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IOT Based Water Quality Monitoring System

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Abstract: Technologies are expanding and developing quickly across a wide range of disciplines as science continues to advance and improve. The improvement of human existence and modernization are the main goals of these developments. It is crucial to recognize that this advancement has come at the expense of making environmental issues worse. Pollution of water is one of the main threats in recent times as drinking water is getting contaminated and polluted. The polluted water can cause various diseases to humans and animals, which in turn affects the life cycle of the ecosystem [1]. The ESP32 microcontroller, along with DS18B20 Digital temperature sensor, turbidity sensor, and pH sensor, are used in the IoT-based water quality monitoring system presented in this project to continuously monitor and assess the water's quality. The ESP32 is programmed using the Arduino IDE software, and the Blynk IoT platform is used for data visualization and remote monitoring. Water temperature, turbidity levels, and pH values may be continuously monitored by the system, and users can access and analyze the data remotely using the Blynk mobile app or web dashboard. It is possible to study historical data patterns and set up alerts to inform users of any changes in the quality of the water. By enabling proactive actions to be performed to maintain and improve water quality while ensuring environmental protection, this system offers an efficient and effective method for managing water quality.
Keywords: ESP32 microcontroller, DS18B20 Digital temperature sensor, Arduino IDE, Blynk IoT platform, Web dashboard

I. INTRODUCTION

In the 21st century, there were lots of inventions, but at the same time pollution, global warming and so on are being formed, because of this there is no safe drinking water for the world's pollution [2]. Drinking water is more precious and valuable for all human beings so the quality of water should be monitored in real time [3]. Systems for monitoring water quality are essential for evaluating, controlling, and preserving the integrity of our water resources. For environmental sustainability, economic growth, and human health, there must be access to clean and safe water. Our water source's health is experiencing unprecedented difficulties due to rising population, industrialization, and climate change.

Monitoring the chemical, physical, and biological properties of water entail the systematic collection, analysis, and interpretation of data. Scientists and water resource managers may learn a lot about the condition and quality of our water bodies by keeping an eye on important characteristics including pH levels, temperature, dissolved oxygen, turbidity, and pollution concentrations. These monitoring systems are crucial for safeguarding the general public's health, protecting the environment, and managing water resources sustainably. They guarantee that water treatment facilities have accurate information to efficiently treat and sanitize water sources, stop the spread of diseases through the water, and safeguard aquatic habitats. Real-time monitoring, remote sensing, and spatial analysis made possible by technological improvements have changed these systems, improving our capacity to monitor and address water quality issues.

