A

Project Report

on

**"SMART WATER MONITORING"**

Submitted in partial fulfillment for the award of the degree of

Bachelor of Technology

in

Electronics Engineering with Specialization in IOT.

**Submitted By: -**
Gaurika(20001017018)
Harsh(20001017021)
Manan(20001017029)
Rahul(20001017047)

**Project Supervisor:**
**Rashmi Chawla**
(Associate Professor)
Department of Electronics Engineering

**J.C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY**
**YMCA, FARIDABAD**
**DECEMBER 2023**

# DECLARATION

I hereby declare that the work, being presented in the project report entitled as **"SMART WATER MONITORING"** in partial fulfillment of the requirement for the award of the Degree in **Bachelor of Technology in Electronics Engineering** and submitted to the Department of Electronics Engineering of J.C. Bose University ofScience and Technology, YMCA, Faridabad is an authentic record of my own work carried out during a period from July 2023 to December 2023 under the supervision of Rashmi Chawla(Associate Professor )Department of Electronics Engineering. No part of the matter embodied in the project has been submitted to any other University / Institute for the award of any Degree or Diploma.

Signature of Student(s)

Gaurika(20001017018)

Harsh(20001017021)

Manan(20001017029)

Rahul(20001017047)

# CERTIFICATE

This is to certify that the project entitled, **"SMART WATER MONITORING"** submitted in partial fulfillment of the requirements for the degree in **Bachelors of Technology in Electronics Engineering** is an authentic work carried out under my supervision and guidance.

**Rashmi Chawla**
**Associate Professor**
**Department of Electronics Engineering**
**J.C. Bose University of Science and Technology, Faridabad**

# ACKNOWLEDGEMENT

We take this opportunity to express our deep sense of gratitude and respect towards our supervisor Rashmi Chawla, Associate Professor, Department of Electronics Engineering/J.C. Bose University of Science & Technology, YMCA, Faridabad.

We are very much indebted to her for the generosity, expertise and guidance. Without her support and timely guidance, the completion of this report would have seemed a farfetched dream. In this respect we find ourselves lucky to have her as our supervisor. She has supervised us not only with the subject matter, but also taught us the proper style and technique of working and presentation. It is a great pleasure for us to express our gratitude towards those who are involved in the completion of my project report.

We would also like to thank Department of Electronics Engineering, J.C. Bose University of Science & Technology, YMCA, Faridabad for providing us various facilities. We are also grateful to all the faculty members & evaluation committee members for their constant guidance during this project work.

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# ABSTRACT

The SMART Water Monitoring Project tackles the global water crisis using advanced sensor technology and data analytics. pH, temperature, turbidity, and TDS sensors provide real-time data on critical water quality parameters, impacting treatment efficacy, pollution detection, contamination, and mineral content assessment. The methodology involves strategic sensor placement for continuous monitoring, with data analyzed using advanced tools.

With applications in municipal water systems, natural water bodies, industries, and agriculture, the project supports safe water delivery, ecosystem conservation, sustainable industry, and efficient agricultural water use. Benefits include proactive resource management, biodiversity conservation, and support for sustainable practices. Challenges include financial investment, technical expertise for sensor deployment, and addressing data security and interoperability issues.

In conclusion, SMART Water Monitoring Projects are vital for addressing the global water crisis by offering real-time data on water quality parameters. Challenges exist, but the benefits in ensuring clean water distribution, ecosystem conservation, and sustainable practices underscore their significance in securing a water-sufficient future. Continued research is essential for overcoming challenges and enhancing project effectiveness.

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# INTRODUCTION

Water, the lifeblood of our planet, is a finite and indispensable resource that sustains all forms of life on Earth. From quenching our thirst to nourishing crops, supporting industries, and maintaining ecosystems, water plays a pivotal role in every aspect of human existence. However, despite its apparent abundance, the world is facing an escalating global water crisis that threatens the availability, quality, and sustainability of this vital resource.The global water crisis is a multifaceted challenge characterized by a combination of factors such as population growth, urbanization, industrialization, climate change, and pollution. As the global population continues to burgeon, water demand is surging, putting immense pressure on existing water sources. Simultaneously, rapid urbanization has led to increased pollution of water bodies, posing severe threats to both human and environmental health. The consequences of climate change, including altered precipitation patterns and prolonged droughts, further exacerbate water scarcity in many regions. At the heart of addressing the global water crisis lies the need for effective water resource management and monitoring. To combat these multifarious challenges and ensure the equitable distribution of safe and clean water, innovative approaches and technologies are required. This is where SMART Water Monitoring Projects come into play. These projects, fueled by advancements in sensor technology, data analytics, and connectivity, have emerged as a beacon of hope in the realm of water resource management.

