IOT BASED DRINKING WATER QUALITY MONITORING SYSTEM

ECD334 Mini Project: Report Submitted by

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Towards the partial fulfillment of the requirement for the award of B. Tech. degree in

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CERTIFICATE

Certified that this is a bonafide report of the project work done by **NIRANJAN S PRASAD.(Reg No. KNR21EC070), SARANG T MAHESH.(Reg No. KNR21EC080), JASIR NUFAIZ V.(Reg No. KNR21EC046) and MOHAMMED SHAFEEHE. (Reg No. KNR21EC058)** on the topic IOT BASED DRINKING WATER QUALITY MONITORING SYSTEM, towards the partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Electronics and Communication Engineering under APJ Abdul Kalam Technological University during the academic year 2023-2024.

Prof Laseena C A	**Dr. V Vinod Kumar**	**Dr. A. Ranjith Ram**
Project Supervisor	Project Co-ordinator	Professor & HoD
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DECLARATION

We, the undersigned, hereby solemnly declare that this project report titled **IOT BASED DRINKING WATER QUALITY MONITORING SYSTEM**, submitted for the partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering from APJ Abdul Kalam Technological University is a bonafide record of our own work carried out under the supervision of **Prof Laseena C A.**

Wherever we have used materials (data, theoretical analysis, and text) from other sources, we have adequately and accurately cited the original sources.

We also declare that this work has not been submitted to any other institution in this University or any other University.

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ABSTRACT

In the wake of increasing concerns about water quality, there is a pressing need for effective monitoring systems to ensure safe drinking water. This project proposes an IoT-based solution utilizing the ESP32 microcontroller to monitor and analyze the quality of drinking water in real-time. The system incorporates various sensors to measure parameters such as total dissolved solids(TDS), temperature, turbidity etc. By providing a cost-effective, scalable, and user-friendly solution, this project aims to contribute to the enhancement of public health and safety through continuous monitoring of drinking water quality. Overall, the proposed system represents a significant step forward in leveraging IoT technology for addressing water quality challenges, contributing to the preservation of aquatic ecosystems and ensuring access to clean and safe drinking water for communities worldwide.

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Chapter 1

INTRODUCTION

In the 21st century, there were lots of inventions, but at same time were pollution, global warming and so on are being formed, because of this there is no safe dri nking water for the world's pollution. Nowadays, water quality monitoring in real time faces challenges because of global warming limited water resources, growing population, etc. Hence there is need of developing better methodologies to monitor the water quality parameters in real time. The water quality parameters pH measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7pH value, less than 7pH has acidic, more than 7pH has alkaline. The range of pH is 0-14 pH. For drinking purpose it should be 6.5-8.5pH. Tds meter is used for checking the water quality . Thermostat is used for detecting the temperature changes. Water pollution ensues when lethal materials move into water sources like ponds, rivers, lakes, seas and oceans, gets dissolved and suspends in water or gets deposited on the bed. Pollution will degrade the quality and purity of water. Ensuring pure and safer water is really challenging due to undue sources of chemicals and contaminants. Pollution of water can be instigated by numerous ways; one of the main reasons for pollution is industrial waste discharge and city sewage. Secondary sources of pollution are pollutants that enter the water from soils or from atmosphere via rain or from groundwater systems

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1.1 PROJECT OVERVIEW :

A water quality monitoring system using IoT involves deploying sensors to collect data on various parameters such as pH, turbidity, dissolved oxygen, and temperature. These sensors transmit data to a central system via the Internet, where it can be analyzed in real-time. The system aims to monitor water quality continuously, detect anomalies or pollutants, and provide timely alerts to prevent water contamination or ensure compliance with regulatory standards. Key components include sensor nodes, a communication network, data processing and analysis software, and a user interface for visualization and decision-making.

1.2 MOTIVATION OF THE PROJECT :

An IoT-based water quality monitoring system utilizing ESP32 offers a compelling solution for real-time, remote monitoring of water parameters. By continuously collecting data on pH, dissolved oxygen, turbidity, and temperature, this system enables early detection of contaminants and deviations from normal conditions, facilitating prompt response to potential health risks and environmental threats. Its remote accessibility empowers stakeholders to monitor water quality from anywhere, facilitating data-driven decision-making processes for water resource management, pollution control, and infrastructure planning. Moreover, the cost-effectiveness of IoT-based monitoring, coupled with its ability to engage local communities in environmental stewardship, underscores its significance in promoting sustainable water management practices and safeguarding aquatic ecosystems.

