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INSOLATION POWERED H2O TRANSCENDENCE SURVEILLANCE SYSTEM

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Abstract: A water monitoring system using solar power is a great way to ensure sustainability and efficiency. Maintaining water cleanliness is important. The existing implementations have the drawback of high-power consumption and are not suitable for industrial wastewater quality monitoring. Implementing this using solar power and lithium-ion battery, helps in energy generation for the system automatically and this implementation gives the alert messages is also an advantage. The purpose of this project is to analyze the quality of a specified amount of water and to develop an Internet of Things (IoT) based water quality monitoring system. The device is powered by a solar array which is deployed with three sensors those are turbidity, pH, and total dissolved solids sensors. Real-time data from sensors is being transmitted to a central hub via an ESP32 microcontroller. Data on water quality can be monitored using Thing Speak software application through IoT development. The pH measurements are good within the range of 4-11 and the water is also identified as clean water. The TDS is good about 300ppm. An SMS will be sent to the authorized person if the readings are greater than the threshold value.

***Index Terms*-Renewable Water Quality Tracking, ESP32 microcontroller, Thing Speak platform, Twilio SMS alerts.**

I. INTRODUCTION:

Securing Our Water Future: A Solar-Powered Water Monitoring System, a vital resource for life, faces increasing threats from pollution, Traditional monitoring methods often lack continuous data collection and rely on external power limiting their effectiveness. This project proposes a Solar-Powered Water Quality Monitoring System (SPWQMS) to address these challenges.

The SPWQMS leverages the Internet of Things (IoT) to continuously monitor key water quality parameters like Total Dissolved Solids (TDS), pH levels, and turbidity. Powered by the sun, the system ensures uninterrupted operation even in remote locations. Real-time data analysis provides valuable insights into water health, accessible through a user-friendly and a dedicated website. This empowers individuals and organizations to make informed decisions for sustainable water management. This project builds upon existing knowledge by offering a self-powered, data-driven solution for water quality monitoring.

The proposed SPWQMS goes beyond continuous monitoring by offering real-time SMS alerts for critical water quality parameters. This empowers users with immediate notification when pre-defined thresholds are breached, enabling faster response and mitigation strategies. By incorporating SMS alerts, the SPWQMS becomes a proactive water quality monitoring system, empowering users to take timely action and safeguard this vital resource. This approach offers a unique and valuable addition to your project, addressing real-world needs for efficient water management.

II. LITERATURE REVIEW:

Solar-powered water quality monitoring systems offer a sustainable and eco-friendly approach to environmental monitoring. It has three components. Solar Power Supply: A solar panel converts sunlight into electricity to power the system Sensing Module: Various sensors measure water quality parameters like pH temperature, turbidity, and dissolved solids Master. Control Unit: A microcontroller processes sensor data, transmits it wirelessly and may display readings on a screen. Research has explored solar-powered water quality monitoring in diverse applications, including ornamental fish tanks.

One study developed a wireless system using solar power, enabling real-time pH and temperature monitoring with remote data transmission via Wi-Fi or Bluetooth to smartphones. This exemplifies the potential for wider water quality monitoring using renewable energy. Another study implemented a solar-powered sensing system for continuous water quality monitoring. The system operated for over 10 hours under direct sunlight and stored energy for low-light periods. This highlights the system's sustainability and adaptability. Furthermore, research has incorporated warning functions into solar-powered water quality monitoring systems. These systems alert users when critical parameters like pH or temperature reach unsafe levels, ensuring timely intervention, Studies have also focused on improving real-time monitoring and data accessibility.

Solar-powered wireless monitoring systems with remote data transmission allow users to track water quality remotely and receive alerts. It helps for continuous monitoring in remote areas without depending on electricity. This helps in the continuous analysis of data. Expenses are reduced. We use three sensors. They are pH, TDS, and turbidity sensors. pH sensors measure the movement of H+ and OH- ions movement. Turbidity tells about the purity of a liquid. TDS describes the concentrations of dissolved solids in the water.