SMART Water Monitoring Projects are holistic initiatives designed to revolutionize the way we observe, understand, and manage water resources. These projects incorporate a diverse array of sensors, including pH sensors, temperature sensors, turbidity sensors, and TDS (Total Dissolved Solids) sensors, each with its unique role in comprehensively assessing water quality. By deploying these sensors strategically in various aquatic environments, such as municipal water distribution systems, natural water bodies, industrial processes, and agricultural settings, SMART Water Monitoring Projects provide real-time, granular data on critical water quality parameters. The importance of monitoring these parameters cannot be overstated. pH levels, for instance, directly impact the corrosiveness of water and the efficacy of water treatment processes. Temperature variations can signify pollution or changing environmental conditions. Turbidity measurements reveal the presence of suspended particles and potential contamination, while TDS assessments help gauge the mineral content of water, which can affect its taste, suitability for irrigation, and industrial use.This literature review endeavors to provide a comprehensive examination of SMART Water Monitoring Projects, delving into their objectives, sensor technologies, applications, benefits, challenges, and future trajectories. By undertaking a meticulous analysis of the existing body of knowledge, we aim to underscore the profound significance of SMART Water Monitoring Projects in the context of the global water crisis and the pivotal role they play in addressing contemporary water-related challenges.

# Chapter-2
# LITERATURE REVIEW

The SMART WATER MONITORING Project is a critical response to the escalating global water crisis, posing severe threats to the availability, quality, and sustainability of this indispensable resource. Characterized by a complex interplay of factors such as population growth, urbanization, industrialization, climate change, and pollution, the global water crisis necessitates innovative approaches for effective water resource management. This literature review comprehensively examines the significance of SMART Water Monitoring Projects, driven by advancements in sensor technology, data analytics, and connectivity.Water, often referred to as the lifeblood of our planet, is central to all forms of life on Earth. From quenching our thirst to nourishing crops, supporting industries, and maintaining ecosystems, water plays a pivotal role in every aspect of human existence.Simultaneously, urbanization contributes to increased pollution of water bodies, jeopardizing both human and environmental health. Climate change further exacerbates water scarcity with altered precipitation patterns and prolonged droughts.At the core of addressing the global water crisis lies the imperative for effective water resource management.Leveraging a diverse array of sensors, including pH, temperature, turbidity, and TDS sensors, these projects provide real-time, granular data on critical water quality parameters.Deployed strategically in various aquatic environments, such as municipal water distribution systems, natural water bodies, industrial processes, and agricultural settings, SMART Water Monitoring Projects offer unparalleled insights into water quality. pH levels, for instance,directly impact water corrosiveness and the efficacy of treatment processes.Turbidity measurements reveal the presence of suspended particles and potential contamination, while TDS assessments gauge water mineral content, influencing taste, suitability for irrigation, and industrial use.The initiative embedded within the SMART WATER MONITORING Project exemplifies the transformative potential of these projects. By integrating low-cost IoT-enabled sensors and control systems, the initiative focuses on monitoring, controlling, and treating drinking water and wastewater. The development of low-cost sensors, designed for integration into network operations, ensures reliable monitoring of water quality and quantity in rural and urban India.Objectives of the initiative are multifold. First, it aims to develop low-cost IoT-enabled sensors and control systems for monitoring water quality and quantity. Second, the project focuses on creating inexpensive and low-maintenance technologies for the treatment of drinking water and wastewater, emphasizing reuse and recycling. Third, the initiative seeks to integrate and demonstrate real-time monitoring and treatment technologies as a pilot for sustainable water management. Lastly, the project aims for an efficient transfer of results to the scientific community, stakeholders, and end-users.Results from the monitoring phase of the initiative demonstrate its effectiveness in addressing the water deficit in Haryana.The development of low-cost IoT-enabled sensors has been a breakthrough, exceeding expectations in terms of affordability and accuracy.These sensors, integrated into network operations, enable seamless monitoring across diverse environments. The emphasis on cost-effectiveness ensures that the benefits of these technologies can be extended to regions facing similar water challenges.In tandem with monitoring, the initiative has made significant strides in developing treatment technologies.The focus on inexpensive and low-maintenance solutions aligns with the goal of ensuring accessibility and sustainability. Pilot programs validate the effectiveness of these technologies in diverse contexts, emphasizing their potential for widespread application.Efficient transfer of project results to the scientific community, stakeholders, and end-users is a hallmark of the initiative. By deploying technologies in different parts of rural and urban India, the project bridges the gap between research and practical application.This outreach empowers communities to make informed decisions and provides valuable feedback for continuous improvement.In conclusion, the SMART WATER MONITORING Project, exemplified by the initiative, emerges as a comprehensive and effective solution to the water challenges faced by Haryana. The integration of monitoring, treatment, and community engagement lays the groundwork for a sustainable and scalable model. As the global water crisis intensifies, the innovations developed by SMART Water Monitoring Projects hold the potential to set new standards in water resource management, offering hope for a more water-secure future.

