IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

AIR AND WATER QUALITY MONITORING SYSTEM

Gayatri Honmane

Student
Department of Electronic and Telecommunication
BIT, Barshi, India

Abstract: Environmental pollution has become a critical global challenge, demanding continuous and reliable monitoring of air and water quality. This project proposes a low-cost, portable, and efficient system capable of real-time measurement of key environmental parameters. The system is developed using an Arduino Uno microcontroller as the central processing unit. For air quality assessment, an MQ135 gas sensor is employed to detect harmful gases such as ammonia, benzene, smoke, alcohol vapors, and carbon dioxide, providing an indicative measure of air pollution levels. Water quality is evaluated using an industrial-grade analog pH sensor to determine acidity or alkalinity, a turbidity sensor to measure cloudiness in Nephelometric Turbidity Units (NTU), and a DS18B20 waterproof temperature sensor to monitor water temperature. The Arduino Uno processes all sensor data and displays the results - air quality status, pH value, turbidity, and temperature - on a 16×2 LCD in 8-bit mode, enabling instant local readout. Designed as a standalone unit, the system is suitable for diverse applications including industrial monitoring, agricultural water management, and water treatment facilities. Its affordability, portability, and real-time feedback capabilities make it an accessible and practical solution for environmental monitoring in resource-limited settings.

Index Terms **-** Arduino Uno, Environmental Monitoring, MQ135, pH Sensor, Turbidity Sensor, DS18B20, Air Quality, Water Quality, LCD Display.

I. INTRODUCTION

Environmental pollution has emerged as one of the most pressing global challenges, with air and water contamination posing significant threats to public health, ecosystems, and sustainable development. Rapid industrialization, dense urban growth, and improper waste disposal have resulted in the release of hazardous pollutants into the atmosphere and water bodies. Traditional monitoring methods rely heavily on manual sampling and laboratory analysis, which, while accurate, are often slow, expensive, and incapable of providing continuous real-time data. As a result, critical pollution events may go undetected until irreversible damage has occurred.

Advancements in embedded systems, microcontrollers, and low-cost environmental sensors have enabled the development of modern, automated monitoring solutions. These systems provide real-time data, require minimal maintenance, and can be deployed in remote or resource-limited areas. Among various prototyping platforms, Arduino has gained significant popularity due to its ease of use, affordability, and strong technical community support, making it suitable for rapid development of monitoring applications.

This project leverages these technological improvements to create an accessible, portable, and cost-effective system capable of measuring key environmental parameters such as air quality, water pH, turbidity, and temperature. By empowering small industries, research institutions, and local communities with real-time pollution data, the system aims to promote proactive environmental management and contribute to sustainable ecological protection.

II. PROBLEM STATEMENT

To design and develop a portable, real-time monitoring system capable of measuring key air and water quality parameters. The system must be able to:

1) Detect the concentration of various harmful gases in the air.
2) Measure the pH, turbidity, and temperature of a water sample.
3) Process the sensor data using a microcontroller.
4) Display the measured values clearly on an integrated display screen for on-the-spot analysis.
5) Be cost-effective and easy to assemble and operate.

III. OBJECTIVES

- To interface an MQ135 air quality sensor, a pH sensor, a turbidity sensor, and a DS18B20 temperature sensor with an Arduino Uno.
- To program the Arduino to read analog and digital data from the sensors accurately.
- To implement the necessary algorithms and calibration procedures for converting raw sensor data into meaningful units (e.g., pH, NTU, °C, PPM).
- To interface a 16x2 LCD in 8-bit mode for displaying the processed data.
- To integrate all components into a functional, standalone prototype.