While real-time data access is valuable, timely notification of critical water quality deviations is essential for effective water management. Twilio, a cloud communications platform, offers a solution through SMS alerts, and faster Response Time, SMS provides a reliable and cost-effective method for immediate notification, enabling users to take swift action and potentially prevent water quality issues from escalating Several studies have emphasized the importance of incorporating warning functions into solar-powered water quality monitoring systems. This research project aims to contribute to the development of more robust and user-centric solar-powered water quality monitoring systems with SMS alerts via Twilio.

Twilio API takes center stage in this project, ensuring data security. Its secure API will be used for encrypted data transmission and user authentication. To enhance user experience, the project will develop a user-friendly interface for customizing SMS alert thresholds and recipient information. By prioritizing these aspects, the research aims to create a more reliable, secure and user-friendly solar powered water quality monitoring system with SMS alerts, ultimately promoting better water management.

III. PROPOSED SYSTEM:

Our SPWQMS (refer to Figure 3.1) utilizes solar power for sustainable operation. The system employs three analog sensors pH, total dissolved solids (TDS), and turbidity to measure key water quality parameters. An ESP32 microcontroller with built-in Wi-Fi acts as the system's brain, collecting sensor data and transmitting it to the Thing Speak IoT platform for real-time analysis. The SMS alert is sent using TWILIO.

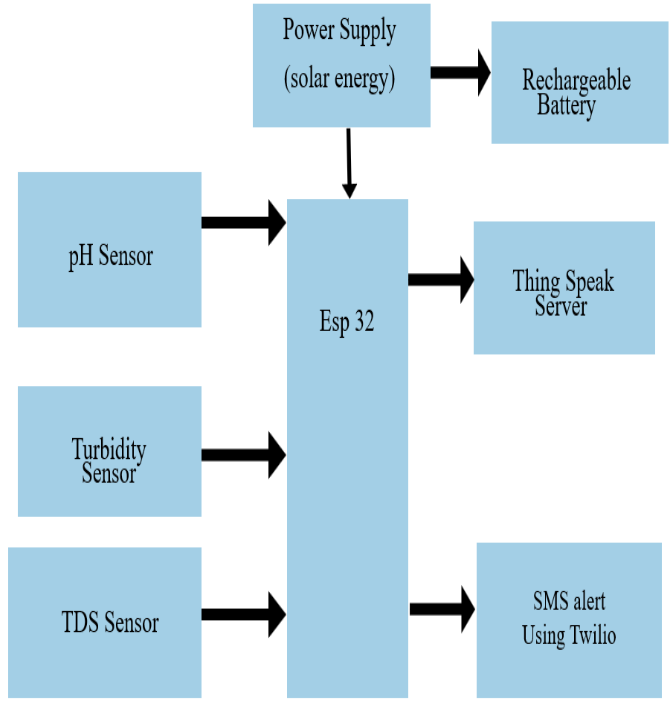


Figure 3.1: Block Diagram

3.1 Hardware Development:

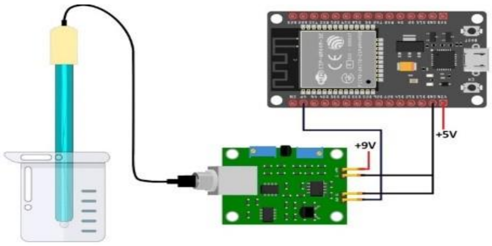
The core hardware components include:

ESP32 Microcontroller: This powerful microcontroller integrates Wi-Fi, Bluetooth, and various peripherals for efficient data processing and transmission Sensors like pH, TDS, and Turbidity. pH sensor Measures water acidity or alkalinity (0-14 range). Turbidity sensor which Measures water cloudiness caused by suspended particles. A TDS sensor is designed to quantify the levels of dissolved solids present in water sample.

Power Supply**:** Solar panel Converts sunlight into electricity to power the system. Lithium-ion batteries Store solar energy for continuous operation. TP4056 charging module ensures safe and efficient battery charging. The Booster converter boosts battery voltage to power the system.

3.2 Hardware Connections:

Figures 3.2, 3.3, and 3.4 illustrate the specific connections between the sensors and the ESP32 microcontroller, ensuring proper data collection.



