [10,11]. A pH sensor is a tool that is specifically aimed to designed for water quality. It can determine both the acidity and alkaline content of water. The range of pH value varies from 0 to 14. Fresh water has a pH value of 7. pH below 7 is considered as acidic and pH above 7 is considered as basic. pH range of water that is suitable for human consumption varies from 6.5 to 8.5[7,8]. Turbidity sensor is designed to measure cloudiness in fluid that is caused by large particles and suspended solids in liquid. A specific calibration formula follows in order for converting the sensor data into voltage. Following then, the voltage is restored to NTU (Nephelometric Turbidity Unit) [7]. The data which is collected through the sensors is then displayed on the LCD screen present in the system. This Water Quality Monitoring system gives a real time data visualization of different aspects of water quality. It aims to provide safe drinking water and to detect early signs of water pollution so that preventive measures can be taken by the concerned authorities.

II. LITERATURE REVIEW

- I M Hakimi and Z Jamil 2021[1] The Kolora meter is a cost-effective water quality measurement device that utilizes IoT technology. It measures temperature and turbidity in water bodies and sends the data to a smartphone app for real-time monitoring. Its remote monitoring capabilities through the Kolora meter App enable early pollution detection and distance monitoring, eliminating the need for on-site personnel. This adaptable system is particularly valuable during limited movement scenarios like the COVID-19 pandemic, providing reliable and real-time results.

- Vaishnavi daigavane and Dr. M.A Gaikwad [2]

Here, Four sensors are used in the proposed system to measure temperature, turbidity, pH, and water level. The primary processing module is the microcontroller unit, and data transmission is handled by the ESP8266 Wi-Fi module. The system is inexpensive, does not require someone to be on duty, and is capable of autonomously monitoring the quality of the water.

- Sai Bhatt Keshpeddi [3] There are two parts of programming in this Smart Water Quality Monitoring System using IoT. In the first part, Arduino UNO is programmed and in the second part, NodeMCU will be programmed. Mostly used soil moisture sensor in agriculture fields so nutrients will be safe.

- Md. Mahbubur Rahman [4] In this paper we focus on several parameter. Like pH, Turbidity, Temperature, Dissolved Oxygen, Salinity. We measure this parameter because WQI mostly depends on those parameters. With the help of sensors, we can check the water quality by use of Wi-Fi module. The system is low in cost and does not require manpower so time and powers both are save.

- Ajith Jerom B [5] The methodology involves designing, setting up, testing, calibrating, and deploying a water quality monitoring system. The system uses sensors to collect data, which is then transmitted to a central server via Wi-Fi and displayed on a web page for real-time monitoring. This system does not require any external person to monitor.

- Varsha Lakshmikantha, Anjitha Hiriyannagowda, Akshay Manjunath, Aruna Patted, Jagadeesh Basavaiah, Audre Arlene Anthony [6] This paper reviews recent innovations in this field, emphasizing the need for real-time water quality examination. Proposing an affordable and effective solution, the paper introduces an IoT-based smart water quality monitoring system. This system, tested on three water samples, ensures uninterrupted monitoring of key parameters. Results are swiftly transmitted to a cloud server for prompt action, securing the supply of pure water and mitigating potential health risks.

- S. Barath Raj, Hari Prasad, S. Prasath, A. Moorthy [7] his project proposes an affordable real-time water quality computing system using the Internet of Things (IoT). Focusing on key parameters such as temperature, pH, and turbidity, the centralized system collects data from various devices. Utilizing a Wi-Fi structure, sensor data is efficiently transmitted to relevant authorities for prompt action. This approach aims to enhance water quality through continuous monitoring, addressing the critical need for timely intervention to safeguard public health.

- C.N. Udanor a,∗ , N.I. Ossai b , E.O. Nwekea , B.O. Ogbuokiri a , A.H. Eneha , C.H. Ugwuishiwua , S.O. Anekea , A.O. Ezuwgua , P.O. Ugwokea , Arua Christiana[8] This paper presents an IoT system utilizing an ESP-32 microcontroller and water quality sensors for automatic data collection in aquaponics fish ponds. Sensors include temperature, pH, dissolved oxygen, turbidity, ammonia, and nitrate. Real-time data is uploaded to the cloud, aiding agriculture, aquaculture, and data science communities. The dataset, valuable for machine learning and data analytics, provides insights for fish farmers on water change timing, stocking density, feed conversion ratios, and fish growth patterns.

