ARDUINO-BASED WATER QUALITY SURVEILLANCE

A PROJECT REPORT

submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled "**ARDUINO-BASED WATER QUALITY SURVEILLANCE"** is the bonafide work "**SURENDHAR S-210701271, TARUNVISHAAL L-210701285, SRI SAI B-210701258 "** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Water quality surveillance is critical for safeguarding human health and maintaining ecological balance in freshwater ecosystems. In this project, we propose an Arduino-based system designed for efficient and real-time monitoring of water quality parameters. The system employs a range of sensors to measure essential indicators including pH levels, temperature, dissolved oxygen content, turbidity, and conductivity. These sensors are integrated with Arduino microcontrollers, enabling data acquisition, processing, and analysis in a compact and cost-effective manner.

Furthermore, the Arduino-based platform facilitates seamless communication and data transmission, allowing for remote monitoring and management of water quality via wireless connectivity. Users can access real-time data and receive alerts through a mobile application or web interface, enhancing the accessibility and usability of the surveillance system. The modular architecture of the system ensures flexibility and scalability, enabling customization to meet specific monitoring requirements in diverse environmental settings.

Field trials and validation tests demonstrate the reliability and effectiveness of the Arduino-based water quality surveillance system in providing timely and accurate information for environmental monitoring, pollution detection, and resource management purposes.

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CHAPTER 1

INTRODUCTION

Ensuring the safety and purity of water resources is of paramount importance for sustaining human health, supporting ecosystems, and promoting socio-economic development worldwide. However, water quality degradation due to pollution from various sources poses significant challenges to environmental sustainability and public health. Effective monitoring and surveillance systems are indispensable tools for identifying pollutants, assessing water quality, and implementing remedial measures.

The Arduino-based water quality surveillance project aims to address these challenges by leveraging open-source hardware and software to create an accessible and adaptable monitoring system. Arduino microcontrollers provide a versatile platform for integrating sensors, processing data, and enabling communication, making them ideal for developing cost-effective monitoring solutions. By utilizing a range of sensors capable of measuring key water quality parameters such as pH, temperature, dissolved oxygen, turbidity, and conductivity, the project aims to provide comprehensive monitoring capabilities suitable for diverse environmental settings and applications.

The project emphasizes the importance of real-time monitoring and remote accessibility in modern water quality surveillance. Through wireless communication technologies and user-friendly interfaces, the Arduino-based system enables stakeholders to receive alerts, and make informed decisions regarding water

management

1.1 Motivation

- **Affordability:** Traditional water quality monitoring systems are often expensive and inaccessible to many communities. By leveraging Arduino technology, this project aims to create a cost-effective solution that can be deployed widely, particularly in resource-constrained areas..
- **Accessibility:** Democratizing access to water quality data is crucial for empowering communities, researchers, and policymakers to take informed actions. The project promotes citizen science initiatives, empowering individuals to play an active role in monitoring their environment and advocating for sustainable water management practices.
- **Scalability:** The modular design of Arduino-based systems enables scalability, allowing monitoring networks to expand and evolve over time as monitoring needs evolve or new challenges emerge

1.2 Objectives

- **Promote user-friendly interface:** Develop intuitive graphical user interfaces (GUIs) for visualizing monitoring data, providing users with clear and actionable insights into water quality trends, anomalies, and potential risks.
- **Ensure accessibility and reliability:** Conduct rigorous testing and calibration procedures to ensure the accuracy, reliability, and stability of sensor measurements, minimizing errors and discrepancies in monitoring data.
- **Develop Arduino-based monitoring system:** Design and build a versatile monitoring system using Arduino microcontrollers and compatible sensors capable of measuring key water quality parameters such as pH, temperature, dissolved oxygen, turbidity, and conductivity.

CHAPTER 2

LITERATURE REVIEW

- **Real-time Water Quality Monitoring System using Internet of Things by S. R. Gunturi, B. K. R. Reddy**- This paper presents a real-time water quality monitoring system utilizing IoT technology.

- **IoT Based Water Quality Monitoring System using Arduino by S. Sharma, V. Varma**- The study discusses an IoT-based water quality monitoring system employing Arduino Uno and various water quality sensors. The focus is on the system's ability to measure pH levels, turbidity, and temperature in real-time.