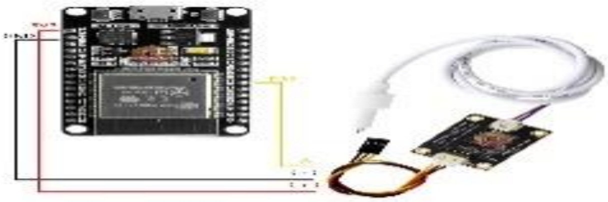


Figure 3.2: Ph sensor with ESP 32 Figure 3.3: TDS sensor with ESP 32

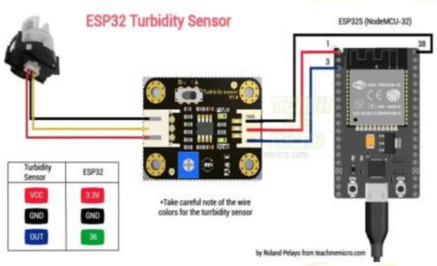


Figure 3.4: Turbidity Sensor with ESP32

The turbidity sensor is connected to the 5v voltage source and its Analog Output is connected to the 25th pin of the ESP32 microcontroller. Both pH and TDS sensors were connected to a 5V common voltage source and their analog output was connected to pins 35 and 34 on the ESP32. The connections of sensors to the microcontroller are established as shown in fig-5 and they are grounded commonly on bread board.

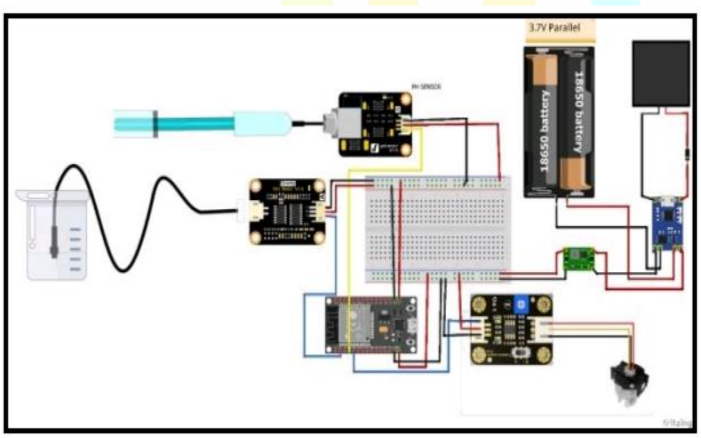


Figure 3.5 –Hardware Implementation

IV. SOFTWARE DEVELOPMENT:

The SPWQMS software leverages the Arduino Integrated Development Environment (IDE) and Thing Speak IoT platform. The Arduino code handles sensor data collection and transmission to Thing Speak. During Sensor Initialization, the code configures each sensor's address and communication protocol. A loop continuously reads sensor data at set intervals using the ESP32's analog and digital input pins. The Arduino Wi-Fi library transmits the data to Thing Speak, utilizing the Thing Speak API for leak API for sending data to a designated channel. Thing Speak acts as an online analytics platform, allowing users to visualize, combine, and analyze real-time data streams.

After hardware development, the ESP32 microcontroller was programmed using the Arduino IDE. The ESP32 connected to a USB port received the uploaded code. The HTTP library within the code enables synchronization with the Thing Speak application. After receiving the data is displayed in Thing Speak website. The system incorporates an alert system using the Twilio application. This triggers an alert when the following threshold levels of sensors exceed.

Turbidity: Sensor reading exceeds 10PPM

PH Level: Sensor reading falls below 6.5 or surpasses 8.5.

TDS: Sensor reading exceeds 150 ppm.