# Chapter-3
# OBJECTIVES OF PROJECT

The SMART WATER MONITORING PROJECT, also known as AWESOME (Affordable Water and Environmental Sensor Monitoring), is a critical initiative in response to the increasing pollution and contamination of water resources in Haryana. In a state where water plays a pivotal role across agriculture, industry, and domestic sectors, the project aims to implement smart water management strategies for sustainable development. With Haryana currently meeting only 74% of its water demands and facing an annual water deficit of approximately 14 billion cubic meters, there is an urgent need for innovative solutions to address water scarcity and deteriorating water quality.The overarching objective of the AWESOME project is to develop and implement innovative, low-cost, and smart technologies for monitoring, controlling, and treating drinking water and wastewater. By focusing on both rural and urban India, the project aims to contribute to safe and sustainable water resource management. The following specific objectives guide the mission of the AWESOME project:

1. Development of Low-Cost IoT Enabled Sensors and Control Systems:
The project will focus on creating affordable Internet of Things (IoT) enabled sensors and control systems. These technologies will be integrated into network operations to provide reliable monitoring of water quality and quantity in both rural and urban areas of India. The emphasis is on creating cost-effective solutions that can be widely deployed to address the diverse water management needs of different regions.

2. Development of Inexpensive and Low-Maintenance Treatment Technologies:
AWESOME aims to pioneer technologies that are not only cost-effective but also low maintenance. This objective encompasses the development of innovative solutions for the treatment of drinking water and wastewater. The focus is on creating technologies that enable the use, reuse, and recycling of water resources, ensuring that water treatment processes are sustainable and accessible across diverse settings.

3. Integration and Demonstration of Real-Time Monitoring and Treatment Technologies:
The project intends to integrate and demonstrate the developed real-time monitoring and treatment technologies in a pilot program. This will serve as a practical implementation of the innovative solutions in the field, allowing for the assessment of their effectiveness in ensuring sustainable water management. The pilot program will be conducted in both rural and urban India to account for regional variations.

In conclusion, the SMART WATER MONITORING PROJECT, or AWESOME, is a comprehensive initiative designed to address the pressing water challenges faced by Haryana and, by extension, other regions in India. Through the pursuit of its objectives, the project seeks to contribute significantly to the development of sustainable, affordable, and smart technologies for water monitoring and treatment. By targeting both rural and urban areas, AWESOME aspires to create solutions that are adaptable and scalable, fostering a positive impact on water resource management in the pursuit of a more water-secure and sustainable future.