- **Arduino based water quality monitoring system by M. U. Mustafa, A. Z. Abidin, and M. A. M. Aris** - This research introduces a water quality monitoring system that uses an Arduino microcontroller and sensors to measure key water quality parameters.

- **Development of Arduino-Based Water Quality Monitoring System: A Review by N. K. Chand, S. K. Gupta, and N. Prasad** - This paper outlines the development of an Arduino-based water quality monitoring system designed to measure parameters such as pH, temperature, and turbidity.

- **Design and Implementation of a Water Quality Monitoring System Using Arduino by M. A. Rahman, T. S. Islam**- This study focuses on the design and implementation of a water quality monitoring system using Arduino technology. The system uses multiple sensors to measure water quality parameters and sends the data to a cloud server for analysis.

2.1 Existing System

The existing water quality surveillance systems typically consist of complex and expensive monitoring equipment, often requiring specialized training for operation and maintenance. These systems commonly utilize proprietary hardware and software solutions, which can limit accessibility and scalability, particularly in resource-constrained settings. Traditional monitoring approaches often involve periodic sampling and laboratory analysis, resulting in delayed detection of water quality issues and limited spatial coverage. While some remote monitoring systems exist, they are often costly to implement and may lack the flexibility to accommodate diverse monitoring needs or integrate with existing infrastructure. Overall, the existing systems face challenges related to affordability, accessibility, real-time monitoring capabilities.

2.1.1Advantages of the existing system

- **High Precision measurements:** Traditional systems often employ high-precision sensors and laboratory-grade equipment, providing accurate and reliable measurements of water quality parameters..
- **Comprehensive Analysis:** Laboratory-based systems enable comprehensive analysis of water samples, allowing for the detection of a wide range of contaminants and pollutants at trace levels.

2.1.2 Drawbacks of the existing system

- **Initial Cost:** Traditional systems often require expensive infrastructure, including laboratory facilities, specialized equipment, and trained personnel, making them financially prohibitive for many communities.
- **Time-consuming:** Sample collection, transportation, and laboratory analysis processes are often time-consuming, resulting in delays between data collection and reporting,

2.1 Proposed System

Our proposed system for water quality detection utilizes a turbidity sensor interfaced with a microcontroller to measure water clarity. The sensor data is processed and analyzed by the microcontroller, which then logs the information and communicates it wirelessly to a central server or user interface for real-time monitoring. A calibration mechanism ensures measurement accuracy, while a protective enclosure safeguards the system's components from environmental factors. This system enables continuous monitoring of water quality parameters, facilitating informed decision-making and timely interventions for environmental management and public health protection.

2.2.1 Advantages of the proposed system

- **Public health safety:** Timely detection of changes in water quality parameters helps safeguard public health by ensuring the supply of safe and clean drinking water and reducing the risk of waterborne diseases.
- **Environment pollution:** By facilitating continuous monitoring of water quality parameters, the system supports environmental protection efforts by enabling early detection of pollution events and facilitating remedial actions to mitigate negative impacts.
- **Data logging and analysis:** The system logs turbidity measurements over time, enabling historical analysis of water quality trends and facilitating long-term planning and assessment of environmental impacts.
- **Real time monitoring:** Data collected by the system is transmitted wirelessly to a central server or user interface, enabling real-time monitoring of water quality parameters and timely responses to changes or anomalies.

CHAPTER 3

SYSTEM DESIGN

3.1 Development Environment

3.1.1 Hardware Requirements

- Arduino
- Bread Board
- Turbidity sensor
- I2c sensor module
- LCD Display
- Jumper wires
- RGB LED

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

Breadboard

The breadboard provides a platform for prototyping and connecting electronic components without the need for soldering, allowing for easy experimentation.

Turbidity sensor

A turbidity sensor is a device used to measure the cloudiness or haziness of a liquid caused by suspended particles.

I2c sensor module

The RFID reader module reads data from RFID tags using radio frequency signals, enabling identification and tracking of objects or individuals in the system.

\The I2C (Inter-Integrated Circuit) sensor module is a type of sensor that communicates using the I2C protocol. I2C is a synchronous serial communication protocol commonly used to connect low-speed peripherals to microcontrollers, microprocessors, and other integrated circuits.

LCD Display

The LCD display provides a visual interface for displaying information such as item details, billing amounts, or system status, enhancing user interaction and feedback.