These alerts are sent as text messages, notifying users of potential water quality concerns

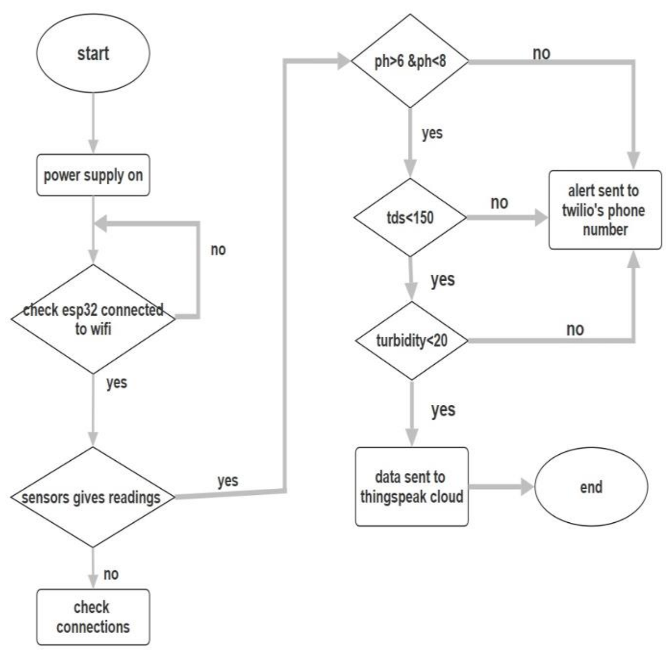
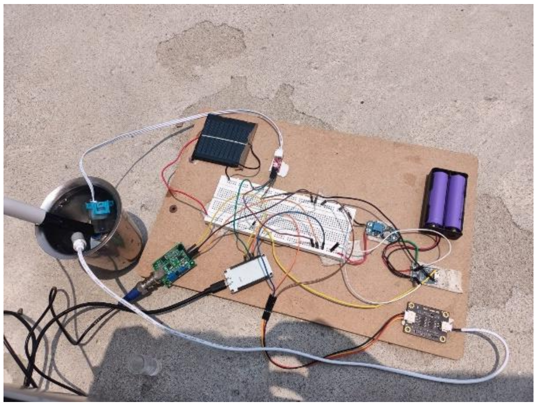


Figure 4.1-Flow chart

V. RESULTS AND DISCUSSIONS:

5.1 RESULTS:

The project prototype successfully demonstrates the functionality of the SPWQMS. A breadboard facilitated connections, and the



solar panel provided power under sunlight. The rechargeable battery is charged using solar power, generating up to 3.7V. Powering on the system activates the booster converter LED, all sensors and the ESP32 LED. The ESP32 connected to Wi-Fi, and sensor readings were displayed on the Thing Speak platform.