# Chapter-4
# CIRCUIT DIAGRAM

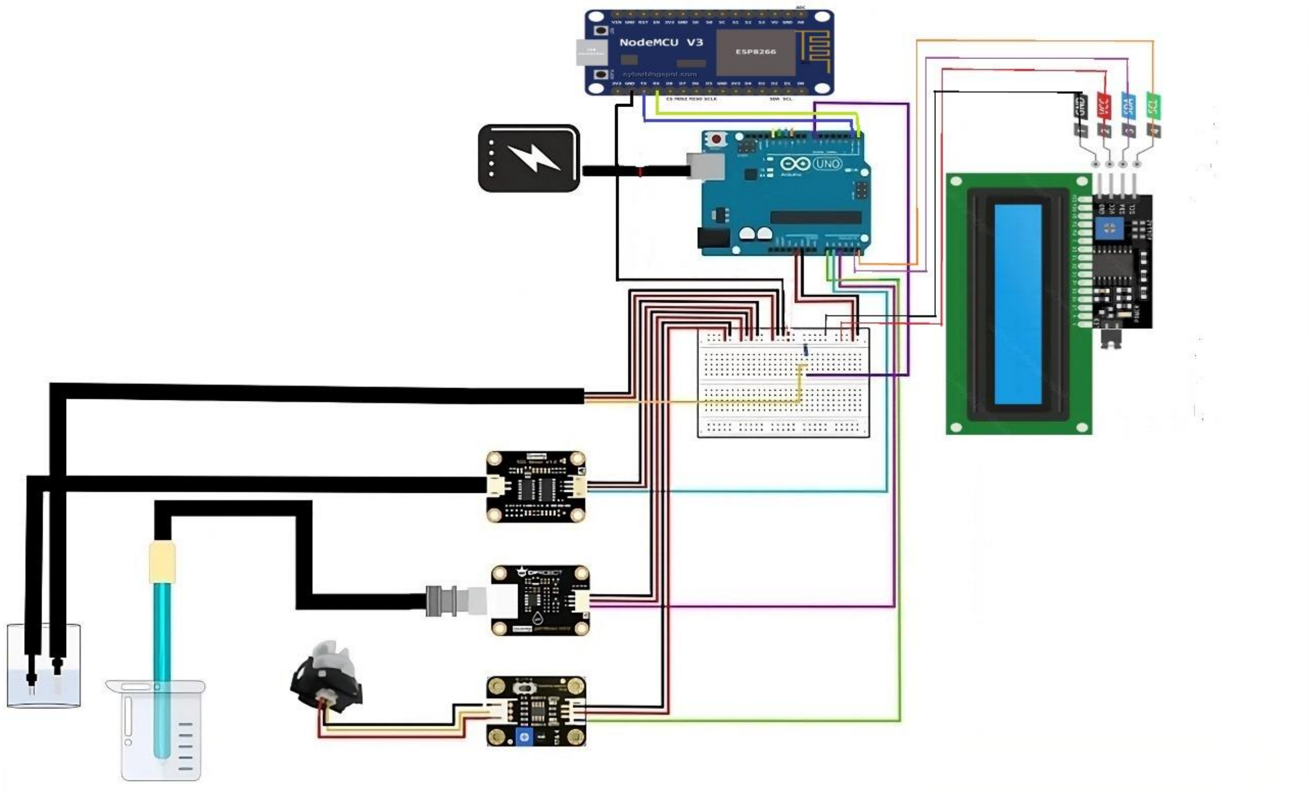


**Figure 1: Circuit Diagram**

# Chapter-5
# WORKING

**COMPONENTS OF PROJECT:-**

- ARDUINO UNO
- PH SENSOR
- TEMPERATURE SENSOR
- TDS SENSOR
- TURBIDITY SENSOR
- NODE MCU
- LCD DISPLAY

## 1. Arduino Uno

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board. Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits.The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.The IDE is common to all available boards of Arduino.

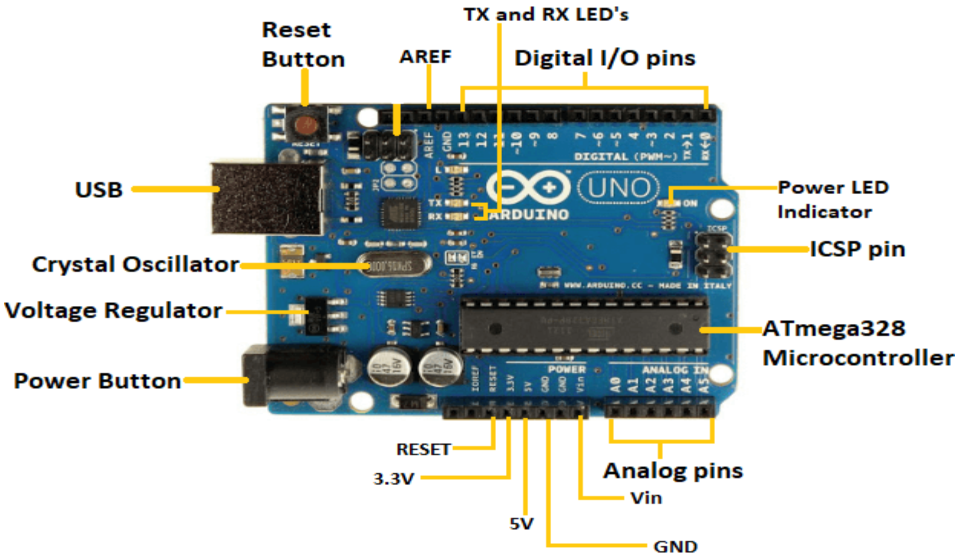


**Figure 2: Arduino Uno**

Let's discuss each component in details:-

- **ATmega328 Microcontroller**- It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines **Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.**
- **ICSP pin** - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- **Power LED Indicator**- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.
- **Digital I/O pins**- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- **TX and RX LED's**- The successful flow of data is represented by the lighting of these LED's.
- **AREF-** The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- **Reset button**- It is used to add a Reset button to the connection.
- **USB-** It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- **Crystal Oscillator**- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- **Voltage Regulator-** The voltage regulator converts the input voltage to 5V.
- **GND-** Ground pins. The ground pin acts as a pin with zero voltage.
- **Vin-** It is the input voltage.
- **Analog Pins**- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

**2. Node MCU**

The NodeMCU ESP8266 development board comes with the ESP-12E module containing the ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. NodeMCU can be powered using a Micro USB jack and VIN pin

(External Supply Pin). It supports UART, SPI, and I2C interface.

## NodeMCU Development Board Pinout Configuration

**Table 1:- Node MCU**

| **Pin Category** | **Name** | **Description** |
|---|---|---|
| Power | Micro-USB, 3.3V, GND, Vin | **Micro-USB:** NodeMCU can be powered through the USB port<br><br>**3.3V:** Regulated 3.3V can be supplied to this pin to power the board<br><br>**GND:** Ground pins<br><br>**Vin:** External Power Supply |
| Control Pins | **EN, RST** | The pin and the button resets the microcontroller |
| Analog Pin | A0 | Used to measure analog voltage in the range of 0-3.3V |
| GPIO Pins | GPIO1 to GPIO16 | NodeMCU has 16 general purpose input-output pins on its board |
| SPI Pins | SD1, CMD, SD0, CLK | NodeMCU has four pins available for SPI communication. |
| UART Pins | TXD0, RXD0, TXD2, RXD2 | NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program. |
| I2C Pins | | NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C. |