IV. BLOCK DIAGRAM

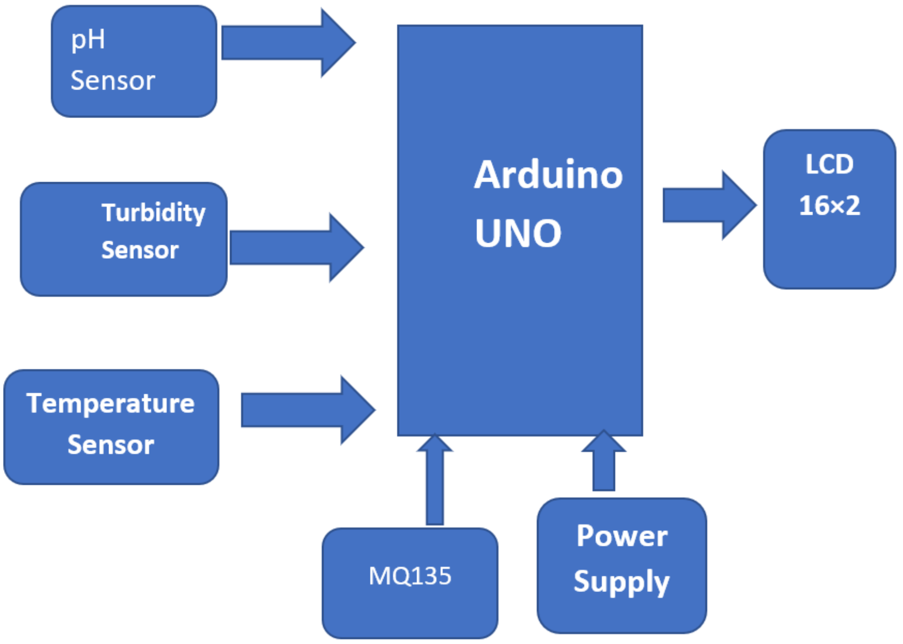

Fig. 1 Block Diagram for Air and Water monitoring system

V. COMPONENT DESCRIPTION

- **Arduino Uno:**
  The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog input pins, a 16 MHz quartz crystal, a USB connection, a power jack, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter to get started. It serves as the brain of our project, executing the program to read, process, and display data.
- **MQ135 Air Quality Sensor:**
  The MQ135 is a metal oxide semiconductor (MOS) type gas sensor. It is sensitive to a wide range of gases, including ammonia (NH3), nitrogen oxides (NOx), alcohol, benzene, smoke, and carbon dioxide (CO2). The sensor's conductivity changes depending on the concentration of these gases in

the air. It provides an analog output voltage that is proportional to the gas concentration. For this project, it gives a qualitative "Air Quality" status (e.g., Good, Poor).

- **Industrial Grade Analog pH Sensor:**
  This sensor measures the hydrogen-ion activity in a water-based solution, indicating its acidity or alkalinity. It consists of a pH probe and a signal conditioning board. The probe generates a small voltage that varies with the pH of the solution. The signal conditioning board amplifies this voltage to a level that can be read by the Arduino's analog-to-digital converter (ADC). The pH scale ranges from 0 to 14.
- **Turbidity Sensor:**
  This sensor measures the relative clarity of a liquid. It works by shining a beam of infrared light into the sample and measuring the amount of light that is scattered by the suspended particles. The more particles present, the more light is scattered, and the higher the turbidity. The sensor outputs an analog voltage that is proportional to the turbidity, which is typically measured in Nephelometric Turbidity Units (NTU).
- **DS18B20 Temperature Sensor:**
  The DS18B20 is a digital temperature sensor. It is waterproof and comes in a probe-like form factor, making it ideal for immersing in liquids. It uses a 1-Wire communication protocol, meaning it requires only one data line (and ground) to communicate with the Arduino. It provides high accuracy temperature readings (±0.5°C) over a range of -55°C to +125°C.
- **16x2 LCD Display:**
  A Liquid Crystal Display (LCD) is a flat-panel display that uses the light-modulating properties of liquid crystals. A 16x2 LCD can display 16 characters per line and has two such lines. In this project, it is operated in 8-bit mode, meaning all eight data lines (D0-D7) are used to send data from the Arduino to the LCD. This provides a straightforward way to display the sensor readings to the user.

VI. WORKING PRINCIPLE

The operation of the system is sequential and continuous.

1) **Power On:** When the system is powered up, the Arduino Uno executes the setup() function. The LCD is initialized and displays a startup message.
2) **Data Acquisition:** The Arduino enters the loop() function.

