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IOT ENABLED RC BOAT WATER POLLUTION MONITORING USING GSM & GPS

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Abstract: In recent trends, there's an rising strain regarding the provision of clean, consumable water. This problem especially arises in pastoral areas due to the ineffectiveness of the governments and the adding population in the country. Thus, this particular design aims to descry and display real- time physicochemical quality of the water in a much further cost effective manner, as opposed to the current styles which involve slice and laboratory styles, through its wireless,multi-sensor network. It takes into consideration multiple factors and presents this real- time quality through the IOT (internet of Things) of its EC (electrical conductivity), TDS (Total Dissolved Solids) as well as temperature of water that's being tested. Also, this remote controlled boat is especially designed for lakes, budgets, gutters etc. where we can not cover water quality in similar complicated scale water surroundings by just using a stationary system because water parameters vary at every single position. To avoid this, we selected a boat which can float and move on the water simply by 2.4 GHZ protocol. This structure is designed as a housing shape which minimizes the resistivity of water inflow and this shape also maintains the stability of water. This water quality monitoring boat includes an GPS (Global Positioning System) which gives the position of the point wherever boat hovers in the reservoir & simultaneously sends the live location of boat via GSM (Global System for Mobile Communication). All the results are generated and displayed with their readings and their graphical analogue measures through the opensource IOT platforms like Blynk/Thingspeak, on with water's contaminations limitation points and its dangerous position announcement.

Index Terms **–** Multi-sensor network, TDS, EC, 2.4GHZ, GPS, GSM, IoT

I. INTRODUCTION

The quality of water (being from any source/reservoir) plays a very crucial part in the health of many living beings, including all species of animals, birds and even human beings. Lakes, reservoirs & canals are one of the most common and major sources of consumable water. The first step towards water pollution monitoring & controlling is to be able to monitor the actual pollutant contents of water bodies. The problem with water pollution monitoring is the manual labour effort of taking a boat through a water body such lake/reservoir/canal, each time to monitor pollutants throughout the water body. So our team has took the initiative to design a solution for sustainable and efficient water quality detection of various water bodies with less complexity. This RC boat which monitors the water pollution contents, does the task of detecting as well as transmitting water quality information/data to an open source IOT platform online. This will initially help us to maintain the water clean, consumable & usable. This project is operated and controlled by an 2.4 GHZ frequency RC remote using which it can be hoovered accordingly, a DC powered propeller system to provide the forward, Backward, Right and Left propulsion and circuitry's arrangement to provide the water pollutant content. We have couple of sensors to determine water quality, we initially use EC sensors as well as turbidity sensor and a Water temperature sensor. These cascaded sensors will monitor the presence of embedded particles in the water body. We have also used in GPS module named "Neo 6M" and GSM module basically named "SIM800", using this communication protocol; the exact location of boat wherever it maneuvers will be captured and simultaneously the real time tracking of the boat can done through SMS notification on an individual's mobile phone.

II. PROPOSED BLOCK DIAGRAM –

The proposed system aims to develop an RC (Remote-Controlled) boat equipped with sensors for monitoring water pollution levels. The boat will be capable of measuring Total Dissolved Solids (TDS), Electrical Conductivity (EC), and temperature of the water. Additionally, it will incorporate GPS and GSM modules to transmit real-time location data to a central server. The microcontroller used in this system is the NodeMCU ESP8266, known for its wireless capabilities and compatibility with various sensors.