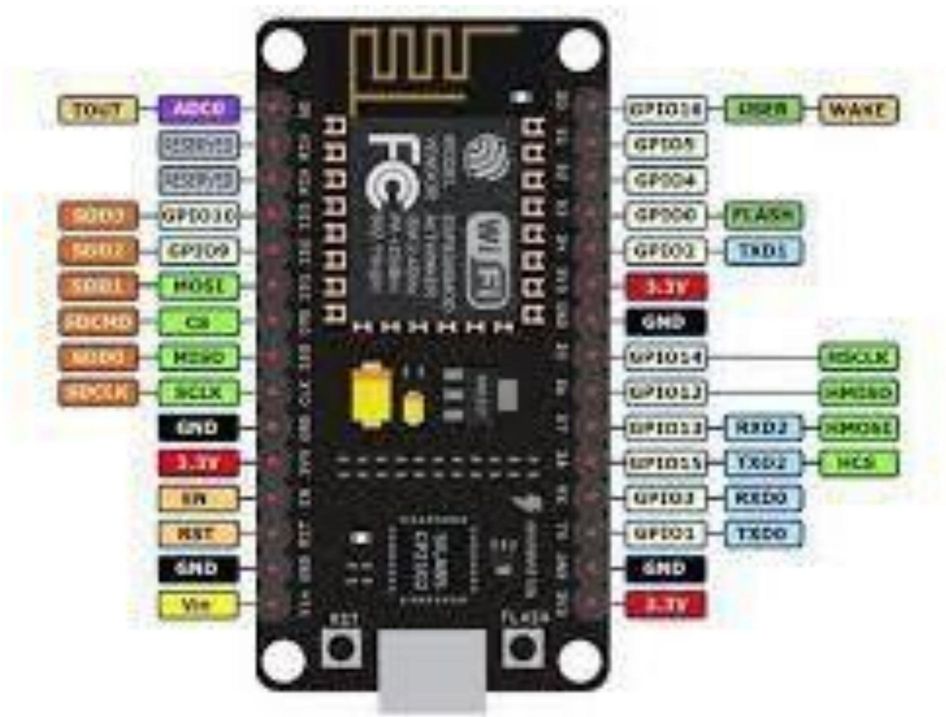


**Figure 3:- Node MCU**

**3. TDS Sensor**

Total Dissolved Solids (TDS) modules are essential instruments for evaluating water quality in diverse applications, utilizing a conductivity-based approach for their operation. The fundamental working principle involves measuring the electrical conductivity of a liquid, which increases with higher concentrations of dissolved solids. TDS modules typically consist of a sensor or probe featuring electrodes that come into contact with the liquid under examination. As water with dissolved solids flows through the sensor, it completes an electrical circuit, enabling the module to quantify the conductivity of the solution. This conductivity measurement is then converted into an estimate of the total dissolved solids concentration, usually expressed in parts per million (ppm) or milligrams per liter (mg/L). Regular calibration, specific to the sensor's design, is critical to maintaining accuracy in TDS measurements over time.The specifications of TDS modules are crucial factors in determining their utility and performance. One key specification is the measurement range, which defines the module's capability to accurately measure TDS levels. Different modules cater to various applications, with some designed for general-purpose use and others specialized for specific industries or environmental conditions. The accuracy and precision of TDS modules depend on factors such as sensor design and calibration methods. Features like a wide measurement range and high accuracy are essential for applications where precise TDS measurements are critical.TDS modules find widespread application across industries, playing a pivotal role in water quality monitoring. Municipal water treatment plants, industrial facilities, and households rely on TDS measurements to ensure compliance with quality standards. Agriculture benefits from TDS modules by assessing water suitability for irrigation, considering the impact of dissolved solids on soil fertility. In aquariums, enthusiasts use TDS modules to maintain optimal conditions for aquatic life, accounting for the sensitivity of certain species to water quality variations. Industries like pharmaceuticals and electronics utilize TDS measurements to guarantee the purity of water used in manufacturing processes.Recent advancements in TDS sensor technology have introduced additional features to enhance functionality.