II. FIGURES AND BLOCK DIAGRAM

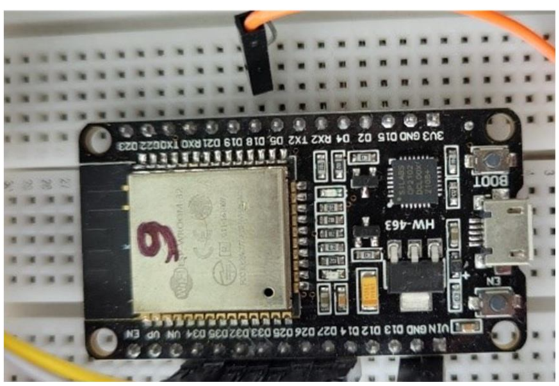

Figure 1. ESP32 MICROCONTROLLER

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Figure 2. 16X2 LCD DISPLAY

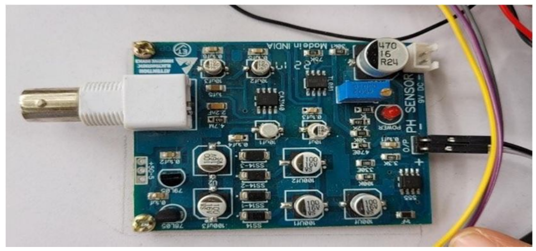

Figure 3. pH SENSOR

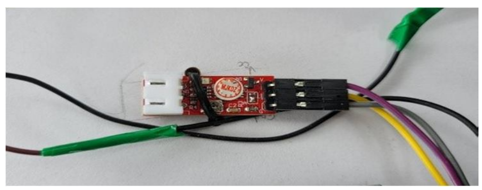

Figure 4. ARDUINO TURBIDITY SENSOR

Figure 5. DS18B20 DIGITAL TEMPERATURE SENSOR

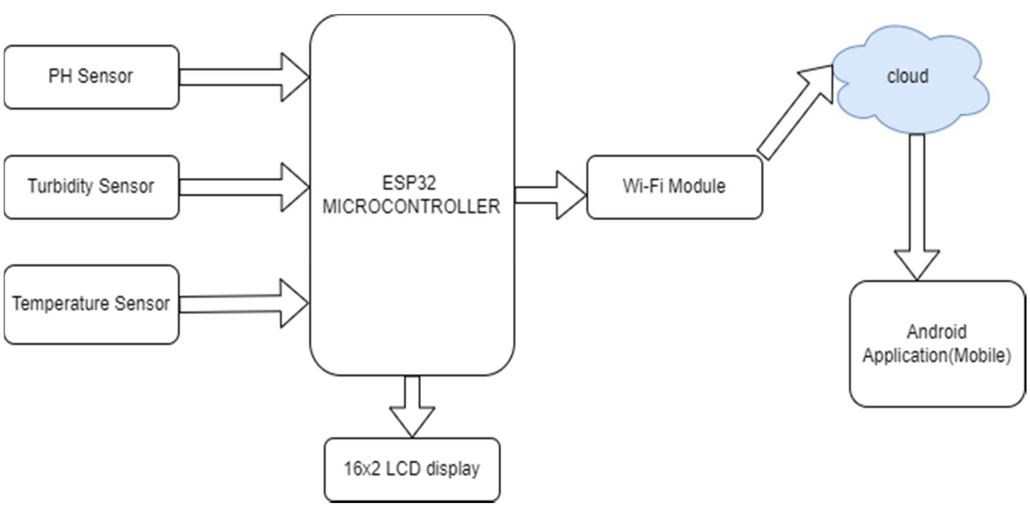

Figure 6. BLOCK DIAGRAM

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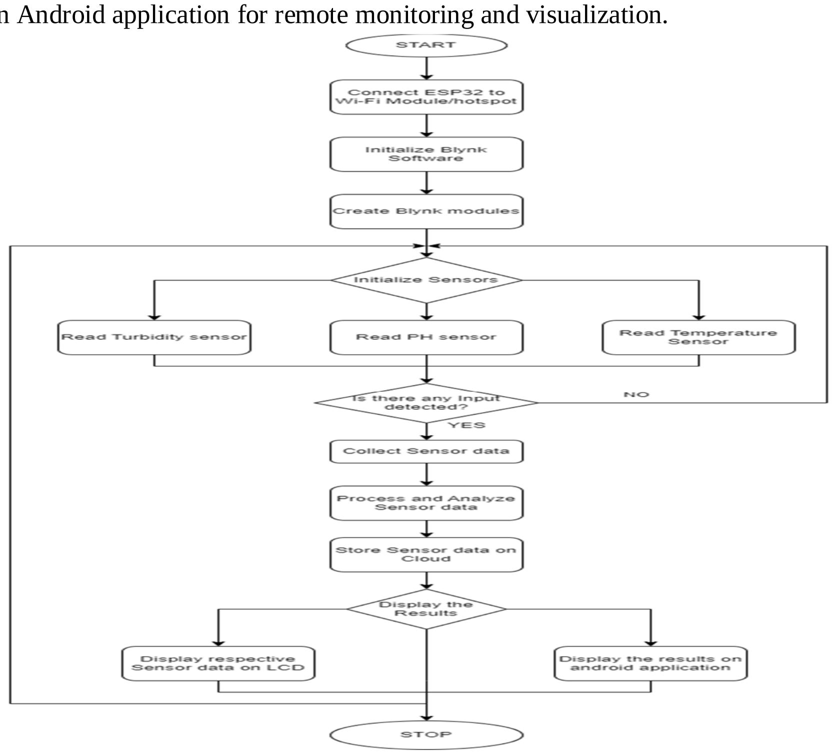
III. WORKING

The ESP32 functions as a microcontroller and connects to the internet and sensors to transmit data. Temperature sensor determines the temperature of the water. Turbidity sensor measures the turbidity, or number of suspended particles, in the water. pH sensor determines whether the water is acidic or alkaline. Blynk IoT Software offers a platform for remote monitoring and data visualization. Programming and uploading code to the ESP32 is done using the Arduino IDE software. Join the ESP32's corresponding pins with the temperature, turbidity, and pH sensors. Install and incorporate the required libraries in the Arduino IDE for each sensor. To set up the sensors and read data from them, write code in the Arduino IDE. As part of Data Acquisition and Processing the ESP32 periodically reads data from each sensor. Sensor readings are collected, analyzed, and translated into useful data formats. For instance, the temperature can be expressed as degrees Celsius from the raw sensor values. Data Transmission is done using Wi-Fi or other accessible network choices, the ESP32 creates an internet connection. Installing and setting up the Arduino IDE's Blynk IoT software. To get an authentication token, create a Blynk project via the Blynk app or web dashboard. To send sensor data to the Blynk server using the authentication token, write code in the Arduino IDE.