1.3 PURPOSE OF THE PROJECT :

The purpose of implementing an IoT-based water quality monitoring system using ESP32 is to leverage the capabilities of IoT and the ESP32 microcontroller to create a cost-effective, efficient, and scalable solution for monitoring water quality in various contexts. This system aims to:

1. Enable real-time monitoring:
2. Increase accessibility:
3. Enhance accuracy and reliability:
4. Enable scalability:
5. Facilitate proactive management:
6. Promote sustainability:

Chapter 2

LITERATURE SURVEY

1. Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project : Nikhil Kedia entitled "Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project." Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper highlights theentire water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain. While automatically improving the water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.

2. Real Time Water Quality Monitoring System : Jayti Bhatt,Jignesh Patoliya entitled "Real Time Water Quality Monitoring System".This paper describes to ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this paper, we present the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature. The measured values from the sensors are processed by microcontroller and this processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing.

3. Industry 4.0 as a Part of Smart Cities : Michal Lom, Ondrej Pribyl, Miroslav Svitek entitled "Industry 4.0 as a Part of Smart Cities". This paper describes the conjunction of the Smart City Initiative and the concept of Industry 4.0. The term smart city has been a phenomenon of the last years, which is very inflected especially since 2008 when the world was hit by the financial crisis. The main reasons for the emergence of the Smart City Initiative are to create a sustainable model for cities and preserve quality of life of their citizens. The topic of the smart cicannot be seen only as a technical discipline, but different economic, humanitarian or legal aspects must be involved as well. In the concept of Industry 4.0, the Internet of Things (IoT) shall be used for the development of so–called smart products. Subcomponents of the product are equipped with their own intelligence. Added intelligence is used both during the manufacturing of a product as well as during subsequent handling, up to continuous monitoring of the product lifecycle (smart processes). Other important aspects of the Industry 4.0 are Internet of Services (IoS), which includes especially intelligent transport and logistics (smart mobility, smart logistics), as well as Internet of Energy (IoE), which determines how the natural resources are used in proper way (electricity, water, oil, etc.). IoT, IoS, IoP and IoE can be considered as an element that can create a connection of the Smart City Initiative and Industry 4.0 – Industry 4.0 can be seen as a part of smart cities.

4. QOI-Aware Energy Management in Internet-of-Things Sensory Environments : Zhanwei Sun,Chi Harold Li,Chatschik Bisdikian,Joel W.Branch and Bo Yang entitled "QOI-Aware Energy Management in Internet-of-Things Sensory Environments". In this paper an efficient energy management frame work to provide satisfactory QOI experience in IOT sensory environments is studied. Contrary to past efforts, it is transparent and compatible to lower protocols in use, and preserving energy-efficiency in the long run without sacrificing any attained QOI levels. Specifically, the new concept of QOI-aware "sensor-to-task relevancy" to explicitly consider the sensing capabilities offered by an sensor to the IOT sensory environments, and QOI requirements required by a task.

Chapter 3

OBJECTIVE

3.1 REAL-TIME WATER QUALITY MONITORING:

This objective focuses on developing a system capable of continuously monitoring the quality of water in real-time. It entails the implementation of sensors to measure key parameters such as temperature, turbidity, and total dissolved solids (TDS) instantaneously and accurately.

3.2 IOT-ENABLED REMOTE DATA TRANSMISSION:

The project aims to utilize Internet of Things (IoT) technology to enable remote transmission of water quality data. This involves leveraging the connectivity features of the ESP32 microcontroller to securely and efficiently transmit the collected data to a remote server or cloud platform over the internet.

3.3 SENSOR-BASED PARAMETER MEASUREMENT:

This objective emphasizes the use of sensors to measure various parameters related to water quality. The sensors, including those for temperature, turbidity, and TDS, play a crucial role in quantifying and assessing the health and safety of drinking water.

3.4 COST-EFFECTIVE ESP32 SOLUTION:

The project aims to develop a cost-effective solution using the ESP32 microcontroller. By utilizing the ESP32's integrated features and capabilities, the system can be implemented in a cost-efficient manner without compromising on performance or functionality.

3.5 SEAMLESS SENSOR-ESP32 COMMUNICATION:

Ensuring seamless communication between the sensors and the ESP32 microcontroller is vital for the proper functioning of the water quality monitoring system. This objective involves establishing robust communication protocols and interfaces to facilitate reliable data exchange between the sensors and the microcontroller.