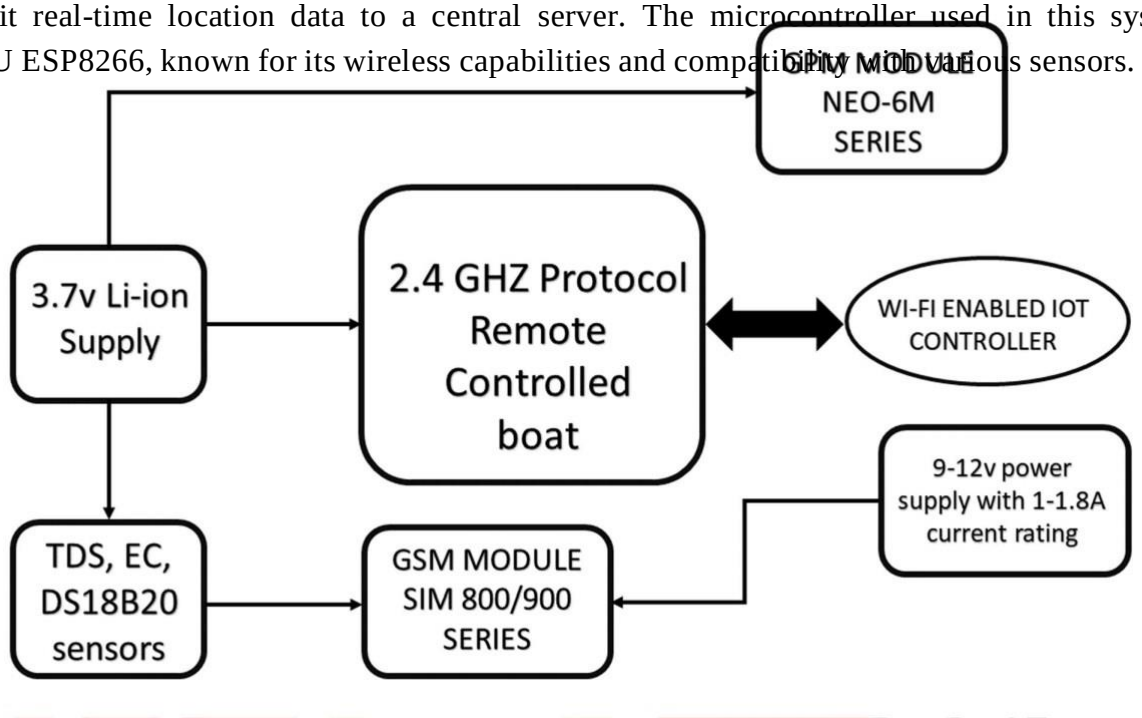

Fig.1. Block Diagram Iot Enabled Rc Boat Water Pollution Monitoring Using Gsm & Gps

The existing system is used to measure the EC and turbidity level of water bodies and further monitor the status of water pollution. Existing system is controlled by the NodeMCU ESP8266, a propeller system to provide the forward, Backward, Right, Left propulsion and Protocol used here is 2.4 GHZ followed by a remote control. A 9V DC motor is used to rotate the propeller through a flexible bearing and shaft. Additionally, we have two sensors, namely EC and turbidity sensors which will detect the presence of embedded particles and TDS range of the water. The real time values are viewed on the IoT platform. In the existing system they are using two sensors namely, turbidity sensor and EC sensor which are used to collect the information from the required water. These sensors are connected to the nodemcu controller. The water parameters data are sensed by the sensors and processed data is sent to the IoT cloud. The output is viewed on the console of user device through the wifi fidelity feature of NODEMCU, through which information about water parameters is transmitted over cloud. The sensor values are collected from the different sources and conclude that they are safe for drinking, consuming, using water by means of EC range and turbidity values. Also we have used a GSM module which works on an 9-12v DC power supply which is included in the project to share the real time location of the boat to the SMS notification of the smart phone. The GSM is interfaced with the GPS module circuitry to obtain the accurate location and co-ordinates.

III. METHODOLOGY USED –

Methodology for the proposed idea is as below explained in steps:

System Design:

Define the specifications and requirements of the RC boat, including the selection of sensors (TDS, EC, temperature), GPS module, GSM module, and the NodeMCU ESP8266 microcontroller. Design the physical layout of the RC boat to accommodate all components while ensuring buoyancy, stability, and waterproofing.

Sensor Integration:

Interface the TDS, EC, and temperature sensors with the NodeMCU ESP8266 microcontroller using appropriate communication protocols. Calibrate the sensors to ensure accurate readings in varying water conditions.

GPS and GSM Integration:

Interface the GPS module with the NodeMCU ESP8266 to receive real-time location data. Implement communication protocols to extract GPS coordinates from the module. Interface the GSM module with the NodeMCU ESP8266 to enable wireless communication with the central server.