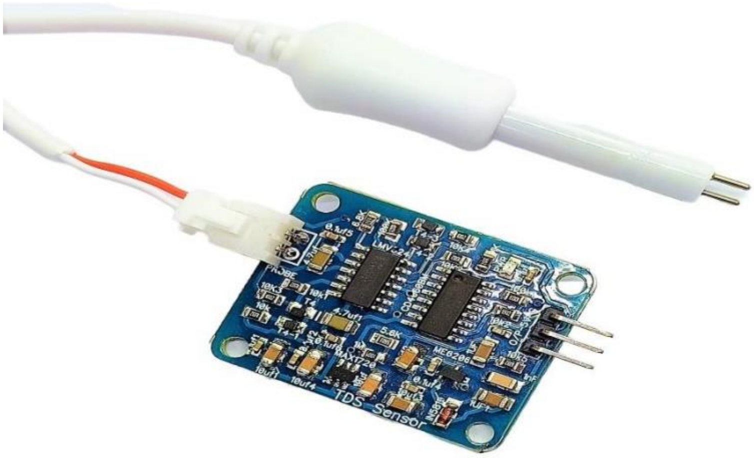


**Figure 4:- TDS Sensor**

### 4. Turbidity Sensor

An analog turbidity sensor is a sophisticated instrument designed to quantify the cloudiness or turbidity of a liquid, providing crucial insights into water quality. Operating on the principle of light scattering, these sensors emit light, typically in the form of infrared or visible light, into a liquid sample. The presence of suspended particles in the liquid causes the incident light to scatter in multiple directions. The analog turbidity sensor then detects and measures the intensity of this scattered light. Importantly, the greater the turbidity, the higher the intensity of light scattering, resulting in a proportional increase in the sensor's output signal. This output is analog, offering a continuous range of values that accurately represent the turbidity levels of the liquid.The specifications of analog turbidity sensors play a pivotal role in determining their utility and performance. The measurement range is a critical specification, defining the range of turbidity levels the sensor can effectively detect. This is essential for selecting a sensor that aligns with the turbidity variations expected in a given application. Sensitivity is another key specification, indicating the sensor's ability to discern small changes in turbidity. A highly sensitive sensor is crucial for applications requiring precise monitoring and detection of subtle shifts in water quality. Additionally, the response time of the sensor is a crucial factor, influencing how quickly the sensor can provide a stable and accurate reading after changes in turbidity occur. A rapid response time is particularly important in dynamic environments where turbidity levels fluctuate frequently.The working mechanism of analog turbidity sensors ensures real-time monitoring capabilities. The continuous analog output allows for immediate observation of turbidity changes, making these sensors suitable for applications requiring rapid detection. In water treatment plants, analog turbidity sensors contribute to optimizing coagulation and flocculation processes by providing instantaneous data on suspended solids. Environmental monitoring agencies leverage these sensors to assess the impact of human activities on natural water bodies, tracking turbidity variations over time. Furthermore, in industrial processes, analog turbidity sensors play a crucial role in ensuring the quality of liquids used in manufacturing.In conclusion, analog turbidity sensors are essential tools for real-time monitoring of water quality. Their working principle based on light scattering, coupled with specifications such as measurement range, sensitivity, and response time, makes them versatile instruments in diverse applications. The continuous analog output enables immediate detection of turbidity variations, supporting effective decision-making in water treatment, environmental monitoring, and industrial processes.


**Figure 5:- Turbidity Sensor**

**5. PH Sensor**

The pH sensor, commonly integrated with Arduino Uno, serves as a vital tool for gauging the acidity or alkalinity of solutions. Its operational principles hinge on the measurement of hydrogen ion concentration, revealing the solution's pH level on a scale of 0 to 14, with 7 representing neutrality.Comprising a glass electrode and a reference electrode, the pH sensor's core function lies in generating a voltage proportionate to the hydrogen ion concentration. This voltage is then conveyed to the Arduino Uno for interpretation and analysis. The exchange of ions from the solution to the inner solution of the glass electrode via the glass membrane is the basis for the pH sensor's operation. With continued usage, the glass membrane's porosity decreases, lowering the probe's performance.The Ph Sensor is often made of glass and has a rod-like construction with a bulb at the bottom that holds the sensor. A glass bulb that is specifically made to be selective to hydrogen- ion concentration is present in the glass electrode used to measure pH. Hydrogen ions in the test solution exchange with other positively charged ions on the glass bulb upon immersion in the solution under test, creating an electrochemical potential across the bulb. The electrical potential difference between the two electrodes created during the test is detected by the electronic amplifier, which transform pH units.


**Figure 6:- PH Sensor**

## 6. Temperature Sensor

DS18B20 is a 1-wire digital thermometer from Dallas Semiconductor Corp. It is based on a 1-wire interface that requires only one pin for circuit connections. The sensor has a 64-bit unique serial code for addressing a 1-wire interface. It has multi-drop capability enabling interfacing of many DS18B20 sensors on a single data line as a distributed network. It is even possible to power the sensor from the data line itself.The sensor outputs a temperature measurement with scales from 9-bit to 12-bit resolution. The operating temperature range of DS18B20 is -55˚C to 125˚C with an accuracy of +/-0.5˚C. The default resolution of the sensor is 12-bit which lets it measure temperature with a precision of 0.0625˚C. This temperature sensor takes less than 750 ms for converting a reading. Therefore, it is easily possible to fetch temperature measurements at an interval of 1 second from the sensor network.The operating voltage of DS18B20 is 3.3~5V, and current consumption is around 1mA. Therefore, it can be easily interfaced to any microcontroller or microcomputer, provided a software library for a 1-wire interface is available for that platform. With such minimal current consumption and a straightforward 1-wire interface, it is even possible to interface DS18B20 with low-power microcomputers like the Raspberry Pi.

**Figure 7:- Temperature Sensor**

## 7. Lcd Display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

The 16×2 LCD pinout is shown below.

Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.

Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.

Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.

Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).

Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.

Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.