3.6 INTERNET-BASED DATA VISUALIZATION:

The project seeks to implement a web-based interface for visualizing water quality data collected by the monitoring system. This objective entails designing and developing a user-friendly web application that enables stakeholders to access and interpret the data conveniently over the internet.

3.7 PROMOTE WATER QUALITY AWARENESS:

In addition to technical objectives, the project aims to raise awareness about water quality issues and the importance of monitoring and maintaining water quality standards. By disseminating information and insights derived from the monitoring system, the project aims to contribute to broader efforts aimed at promoting water quality awareness and environmental stewardship.

Chapter 4

PROPOSED METHOD

A proposed IoT-based water quality monitoring system could consist of several components working together seamlessly. At its core, the system would utilize ESP32 microcontroller boards equipped with sensors for measuring key water quality parameters such as pH, dissolved oxygen, turbidity, and temperature.

These ESP32 boards would be connected to the internet via Wi-Fi or other communication protocols, allowing them to transmit data to a central server or cloud-based platform for storage and analysis.

A user-friendly web or mobile interface would provide stakeholders with real-time access to water quality data, enabling them to view trends, set alerts for abnormal conditions, and generate reports.

Additionally, the system could incorporate features for data visualization, such as graphs and maps, to facilitate better understanding and interpretation of the collected data.

To ensure reliability and scalability, the system should be designed with robust security measures to protect sensitive information and prevent unauthorized access. Regular maintenance and calibration of sensors would also be essential to ensure the accuracy and reliability of the collected data over time.

Overall, this proposed system would provide a comprehensive and user-friendly solution for monitoring and managing water quality in various environments, from urban water systems to natural ecosystems.

4.1 WORKING

1. Measurement of Water Quality Parameters: The system employs sensors to measure key parameters indicative of water quality, including temperature, turbidity, and total dissolved solids (TDS). These sensors serve as the primary means of assessing the health and safety of drinking water.

2. Data Collection with ESP32 Microcontroller: The ESP32 microcontroller serves as the central processing unit of the system. It collects data from the various sensors deployed within the water monitoring setup. By interfacing with the sensors, the ESP32 gathers real-time data on temperature, turbidity, and TDS levels in the

water.
3. Transmission to Cloud Platform via Wi-Fi Module: Once the data is collected by the ESP32 microcontroller, it is transmitted to a cloud platform using a Wi-Fi module. This wireless communication technology enables seamless transfer of the gathered data to a remote server accessible over the internet.
4. Data Storage for Accessibility: The transmitted data is stored on the cloud platform, ensuring accessibility from anywhere with an internet connection. This facilitates remote monitoring and analysis of water quality parameters by authorized personnel or stakeholders.
5. Real-Time Monitoring via Web Interface: The stored data is presented through a web interface, enabling real-time monitoring of water quality parameters. Users can access the web interface from any internet-enabled device, such as a computer or smartphone, to view the current status of temperature, turbidity, and TDS levels in the monitored water sources.
6. OLED Display for Local Information: Additionally, the system incorporates an OLED display to locally display water quality parameters. This provides an immediate visual representation of the measured data, allowing for quick assessment without the need for accessing the web interface.