Data Acquisition and Processing:

Develop firmware for the NodeMCU ESP8266 to collect sensor data and GPS coordinates at regular intervals. Implement algorithms to process sensor data, including TDS, EC, and temperature readings. Package the collected data into a suitable format for transmission.

Communication and Transmission:

Establish Wi-Fi connectivity using the NodeMCU ESP8266 to transmit data to the central server when within range of a Wi-Fi network. Utilize the GSM module to transmit data when Wi-Fi connectivity is unavailable, ensuring continuous data transmission. Implement error-checking mechanisms to ensure data integrity during transmission.

Power Management:

Design a power management system to optimize energy usage and prolong battery life.
Implement sleep modes and power-saving features to reduce power consumption during idle periods.

Data Analysis and Visualization:

Develop algorithms to analyze the collected data for pollution levels, trends, and anomalies. Generate alerts and notifications based on predefined thresholds for TDS, EC, and temperature levels. Create user-friendly interfaces (web portal or mobile app) for stakeholders to access real-time and historical data, boat locations, and pollution trends.

Testing and Validation:

Conduct thorough testing of the RC boat system in controlled environments and real-world conditions. Validate the accuracy and reliability of sensor readings, GPS tracking, and data transmission. Iterate on the design and implementation based on test results and feedback.

Deployment and Maintenance:

Deploy the RC boats in target water bodies for continuous monitoring of water pollution levels. Establish a maintenance schedule for routine inspections, sensor calibrations, and firmware updates. Provide training and support for end-users to ensure proper operation and maintenance of the monitoring system. By following this methodology, the RC boat water pollution monitoring project can effectively monitor TDS, EC, temperature levels, and live boat locations while contributing to environmental conservation efforts.

IV. SYSTEM OVERVIEW –

The proposed system i.e. “IOT ENABLED RC BOAT WATER POLLUTION MONITORING USING GSM & GPS” consists of several sensors and controller which are listed below with the overview of their specification –

- NodeMCU (Microcontroller)
- TDS V1.0 (Turbidity and EC sensor)
- DS18B20 (Waterproof temperature sensor)
- GSM 800/900A (GSM module)
- GPS Neo-6M (GPS module)

I. NODEMCU (MICROCONTROLLER) –

The NodeMCU ESP8266 is a versatile and widely-used development board renowned for its compact size and powerful features. It serves as an essential tool in the,IoT (Internet of Things) and embedded systems development.

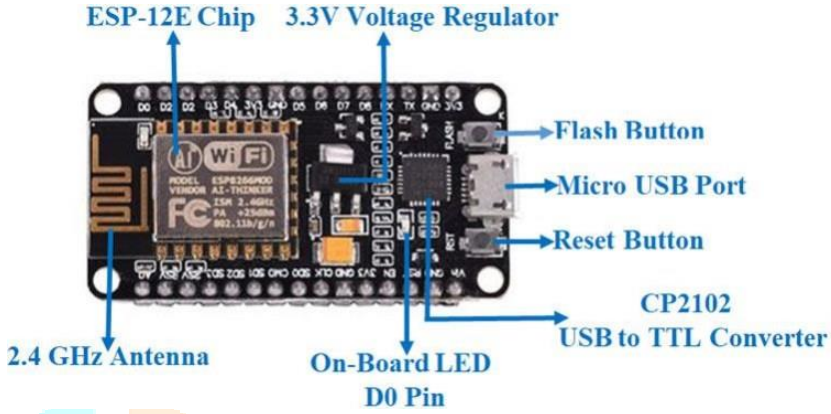

Fig.2. System component – NODEMCU ESP8266

◆ The NodeMCU ESP8266 is an integrated development board built around the ESP8266 microcontroller module, designed to facilitate the rapid prototyping of IoT projects and embedded systems. At its core, the ESP8266 microcontroller boasts a 32-bit Tensilica Xtensa LX106 processor, clocked at speeds of up to 80MHz (with the possibility of overclocking to 160MHz), rendering it capable

◆ of handling a wide range of tasks with remarkable efficiency.

◆ One of the most notable features of the NodeMCU ESP8266 is its built-in Wi-Fi connectivity, which enables seamless communication with local networks and the internet. This functionality allows devices built with the NodeMCU ESP8266 to interact with online services, exchange data with remote servers, and participate in IoT ecosystems. The board supports the 802.11 b/g/n Wi-Fi standards, ensuring compatibility with most modern wireless networks.