Cloud Visualization and Monitoring: Through the internet, the ESP32 transmits the sensor data that has been processed to the Blynk cloud server. To see the sensor data, open the Blynk app or web dashboard and add widgets (such as gauges and graphs). Set up the widgets such that they show pertinent sensor readings like temperature, turbidity, and pH. Using the Blynk app or web dashboard, users may obtain water quality data remotely and in real time. Data Analysis and Historical Tracking i.e., Users of the Blynk platform can create reports and examine past data patterns. Users can look at earlier sensor data to spot trends or outliers in the water quality over time. Blynk offers data export and logging options that ease additional analysis and reporting. This water quality monitoring system combines the ESP32 microcontroller, some sensors, Blynk IoT software, and Arduino IDE software to offer real-time monitoring, remote access, and data analysis, facilitating efficient water quality management and environmental conservation efforts.

IV. FLOWCHART

The Blynk software is initialized to communicate with the ESP32 and the Blynk cloud server. Blynk modules are created within the Blynk software, which will be used to receive and display sensor data. The sensors (turbidity, pH, and temperature) are initialized to start collecting data. The collected sensor data is processed to ensure accuracy and validity. The analyzed data is then stored for future reference or analysis. The system displays the sensor data on an LCD for local monitoring and visualization. The system also displays the sensor data on an Android application for remote monitoring and visualization.



V. RESULTS

The collected sensor data is continuously updated and displayed on both an LCD screen and an Android application. The sensor data is visually represented on an LCD screen and an Android application, providing an intuitive and user-friendly interface for monitoring, and analyzing the water quality parameters. By connecting the ESP32 microcontroller to Wi-Fi, the system enables remote access to the sensor data. The Android application, powered by Blynk software, allows users to access data from anywhere using a smartphone or tablet. The collected sensor data is processed to ensure accuracy and validity. This may involve filtering out noise, applying calibration factors, or performing other data processing techniques to obtain reliable water quality measurements. The Blynk software serves as a powerful platform for creating custom Android applications and modules to receive and display sensor data. It enables seamless integration between the ESP32 microcontroller, cloud storage, and Android application. The system is designed to continuously collect, process, analyze, and display water quality data. It ensures ongoing monitoring and provides up-to-date information for decision-making, research, or other purposes.

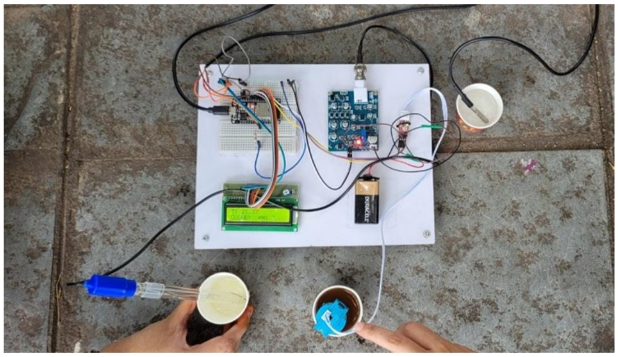


Figure 7. Sensor data output on LCD

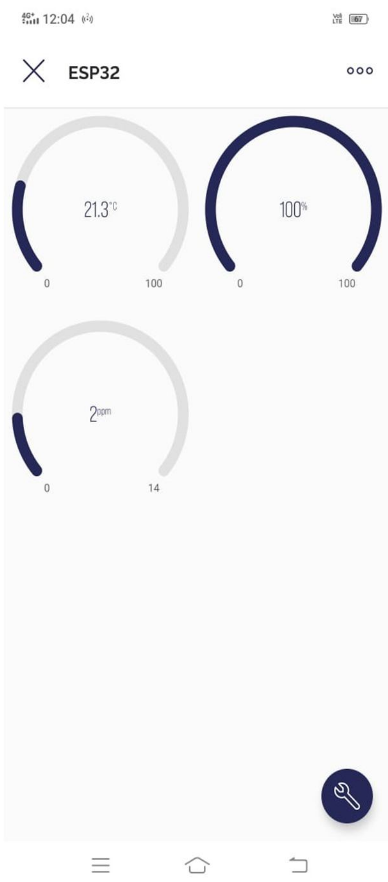


Figure 8. Output in Blynk Software

VI. CONCLUSION

Water Pollution is a major threat to any country, as it affects health, economy, and spoils bio- diversity [1]. In this work, causes and effects of water pollution are presented, as well as a comprehensive review of different methods of water quality monitoring and an efficient IOT based method for water quality monitoring has been discussed [1]. Although there have been many excellent smart water quality monitoring systems, the research area remains challenging [1].