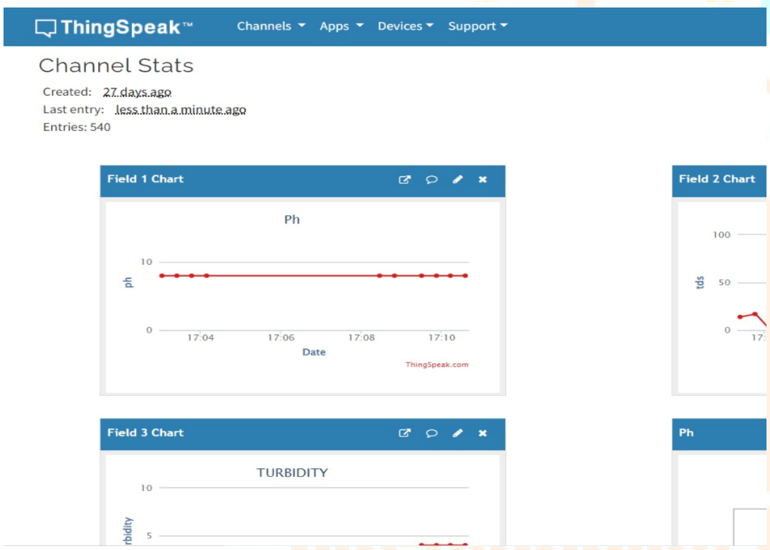


Figure 5.1-ThingSpeak output

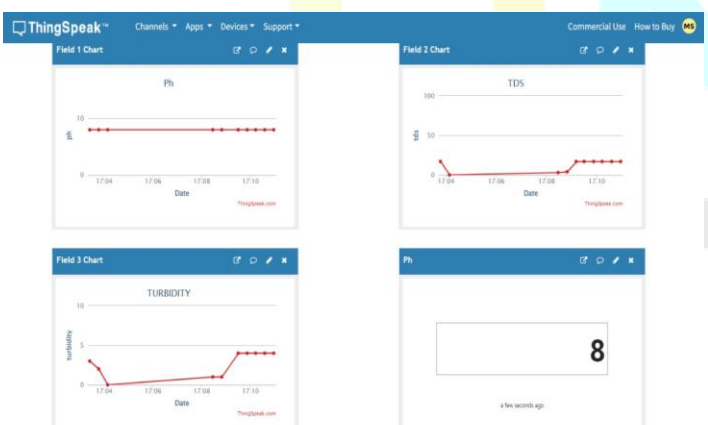


Figure 5.2-Thingspeak output

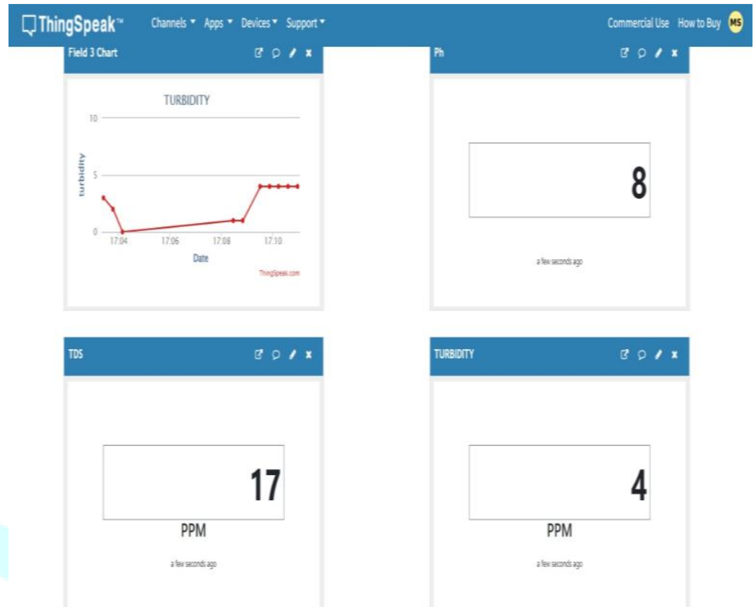


Figure 5.3-ThingSpeak output

Figure 5.1 showcases sensor data representation within a Thing Speak channel. The channel features three field charts and ESP32 LED, The ESP32 is connected to Wi-Fi, and sensor readings are displayed on the Thing Speak platform. Figure 8 showcases sensor data representation within a Things Speak channel. The channel features three field charts and three gauges widgets displaying sensor readings in both graphical and Figure 5.3 shows the representation of sensor data in Things Speak channel. The channel includes three field charts and three numerical widgets that show sensor readings. The field charts show the graph representation of sensor values. Figure 5.4 represents the prototype hardware of the entire system.

Table: Representation of Threshold low and high values of sensors.

Sensors	Threshold Low	Threshold High
pH	6.5	8.5
Turbidity	0	10
TDS	0	300

Whenever the sensors data crosses the threshold, we get an SMS alert as shown below with their readings as shown in figure 5.5.

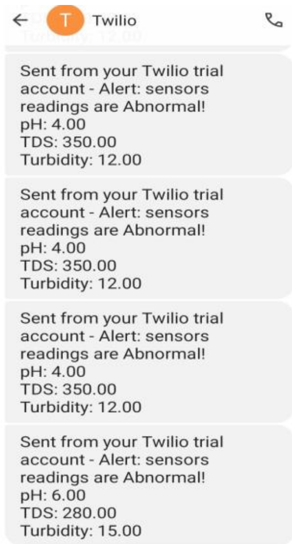


Figure 5.5-Alert SMS notification

5.2 DISCUSSIONS:

We successfully monitored water quality by using renewable energy source and when the readings were out of threshold range then we got an SMS alert through the Twilio app.

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