4.2 BLOCK DIAGRAM

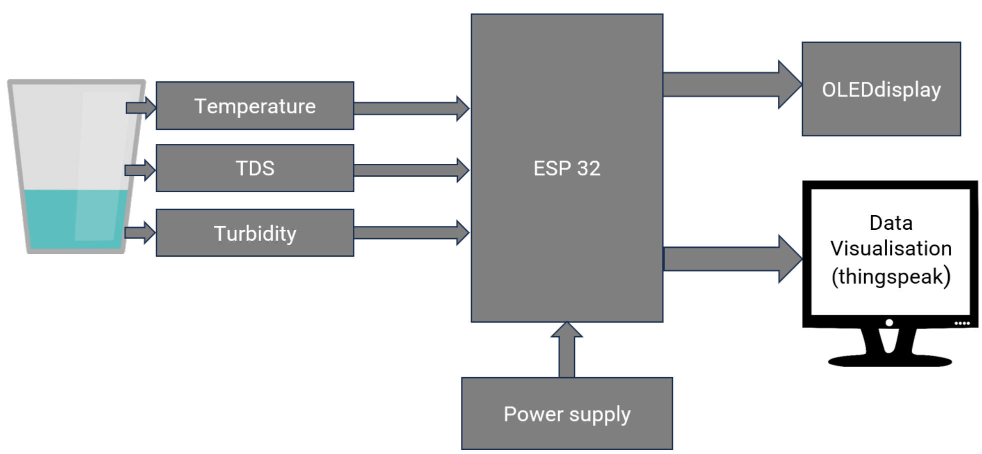

Figure 4.1: Block Diagram

4.3 CIRCUIT DIAGRAM

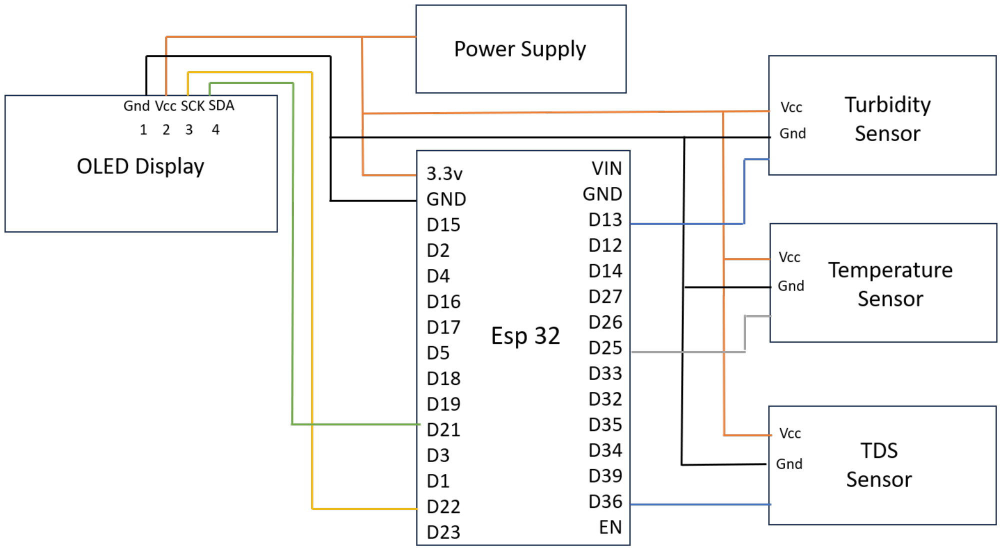

Figure 4.2: Circuit Diagram

Chapter 5

SYSTEM DESIGN

5.1 COMPONENTS SPECIFICATION

5.1.1 ESP 32

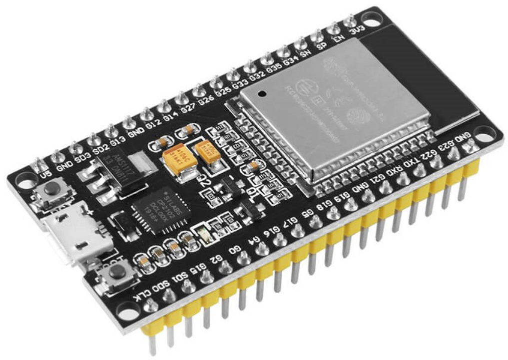

Figure 5.1: ESP 32

Description: The ESP32 is a versatile microcontroller renowned for its integrated Wi-Fi and Bluetooth capabilities, making it ideal for Internet of Things (IoT) development projects.
Functionality: The ESP32 serves as the central processing unit of the water quality monitoring system, facilitating data collection from sensors, communication with external devices or networks, and overall system control.
Wi-Fi and Bluetooth Capabilities: The integrated Wi-Fi enables wireless communication with the cloud platform for data transmission and remote monitoring, while Bluetooth connectivity provides additional flexibility for device pairing or data exchange with compatible devices.

5.1.2 TDS Sensor

Figure 5.2: TDS Sensor

Function: The Total Dissolved Solids (TDS) sensor measures the concentration of dissolved solids in water by detecting changes in its electrical conductivity. Dissolved solids can include various inorganic salts, organic matter, and other substances that have dissolved in water.
Principle: As dissolved solids increase in water, the conductivity of the water also increases due to the presence of ions. The TDS sensor utilizes this principle to quantify the level of dissolved solids by measuring the electrical conductivity of the water sample.
Application: This sensor is crucial for assessing the overall mineral content and purity of water, as high TDS levels can indicate contamination or the presence of undesirable substances.
Principle: It utilizes electronic components to sense temperature variations in the water and provides precise temperature readings.
Application: Monitoring water temperature is essential as it can affect various chemical and biological processes in water bodies. Fluctuations in temperature can impact the solubility of substances, microbial growth rates, and overall ecosystem health