An IoT-based water quality monitoring system using the ESP32 microcontroller holds significant importance as it enables real-time monitoring of water parameters, such as pH, turbidity, and temperature. Its purpose is to provide early detection of deviations in water quality, allowing for prompt action to protect public health and the environment. Different water samples are tested with the assistance of Arduino based sensors and collected their values of different metrics [4].

The system enables data-driven decision making, control, enhancing operational efficiency and cost-effectiveness. It plays a crucial role in environmental conservation by identifying pollution sources and facilitating swift intervention. Additionally, it promotes public awareness and engagement, encouraging individuals and communities to actively participate in water conservation efforts. By integrating sensors, the system can provide real-time monitoring of key water quality parameters. The data collected can be sent to a cloud-based platform for storage, analysis, and visualization. This enables efficient monitoring of water quality in various settings such as industrial processes, water treatment plants, or natural water bodies.

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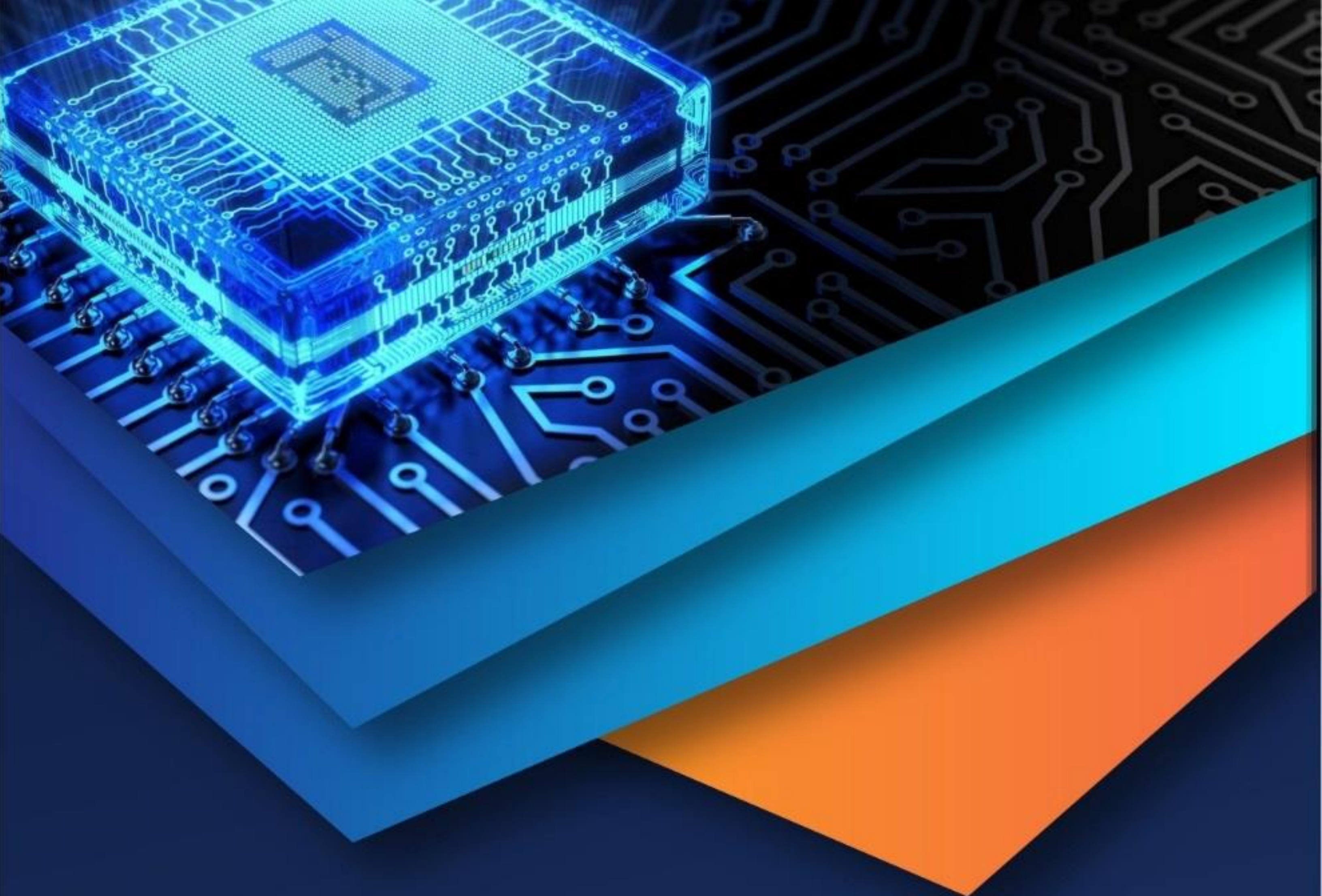

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