- **Temperature:** It sends a request to the DS18B20 sensor via the 1-Wire protocol to read the temperature.
- **Air Quality:** It reads the analog voltage from the AOUT pin of the MQ135 sensor.
- **pH Level**: It reads the analog voltage from the output of the pH sensor's signal conditioning board.
- **Turbidity:** It reads the analog voltage from the Turbidity sensor's output.

3) Data Processing:

- The raw ADC values (0-1023) from the analog sensors are converted into voltage levels (0-5V).
- These voltage values are then passed through the calibration formulas to calculate the final pH, Turbidity (NTU), and Air Quality status.
- The digital data from the DS18B20 is already in degrees Celsius.

4) Data Display:

- The Arduino clears the LCD screen to display the new set of readings.
- It positions the cursor on the first line and prints the Air Quality and Temperature values. For example: Air:Good T:25.5C.
- It then positions the cursor on the second line and prints the pH and Turbidity values. For example: pH:7.1 NTU:15.2.

5) **Looping:** After a predefined delay (e.g., 2-3 seconds), the entire process repeats, providing continuous real-time updates of the environmental parameters.

VII. RESULTS AND DISCUSSION

The developed Water and Air Quality Monitoring System successfully measures and displays four essential environmental parameters—air quality, pH level, turbidity, and temperature—providing real-time insights into local environmental conditions. The system was tested under various sample conditions to evaluate its performance, responsiveness, and reliability.

- **Air Quality Measurement**
  Using the MQ135 sensor, the system provided a qualitative indication of air pollution levels. Changes in gas concentration were reflected by noticeable variations in sensor output, allowing the detection of common pollutants such as ammonia, smoke, and carbon dioxide. While not designed for highly precise quantitative measurements, the sensor effectively indicated relative changes in air quality, making it suitable for preliminary environmental assessment.
- **Water pH Measurement**
  The analog pH sensor successfully detected variations in acidity and alkalinity across different water samples. The readings remained stable after calibration, demonstrating the system's capability to indicate whether water is acidic, neutral, or basic. Minor deviations from laboratory-grade accuracy were observed, which is expected from low-cost sensors, but the results remained acceptable for general-purpose monitoring.
- **Turbidity Measurement**
  The turbidity sensor produced reliable readings in Nephelometric Turbidity Units (NTU), differentiating clearly between clean water, slightly turbid samples, and highly turbid samples. The infrared-based detection method responded accurately to changes in particle concentration, making it suitable for basic water clarity assessment.

- **Temperature Measurement**
  The DS18B20 waterproof temperature sensor delivered highly accurate temperature readings with quick response time. Its digital interface ensured minimal noise interference, contributing to the overall consistency of the system's water quality measurements.

VIII. CONCLUSION

This project successfully demonstrates the design and implementation of a versatile and cost-effective Water and Air Quality Monitoring System using the Arduino Uno platform. The system effectively integrates multiple sensors to measure four critical environmental parameters—air quality, water pH, turbidity, and temperature—and displays the results in real-time on an LCD screen.

The project achieves its objective of creating a portable, standalone unit that can be used for localized environmental assessment. It highlights the potential of using open-source hardware and low-cost sensors to make environmental monitoring technology more accessible. While the system has limitations in terms of precision compared to professional equipment, it serves as an excellent educational tool and a proof-of-concept for more advanced monitoring solutions. The future scope for this project is vast, with clear pathways for enhancement through IoT connectivity, data logging, and the integration of more sophisticated sensors, paving the way for a comprehensive and smart environmental monitoring network.

IX. REFERENCES

1. Monk, S. (2016). Arduino Cookbook: Recipes to Begin, Expand, and Enhance Your Projects. O'Reilly Media.
2. Aswale, P., & Gaikwad, P. (2018). "Microcontroller based Air and Water Pollution Monitoring System," International Journal of Advanced Research in Computer and Communication Engineering, 7(4).
3. Figaro Engineering Inc. MQ135 Gas Sensor Datasheet.
4. Herman, S. L. (2014). Electrical Transformers and Rotating Machines. Cengage Learning.
5. Wilson, J. S. (2016). Sensor Technology Handbook. Newnes Publishing.