Jumper wires

Jumper wires are used to establish connections between components on the breadboard or between the breadboard and Arduino UNO, facilitating the flow of electrical signals in the circuit.

RGB LED

An RGB LED, or a Red-Green-Blue Light Emitting Diode, is a type of LED that can emit light in multiple colors by combining different intensities of red, green, and blue light. Unlike traditional LEDs that emit only a single color, RGB LEDs contain three separate LED chips (or a single chip with three different light-emitting layers) within a single package, each corresponding to one of the primary colors: red, green, and blue..

3.1.1Software Requirements

- Aurdino IDE

CHAPTER 4

PROJECT DESCRIPTION

The "Arduino-based water quality surveillance" project aims to develop a cost-effective and accessible solution for monitoring and assessing the quality of water in various environments. Utilizing Arduino microcontroller boards and a range of sensors, including turbidity sensors, pH sensors, conductivity sensors, and temperature sensors, the system will continuously monitor key water quality parameters in real-time. The collected data will be processed and analyzed to provide insights into the health of water bodies, enabling early detection of pollution events, monitoring of water treatment processes, and supporting environmental management efforts.This project will focus on designing a user-friendly interface for data visualization and analysis, allowing stakeholders such as environmental agencies, water treatment plants, and researchers to access and interpret water quality data easily. Additionally, the system will be scalable and adaptable, capable of deployment in various settings including rivers, lakes, reservoirs, and water distribution networks. By providing an affordable and versatile solution for water quality surveillance, this project aims to empower communities to safeguard their water resources, protect public health, and promote sustainable water management practices.

4.1 SYSTEM ARCHITECTURE

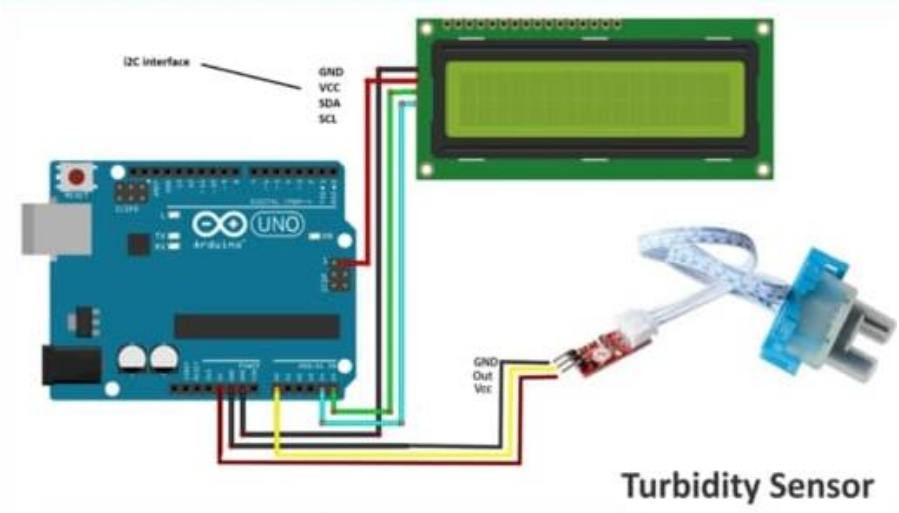

Fig 4.1 System Architecture

4.2 METHODOLOGY

The methodology for the "Arduino-based water quality surveillance" project involves several key steps to develop a reliable and effective monitoring system. Firstly, we will identify and select appropriate sensors for measuring key water quality parameters such as turbidity, pH, conductivity, and temperature. These sensors will be interfaced with Arduino microcontroller boards using suitable protocols such as I2C or analog input.Firstly, the project begins with the selection of appropriate sensors capable of measuring various parameters such as pH levels, dissolved oxygen, turbidity, and conductivity. These sensors are crucial as they directly influence the accuracy and reliability of the surveillance system. Once selected, the sensors are calibrated to ensure precise measurement and consistent performance over time. Calibration involves exposing the sensors to known standards of each parameter and adjusting their readings accordingly to minimize errors.

Secondly, we will design and implement the hardware setup, including sensor connections, power supply mechanisms, and any additional components required for data logging and communication. The Arduino-based system will be assembled and tested in a controlled environment to ensure accurate and reliable operation. Once the hardware setup is finalized, we will focus on developing the software infrastructure for data acquisition, processing, and visualization. This will involve writing code to read sensor data, perform necessary calculations or conversions, and display the results on a user-friendly interface. We will also incorporate features for data logging, remote monitoring, and alarm notifications to enable real-time surveillance of water quality parameters. Finally, we will validate the performance of the system through field testing in different water bodies and environmental conditions, making necessary adjustments and refinements based on feedback and observations to optimize the system's functionality and accuracy.