◆ In terms of connectivity, the NodeMCU ESP8266 provides a plethora of GPIO (General Purpose Input/Output) pins, offering flexibility for interfacing with various sensors, actuators, and peripheral devices. These GPIO pins support digital input/output operations, analog input measurements, and PWM (Pulse Width Modulation) output control, enabling a wide range of applications.

◆ The NodeMCU ESP8266 board also features a USB-to-Serial interface chip, typically the CH340 or CP2102, which facilitates easy programming and debugging via a standard USB connection. This interface allows developers to upload firmware, monitor serial output, and interact with the microcontroller directly from their computer, streamlining the development process.

II. TDS V1.0 (TURBIDITY SENSOR) –

◆ The TDS (Total Dissolved Solids) sensor V1.0 is an analog sensor designed to measure the concentration of dissolved solids in a liquid solution. It operates on the principle of conductivity, where the electrical conductivity of the solution is directly proportional to the concentration of dissolved ions, including salts, minerals, and other organic and inorganic substances.

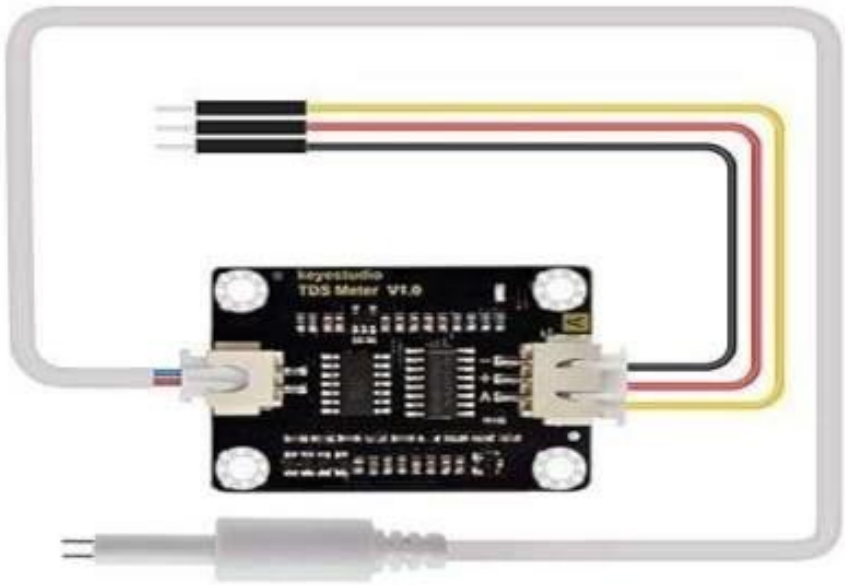

Fig.3. System component – TDS V1.0 SENSOR

◆ The TDS sensor V1.0 typically consists of two electrodes, immersed in the liquid solution being tested. When voltage is applied across these electrodes, an electric current flows through the solution. The magnitude of this current is influenced by the number and type of dissolved ions present in the solution, which in turn affects its conductivity.

◆ The TDS sensor V1.0 is calibrated to provide accurate measurements of TDS levels in parts per million (ppm) or milligrams per liter (mg/L). It converts the conductivity readings obtained from the solution into TDS measurements using pre-determined calibration factors specific to the sensor model.

III. DS18B20 (WATERPROOF TEMPERATURE SENSOR) –

Fig.4. System component – DS18B20 SENSOR

◆ The DS18B20 sensor is a digital temperature sensor manufactured by Maxim Integrated. It operates on the one-wire communication protocol, allowing multiple sensors to be connected to a single microcontroller pin. This feature simplifies wiring and makes it suitable for applications where space and complexity are concerns.

◆ One of the standout features of the DS18B20 sensor is its high level of accuracy, with temperature readings typically accurate to within ±0.5°C in the range of -10°C to +85°C. This level of precision makes it ideal for applications where precise temperature measurement is critical.

◆ The DS18B20 sensor is also known for its wide temperature range, spanning from -55°C to +125°C. This wide range of operation makes it suitable for use in a variety of environments, from extreme cold to high temperatures.