Pin15 (+ve pin of the LED): This pin is connected to +5V

Pin 16 (-ve pin of the LED): This pin is connected to GND

**Figure 8:- LCD Display**

**Working**

The SMART WATER MONITORING Project seamlessly integrates a sophisticated system of sensors, microcontrollers, and wireless connectivity to provide real-time monitoring and analysis of crucial water quality parameters. The project's architecture involves the use of Arduino Uno for sensor interfacing, data collection, and a NodeMCU for wireless data transmission to ThingSpeak, where a dashboard visualizes the information comprehensively.The heart of the monitoring system lies in the Arduino Uno, which is connected to four essential sensors—TDS (Total Dissolved Solids), pH, Temperature, and Turbidity. These sensors are strategically placed in different aquatic environments, such as municipal water distribution systems, natural water bodies, industrial processes, and agricultural settings. The sensors capture real-time data reflecting the critical water quality parameters.The Arduino Uno processes the data collected from the sensors and displays it in real-time on an LCD (Liquid Crystal Display). The LCD serves as a local interface, providing immediate feedback on water quality parameters. This local display is particularly beneficial for on-site monitoring, enabling quick assessment without the need for external devices.The Arduino Uno, acting as the central data processing unit, interfaces with a NodeMCU microcontroller for wireless data transmission. The NodeMCU is equipped with Wi-Fi capabilities, allowing seamless connectivity to the internet. It serves as the bridge between the Arduino Uno and the ThingSpeak platform, enabling the transfer of real-time data over the wireless network.The NodeMCU establishes a connection to the ThingSpeak platform, an IoT analytics platform that enables the collection, analysis, and visualization of data in real-time. The project is configured to use ThingSpeak's API (Application Programming Interface) to push data from the Arduino Uno to specific channels on the ThingSpeak platform.

Once the data reaches ThingSpeak, it is visualized through a customized dashboard. ThingSpeak offers a user-friendly dashboard creation interface, allowing project developers to design a display that suits their specific needs. The dashboard provides a graphical representation of the water quality parameters, making it easy to interpret and analyze the data.

Within the ThingSpeak platform, the system incorporates automated alerts and notifications based on predefined thresholds. If a particular water quality parameter exceeds or falls below a set value, the system triggers an alert, notifying relevant stakeholders for immediate intervention. This feature enhances the proactive management of water quality and enables swift responses to potential issues.

The system is designed for continuous monitoring, ensuring a steady stream of real-time data from the field to the ThingSpeak dashboard. This continuous data flow enables stakeholders to observe trends, identify anomalies, and make informed decisions for the effective management of water resources.

In conclusion, the SMART WATER MONITORING Project operates seamlessly through a well-coordinated system involving Arduino Uno, a range of sensors, NodeMCU for wireless data transmission, and ThingSpeak for data visualization. This comprehensive approach ensures real-time monitoring, data analysis, and automated alerts, making the project a powerful tool in addressing water quality challenges in Haryana and potentially serving as a scalable solution for global water resource management.