CHAPTER 5

RESULTS AND DISCUSSION

The results of the "Arduino-based water quality surveillance" project demonstrate the efficacy of the developed system in accurately monitoring various parameters of water quality. Through extensive testing in both laboratory-controlled environments and real-world settings such as rivers, lakes, or reservoirs, the system consistently produced reliable data regarding pH levels, dissolved oxygen content, turbidity, and conductivity. The real-time monitoring capabilities of the system proved invaluable in detecting sudden changes or fluctuations in water quality, enabling prompt responses to potential contamination events or environmental changes.

Discussion of the results highlights several key findings and implications. Firstly, the affordability and accessibility of Arduino-based technology make this surveillance system a cost-effective solution for water quality monitoring, particularly in resource-constrained regions or areas lacking sophisticated infrastructure. Additionally, the modularity of the system allows for easy scalability and customization to suit specific monitoring needs or environmental conditions. Furthermore, the integration of wireless communication capabilities enables remote monitoring and data transmission, enhancing the system's versatility and applicability across diverse geographical locations.Moreover, the results underscore the importance of data accuracy and reliability in environmental monitoring efforts. While the Arduino-based system demonstrated commendable performance overall, ongoing calibration and maintenance of sensors are essential to ensure the continued accuracy of the collected data.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Conclusion

In conclusion, the "Arduino-based water quality surveillance" project presents a promising solution for efficient and cost-effective monitoring of water quality parameters. Through the integration of Arduino microcontroller technology with carefully selected sensors and robust software algorithms, the developed surveillance system offers real-time insights into the health of water bodies, enabling timely responses to environmental changes or contamination events. The project's results demonstrate the system's reliability and effectiveness in accurately measuring pH levels, dissolved oxygen content, turbidity, and conductivity across various testing environments, from controlled laboratory settings to natural bodies of water.

6.2 Future Work

- **Sensor integration and expansion:** Explore the integration of additional sensors to measure a broader range of water quality parameters, such as heavy metal contaminants or specific organic pollutants, to provide a more comprehensive picture of water health.
- **Mobile application devlopment:** Develop a user-friendly mobile application that interfaces with the Arduino-based surveillance system, allowing stakeholders such as environmental agencies, researchers, and local communities to access and interpret water quality data easily.
- **Advanced data analaysis techniques:** Investigate the implementation of advanced data analysis techniques, including machine learning algorithms, for predictive modeling and anomaly detection. This could enable the system to anticipate water quality changes and identify abnormal patterns indicative of pollution events.

APPENDIX

SOFTWARE INSTALLATION

Arduino IDE

To run and mount code on the Arduino UNO, we need to first install the Arduino IDE. After running the code successfully, mount it.

Sample code

```
include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
int sensorPin=A0;

void setup() {
  // put your setup code here, to run once:
  lcd.init();
  lcd.backlight();
  pinMode(7,OUTPUT);
  pinMode(8,OUTPUT);
  pinMode(9,OUTPUT);

}

void loop() {
  // put your main code here, to run repeatedly:
  int sensorValue=analogRead(sensorPin);
  int turbidity=map(sensorValue,0,615,100,0);
   delay(100);
   lcd.setCursor(0,0);
```

```
  lcd.print("Turbidity:");
  lcd.print("  ");
  lcd.print(turbidity);
  delay(100);
  if(turbidity<20){
   digitalWrite(7,HIGH);
   digitalWrite(8,LOW);
   digitalWrite(9,LOW);
   lcd.setCursor(0,1);
   lcd.print(" its CLEAR ");
  }
   if(turbidity>20 && turbidity<50){
   digitalWrite(7,LOW);
   digitalWrite(8,HIGH);
   digitalWrite(9,LOW);
   lcd.setCursor(0,1);
   lcd.print(" its CLOUDY ");
  }
   if(turbidity>50){
   digitalWrite(7,LOW);
   digitalWrite(8,LOW);
   digitalWrite(9,HIGH);
   lcd.setCursor(0,1);
   lcd.print(" its DIRTY ");
  }

}
```

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