5.1.3 Turbidity Sensor

Function: The turbidity sensor detects suspended particles in liquids, such as water,

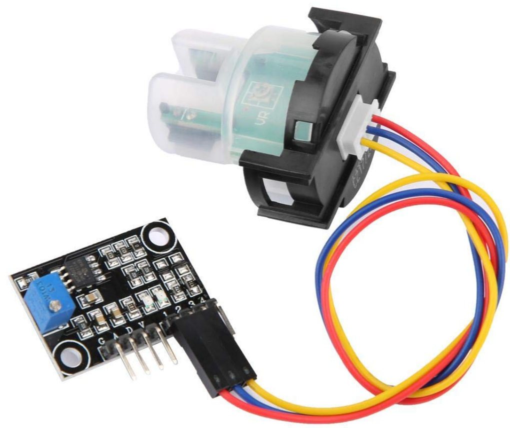

Figure 5.3: Turbidity Sensor

by measuring the light scattering caused by these particles.

Principle: When light passes through water containing suspended particles, the particles scatter the light in various directions. The turbidity sensor measures the intensity of light scattered at different angles to quantify the turbidity of the water.

Application: Turbidity is a key indicator of water clarity and can reflect the presence of sediment, silt, or other particulate matter. Monitoring turbidity is crucial for assessing water quality, especially in terms of aesthetics, aquatic habitat suitability, and drinking water safety.

5.1.4 OLED display

Figure 5.4: OLED display

Description: OLED (Organic Light-Emitting Diode) displays are characterized by vibrant colors and deep blacks, achieved through pixel-level light emission.
Functionality: The OLED display is utilized to visually present information such as water quality parameters and system status in a clear and user-friendly manner.
Advantages: OLED technology offers superior image quality, wider viewing angles, and faster response times compared to traditional LCD displays. These characteristics make OLED displays well-suited for applications requiring high contrast and visual clarity.

5.1.5 Resistor

Figure 5.5: Resistor

Description: A resistor is a passive electronic component designed to restrict the flow of electric current within a circuit.
Functionality: Resistors are used in electronic circuits to control voltage levels, limit current flow, adjust signal levels, and protect components from excessive currents.
Role in the System: Resistors may be employed within the water quality monitoring system for various purposes, such as voltage division, current limiting, or signal conditioning. Their specific values and configurations depend on the requirements of individual circuit elements and components.