III. METHODOLOGY

FLOW CHART
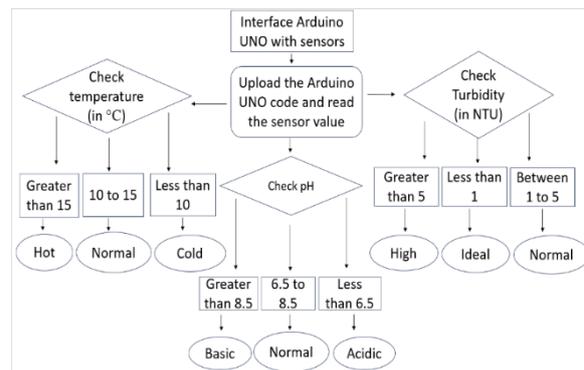
SETUP

Fig 1.1: Temperature measurement of water sample
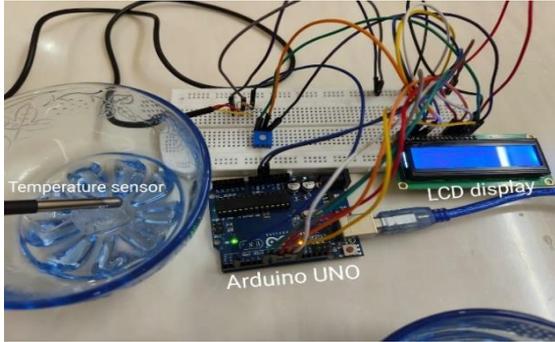
Fig 1.2: Turbidity measurement of water sample

IV. RESULTS AND DISCUSSIONS

This study proposes a water quality monitoring system integrates pH, temperature, and turbidity sensors to ensure comprehensive environmental surveillance. The core components include Arduino-based microcontrollers, specialized sensors.

The interpretation of collected data and drawing meaningful conclusions heavily relies on the results and discussion section in a water monitoring system utilizing pH, turbidity, and temperature sensors. This section plays a pivotal role in unravelling the insights obtained from the data and forming comprehensive conclusions.

V. RESULTS

The pH levels were monitored at regular intervals using a E-399 pH sensor. The recorded pH values ranged from 6.7 to 7.7 over the monitoring period. Turbidity levels were measured using a turbidity sensor. The turbidity values varied between 1 to 2. Temperature data was collected using a DS18B20 temperature sensor. The temperature of the water ranged from 10°C to 15°C.

VI. DISCUSSIONS

In this study, water samples from various locations in Pune were collected, recording the pH levels, turbidity values, and temperature values for each sample. Overall, the findings indicating slightly acidic to neutral pH levels, minimal sedimentation level and temperatures falling in range for human use. This system primarily focuses on monitoring pH, temperature, and humidity, while other systems may include additional parameters tailored for specific industries or agricultural practices [18.19]. This Fig making it suitable for low-budget industrial applications. Other systems may have different cost structures or may prioritize different features over cost-effectiveness

Table 1: Values of Parameters

Sample ID	Location	PH VALUE	TURBIDITY (in NTU)	TEMPERATURE (in °C)
1	Koregaon Park	7.5	1	14
2	Upper Indiranagar	6.7	1.5	10
3	Swargate	6.8	2	15
4	Dhankawdi	7.7	1.5	13

VII. FUTURE SCOPE

The future outlook for a water quality monitoring system, integrating pH, turbidity, and temperature sensors, holds great promise, showcasing potential applications across diverse sectors.

This system can be used for continuous monitoring of water bodies so it can provide real – time data on temperature, turbidity, and pH levels allowing for quick changes in water quality. By upgrading the system and additional of multiple sensors for dissolved oxygen, nitrates, phosphates and biological oxygen demand (BOD) will provide a more complex overview of water quality. With the help of Machine Learning and AI tools this water quality monitoring system can be made more advanced which can significantly enhance its capability. This system can be used in Aqua culture facilities to maintain suitable water condition for aquatic organisms. In Irrigation management this system can be used for monitoring water quality in irrigation system, this helps the crops receive water with suitable pH levels and turbidity.

VIII. CONCLUSION

- A water quality monitoring system equipped with temperature, turbidity, and pH sensors is a smart technique for assessing water quality and safety.

- pH sensor indicates water acidity in which sudden changes suggest potential pollutants. Turbidity sensor detects tiny particles, indicating water clarity. Significant turbidity may imply water contamination. Temperature sensor determines water temperature suitability for human consumption.

- Water samples from various locations in Pune were collected. pH levels exhibited within a range of 6.7 to 7.7. Turbidity ranging from 1 to 2 NTU.

Temperature measurements spanning from 10°C to 15°C.

- Its operational efficiency removes the need for constant human supervision highlights cost-effectiveness. The efficiency of this technology not only guarantees the safety of the water but also makes water quality monitoring more financially feasible.

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