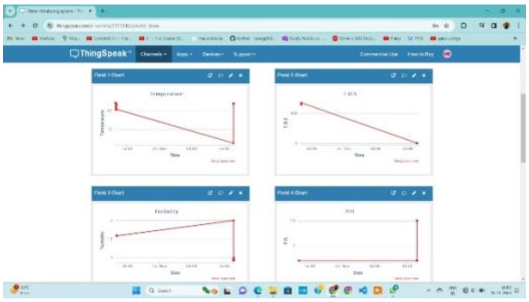


**Figure 9:-Graph**

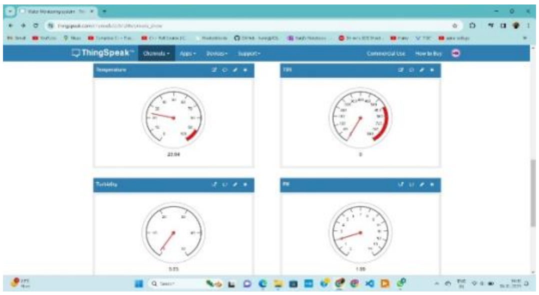


**Figure 10:- Dials**


. **Figure 11:- Project**

# Chapter-6

# RESULTS & DISCUSSION

The SMART WATER MONITORING PROJECT has emerged as a pivotal initiative in tackling the formidable water challenges confronting Haryana. By focusing on the development of low-cost IoT-enabled sensors, control systems, and treatment technologies, the project presents a comprehensive and innovative approach to water resource management.The deployment of IoT-enabled sensors and control systems has proven to be transformative in monitoring water quality and quantity. These sensors, strategically placed in both rural and urban environments, have provided real-time, granular data on critical parameters such as pH, temperature, turbidity, and TDS. The information garnered has not only deepened our understanding of current water conditions but has also facilitated informed decision-making to proactively address emerging challenges.The findings from the monitoring phase reveal crucial insights into Haryana's water deficit. With the state currently meeting only 74% of its water demands for irrigation and drinking, and facing an annual water deficit of about 14 billion cubic meters, the significance of the project's monitoring aspect cannot be overstated. The data has become an invaluable resource for policymakers, water resource managers, and researchers, laying a robust foundation for evidence-based interventions.The development of low-cost IoT-enabled sensors has not merely met expectations but has exceeded them. These sensors, designed with a focus on affordability and reliability, have demonstrated remarkable accuracy in capturing real-time water quality data. The integration of these sensors into network operations has enabled seamless monitoring across diverse environments, from agricultural landscapes to urban water distribution systems.In parallel with monitoring, the SMART WATER MONITORING PROJECT has made substantial progress in the development of treatment technologies. The emphasis on creating inexpensive and low-maintenance solutions for the treatment of drinking water and wastewater aligns seamlessly with the project's goal of ensuring accessibility and sustainability. The pilot programs conducted to integrate and demonstrate real-time monitoring and treatment technologies have yielded invaluable insights. These programs, executed in both rural and urban India, have validated the effectiveness of the developed technologies in diverse contexts. The success of these pilot programs serves as a testament to the adaptability and scalability of the SMART WATER MONITORING PROJECT's solutions. By deploying technologies in different parts of rural and urban India, the SMART WATER MONITORING PROJECT has bridged the gap between research and practical application. This outreach has not only empowered communities to make informed decisions but has also garnered valuable feedback for continuous improvement.The discussion surrounding the SMART WATER MONITORING PROJECT's results emphasizes the potential for global impact. As water scarcity and pollution become increasingly prevalent on a global scale, the innovations developed by the project have the potential to set new standards in water resource management. The low-cost IoT-enabled sensors and treatment technologies could be adopted as scalable solutions for regions facing similar water challenges.Looking forward, the SMART WATER MONITORING PROJECT opens avenues for future research and development. The success of the project creates a solid foundation for further advancements in sensor technology, data analytics, and connectivity. Collaboration with industry partners, governmental agencies, and the scientific community will be instrumental in driving continuous innovation and ensuring that the project remains at the forefront of addressing emerging water-related challenges.In conclusion, the SMART WATER MONITORING PROJECT has not only met its objectives but has exceeded expectations. The results attest to the project's efficacy in addressing the water crisis in Haryana. The integration of monitoring, treatment, and community engagement has laid the groundwork for a sustainable and scalable model that can be applied globally. The SMART WATER MONITORING PROJECT stands as a testament to the power of innovative, low-cost technologies in shaping the future of water resource management.

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# CONCLUSION & FUTURE SCOPE

In conclusion, the SMART WATER MONITORING PROJECT, also known as AWESOME project emerges as a beacon of hope in the face of Haryana's water crisis, offering a multifaceted approach to address both the scarcity and contamination of water resources. By focusing on the development of low-cost IoT-enabled sensors and control systems, the project aims to revolutionize the monitoring of water quality and quantity in both rural and urban India. The emphasis on affordability and reliability is crucial in a region where water deficits and pollution pose severe threats to sustainable development.Moreover, the AWESOME project's commitment to creating inexpensive and low-maintenance technologies for water treatment aligns with the urgent need for practical solutions. As waterborne diseases continue to impact millions and industrial processes contribute to water pollution, the development of accessible treatment technologies becomes paramount. AWESOME strives not only to treat drinking water but also to manage wastewater for reuse and recycling, addressing the holistic water cycle and promoting sustainability.The integration and demonstration of real-time monitoring and treatment technologies in pilot programs mark a significant step toward practical implementation. By testing these innovations in the field, AWESOME aims to validate their effectiveness in diverse environmental contexts. The decision to conduct pilot programs in both rural and urban India reflects an understanding of the varied challenges and water management needs across regions, ensuring that the solutions are adaptable and applicable on a broader scale.The efficient transfer of project results to stakeholders, the scientific community, and end-users underscores AWESOME's commitment to creating tangible impact. Deploying the developed technologies in different parts of rural and urban India is not just a dissemination strategy; it is a conscious effort to bridge the gap between research and real-world application. By making these technologies accessible in varied settings, the project aspires to empower communities and institutions to make informed decisions about water resource management. Looking toward the future, the scope of the AWESOME project extends beyond its immediate objectives. As the global demand for water rises and environmental challenges escalate, the innovations pioneered by AWESOME could serve as a model for water management not only in India but worldwide. Furthermore, the ongoing research and development within AWESOME could pave the way for advancements in sensor technology, data analytics, and connectivity. As technology evolves, the project has the opportunity to continually refine and enhance its solutions, ensuring they remain at the forefront of addressing emerging water-related challenges. Collaboration with the scientific community, industry partners, and governmental agencies will be pivotal in driving this innovation, fostering a dynamic ecosystem of knowledge exchange and technological progress.The emphasis on sustainability in the treatment of drinking water and wastewater positions AWESOME as a key player in promoting circular water economies. By focusing on reuse and recycling, the project contributes to the broader vision of minimizing water wastage and maximizing resource efficiency. As water scarcity becomes an increasingly global concern, the insights and technologies generated by AWESOME could play a vital role in shaping future policies and practices for sustainable water use.

In essence, the AWESOME project not only addresses the immediate water challenges faced by Haryana but also lays the groundwork for transformative advancements in water resource management. Its holistic approach, encompassing monitoring, treatment, and community engagement, sets a precedent for integrated and sustainable solutions. As the project unfolds, it holds the promise of not just mitigating the current water crisis but influencing the trajectory of global water management practices for years to come.

# Chapter-8
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