5.2 HARDWARE SETUP

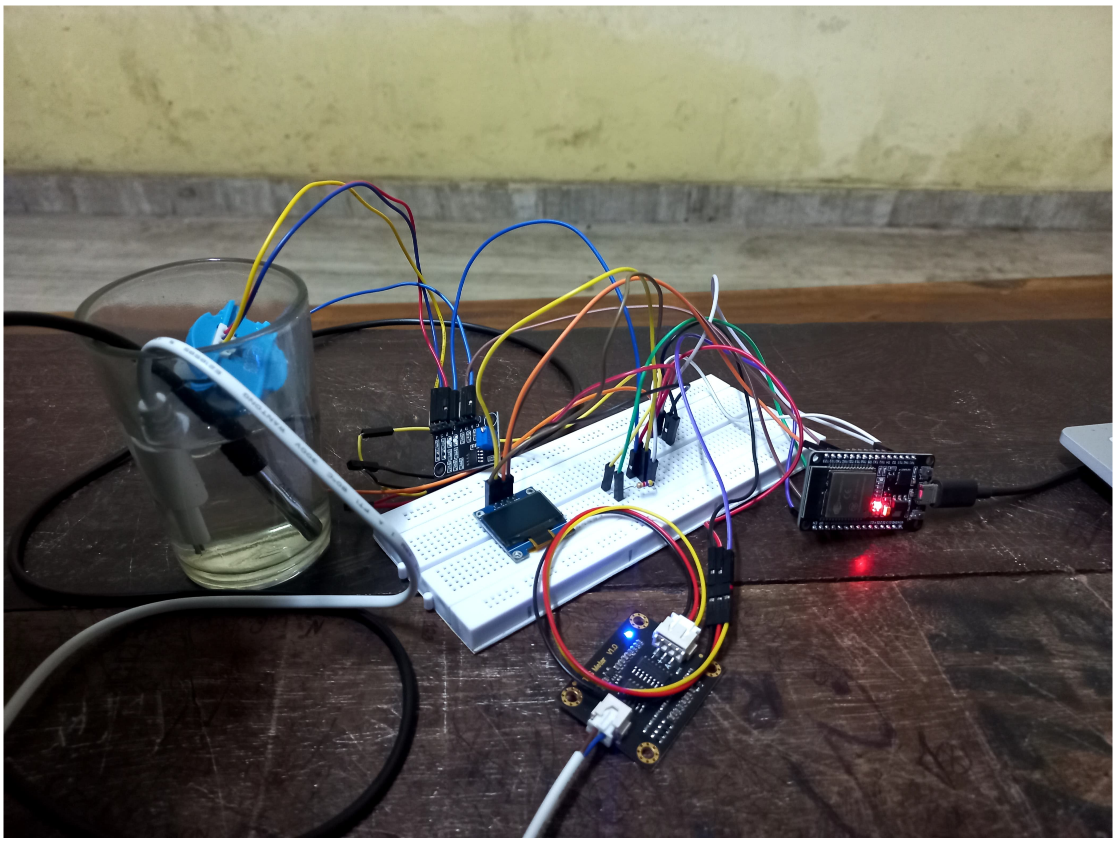

Figure 5.6: Hardware Setup

Chapter 6

RESULTS

6.1 THINGSPEAK WINDOW

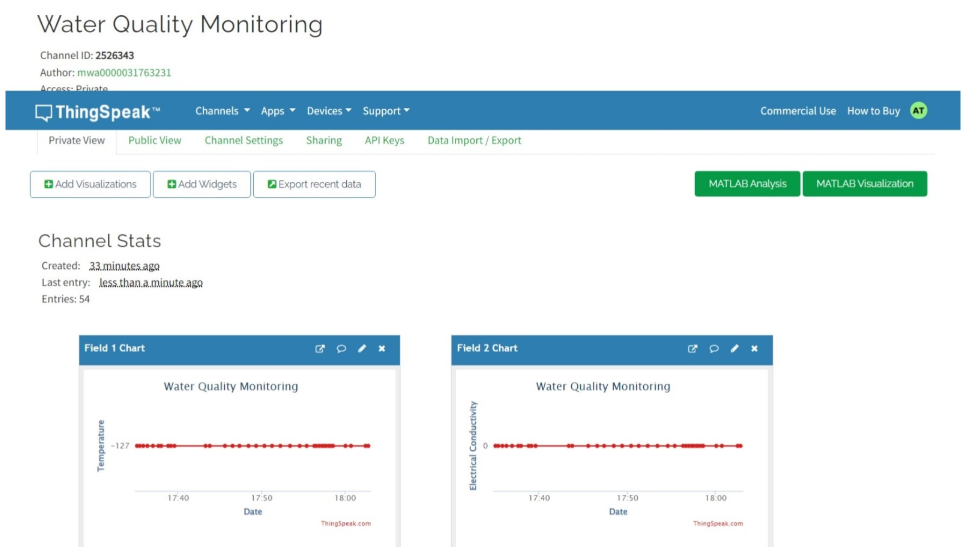

Figure 6.1: ThingSpeak Window

6.2 RESULT ANALYSIS

The World Health Organization (WHO) is responsible for establishing guidelines and standards for various aspects of water quality, including parameters such as Temperature, Total Dissolved Solids (TDS), and Turbidity. Here are the WHO standards for these parameters:

6.2.1 Total Dissolved Solids (TDS)

Acceptable Level: TDS levels below 150 mg/L are considered acceptable for drinking water by WHO standards. Preference for Lower Levels: While 150 mg/L is deemed acceptable, lower TDS levels are preferred for better taste and palatability of drinking water.

6.2.2 Turbidity

Acceptable Level: Turbidity levels below 5 nephelometric turbidity units (NTU) are considered acceptable for drinking water according to WHO guidelines. Preference for Lower Levels: Even lower turbidity levels are preferred for optimal clarity and visual appeal of drinking water.

6.2.3 Temperature

Comfortable Range: The WHO does not specify an exact temperature range for drinking water, but temperatures are typically kept within a comfortable range for consumption. Usual Range: Drinking water temperatures are usually maintained between 10°C to 20°C (50°F to 68°F) to ensure it is refreshing and pleasant to drink.

Chapter 7

CONCLUSION

Monitoring of TDS Temperature sensors of Water makes use of water detection sensor with unique advantage and existing network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast and displayed on screen. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded to monitor industrial and agricultural production and so on. It has widespread application and extension value. By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and results will be available to the end user through the Wi-Fi and the values displayed on screen.

Chapter 8

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