IV. GSM 800/900A (GSM MODULE) –

◆ The GSM SIM900 module is a widely-used communication module that enables devices to connect to GSM (Global System for Mobile Communications) networks, facilitating data transmission and communication over cellular networks.

Fig.5. System component – GSM 900A MODULE

◆ The GSM SIM900 module is a compact and versatile communication module designed to enable

devices to establish connections to GSM networks, allowing for data transmission and communication over cellular networks. It serves as a crucial component in various applications, including IoT (Internet of Things), remote monitoring systems, security systems, and more.

◆ At its core, the GSM SIM900 module integrates a GSM/GPRS (General Packet Radio Service) modem, which enables devices to communicate with GSM networks using standard AT commands. The module supports quad-band GSM frequencies (850/900/1800/1900 MHz), ensuring compatibility with GSM networks worldwide. This broad frequency range allows for global deployment of devices equipped with the SIM900 module, making it an ideal choice for international projects.

◆ The GSM SIM900 module features a UART (Universal Asynchronous Receiver-Transmitter) interface, allowing it to communicate with microcontrollers, embedded systems, and other devices using serial communication protocols. This interface simplifies integration with existing hardware platforms, enabling seamless communication between the GSM module and the host device.

V. GPS NEO 6M (GPS MODULE) –

◆ The GPS NEO-6M module is a small, lightweight GPS receiver module designed to accurately determine and relay location information. It is equipped with the u-blox NEO-6M GPS chipset, renowned for its high sensitivity and fast time-to-first-fix performance. The module receives signals from multiple GPS satellites orbiting the Earth, enabling it to triangulate its position with exceptional accuracy.

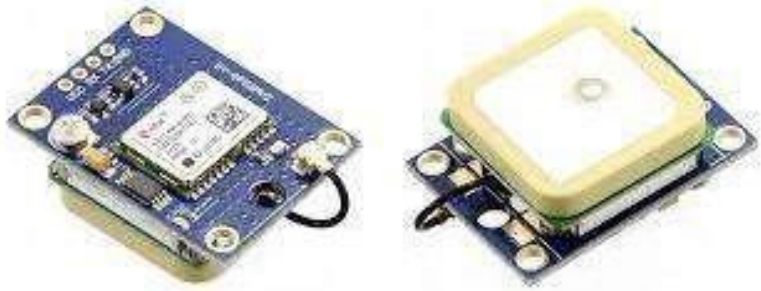

Fig.6. System component –GPS NEO-6M

◆ At the heart of the GPS NEO-6M module is the u-blox NEO-6M GPS chipset, which features advanced signal processing algorithms and low-power consumption. This chipset allows the module to acquire and track GPS satellite signals even in challenging environments, such as urban canyons or dense foliage, ensuring reliable operation in various scenarios.

◆ The GPS NEO-6M module typically communicates with the host microcontroller or system via a serial interface, commonly using UART (Universal Asynchronous Receiver-Transmitter) communication protocol. This enables seamless integration with a wide range of embedded systems, microcontrollers, and development boards, making it ideal for use in IoT (Internet of Things), navigation, tracking, and location-based applications.

VI. CONCLUSION –

Henceforth, after our first stage of project analysis, we have finally concluded that, to assess water quality currently involves manual water sampling, followed by sending these samples to laboratories for testing, incurring additional human effort, cost, and time. Our proposed system aims to automate this process, displaying water properties effortlessly on-Cloud. Utilizing water detection sensors, along with the existing GSM network, enables the system to monitor Turbidity, EC and Water Temperature automatically. This approach proves cost-effective, eliminating the need for dedicated personnel and ensuring swift results. Moreover, the system offers versatility, allowing for the monitoring of various water quality parameters by simply adapting sensors and software. Its straightforward operation facilitates its application in monitoring hydrology, air pollution, industrial, and agricultural production, among others. Deploying sensor devices in the environment for data collection and analysis enhances environmental monitoring, enabling real-time interaction with other networked objects. Ultimately, the collected data and analysis results are made accessible to end-users via Wi-Fi connectivity, contributing to a smarter, more responsive environment.

VII. REFERENCE PAPER HYPERLINKS –

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