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ANALYSIS OF CLOUD BASED SMART WATER DAM MANAGEMENT SYSTEM USING LORA TECHNOLOGY

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Abstract: A serious issue facing many countries around the world is a lack of water. To avoid water waste, a system for monitoring water levels has been developed. This system automatically detects and signals water levels in reservoirs, overhead tanks, and other storage containers while wirelessly transmitting water level information to registered users. Automating tasks may be something people want to do to save energy and boost productivity. Ultrasonic sensors, which use high-frequency ultrasonic vibrations to detect the level of liquids or solids, are widely used to check the level of water. These sensors are mounted at the tank's top and time how long it takes the sensor to receive a return signal while also sending out waves. The suggested approach suggests using a webserver for the internal analysis of water dams, household/society water tanks, and municipal water towers. Checking the water level in these containers can be challenging and time-consuming. The study also seeks to find a solution to the issue of water waste. People commonly forget to turn off the motor after the tank is full, wasting water. Water waste can be reduced by using the water level monitoring equipment to keep an eye on water levels and usage. To determine and display the water level in an overhead tank or any other water container, utilise a water level indicator. We describe a water level sensor device's NodeMCU-based design in this paper. An ultrasonic sensor generates ultrasonic waves, a water sensor detects the water level, LEDs show the water level, and a computer keeps track of the water levels. This very efficient circuit can monitor the level of any liquid in any application.

Keywords: OLED Li-ion battery, OLED display, ESP8266, TP4056, LoRa SX1278, ultrasonic sensor

I. INTRODUCTION

Earth's entire water volume is around 1.4 billion cubic kilometres, and since 95% of it is in the oceans, it cannot be used for human consumption. Since statistics indicate that by 2025, more than 50% of the world's population may experience water shortages, it is vital to conserve fresh water resources. Through monitoring technology that focuses on air pollution and disaster management, this issue has been handled. Monitoring the water level in an overhead dam can be challenging and often requires manual inspection or allowing water to overflow from the top. Electronic water level gauges employ dipped electrodes or float switches to solve this problem. However, the use of these electrodes may cause corrosion, which could impair the system's long-term function. A contactless technique of measuring water levels utilising an Ultrasonic module with an Arduino and a flood detection system has been created to address this issue. In order to monitor water levels in irrigation and agricultural projects, as well as chemical enterprises, electric water controllers were originally developed in the early 1990s. When solid-state electronics are combined with integrated electronics, the performance, price, and installation are all improved. Water flow can be controlled in a variety of applications, such as swimming pools, pumps, and hot tubs, via indicators for water level sensors. The entire volume of water on Earth is around 1.4 billion cubic kilometers, or the equivalent of a 3 kilometer thick layer. 95% of this water, which is not suitable for human consumption, is found in the oceans. More than 50% of the world's population is predicted by experts to experience water scarcity by 2025. For instance, a person in India uses 135 litres of water on average per day, and it is anticipated that this amount will increase by 40% over the next several years. Therefore, safeguarding freshwater resources is essential. Even though some research have focused on monitoring technologies for air pollution and disaster management, electronic water level indicators can be a useful alternative for water level monitoring. Conventional systems that use dipped electrodes or float switches would not be long-term reliable, in contrast to the contactless

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ultrasonic modules with Nodemcu and Flood Alert System used in this research. In the 1990s, the first electric water controllers were developed to track liquid levels in commercial settings and irrigation projects. Since then, they have been enhanced with solid-state and integrated circuits, offering costefficient alternatives with easy installation. These water level sensors can improve the efficiency of water systems in many different contexts, such as pools, pumps, and hot tubs. Flooding increases the spread of water- and vector-borne diseases, endangering public health as well as water supplies. The contamination of drinking water sources and standing water, which can house chemical hazards and breed mosquitoes, is one of the most obvious threats associated with floods.

II. RELATED WORK

In the paper "Monitoring System In LORA Network Architecture Using Smart Gateway In Simple Lora Protocol" [3], Dania Eridani described the different uses of LoRa and its architecture. The throughput in this system has a reliable result but a lesser value than LoRaWAN, in contrast. It occurs because this system provides features that LoRa gateway systems often do not: a web server and a data entry mechanism into a database.

According to the paper "Design of Flooding Detection System Based on Velocity and Water Level DAM with ESP8266" by Herman Yuliandoko and Sholeh Hadi Pramono [4], flooding detection is very important and it can use velocity and water level detection on a dam. The ESP8266 is a fantastic option for rural applications because of its low power consumption and strong sensor detection capabilities. The ESP8266 is rarely used, and most research employ wireless sensor networks instead.

Anto Merline Manoharan explained that the solution for the smart water distribution and quality monitoring in smart villages is a backup networking option for areas where cellular networks are not available in their article "Smart Water Quality Monitoring And Metering Using LORA For Smart Villages" [5]. These Lora-Wan are appropriate for use in wilderness settings like forests and mountains without cellular service. The suggested remedy will save water while providing them with high-quality water.

The authors of "Automatic Water Level Control System," Asaad Ahmed Mohammedahmed Eltaieb and Zhang Jian Min, introduced readers to the finest software and hardware architecture for interfacing in their paper "Automatic Water Level Control System" [6]. The system uses cutting-edge sensor technologies in order to determine the water level. The motor is controlled by an Arduino and a relay. Various cables are connected at the Beaker's junction points. as soon as water is added to the beaker. The amount of water that contacts the wire in the dams determines its level. They have an LCD monitor that displays the water level as a consequence. The authors of the study "An IoT Based Dam Water Management System for Agriculture [11]" propose an Internet of Things (IoT) based dam water management system (IoT-DWM) to lessen water wastage and alleviate water scarcity in agricultural fields. Field sensors, an IoT network, and a controller for the dam make up the system, which determines how much water is required based on a variety of parameters. The system has been put to the test in Thanjavur, India, and simulations show that it saves a significant amount of water. An experimental system has been developed and tested for large-scale water management.

According to Jo ao Mesquita and Diana Guimar in their paper "Assessing the ESP8266 WiFi module for the Internet of Things [14]," the ESP8266 module is a low-cost, WiFi-enabled device that has the potential for battery-powered Internet of Things applications with small transmission intervals. The module provides good connection within normal building deployments, with packet delivery ratios of 99% or higher on the same floor, while still being functional across floors, according to the study's authors. They describe the energy consumption, communication range, and sleep modes of the module. The module's performance during handoffs and in usage cases without infrastructure will be assessed in further development.

Alessio Carullo and Marco Parvis describe a low-cost ultrasonic sensor in their paper "An Ultrasonic Sensor for Distance Measurement in Automotive Applications [15]" that measures the distance between specific points on a moving vehicle and the ground using the time of flight of an ultrasonic pulse. The sensor utilises a limited optimisation technique to recognise reflected pulses with a precision of greater than 1 mm and automatically adapts to changing environmental conditions. The sensor works at speeds up to 30 m/s and is suitable for active suspension systems and headlight levelling systems.

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III. BLOCK DIADRAM

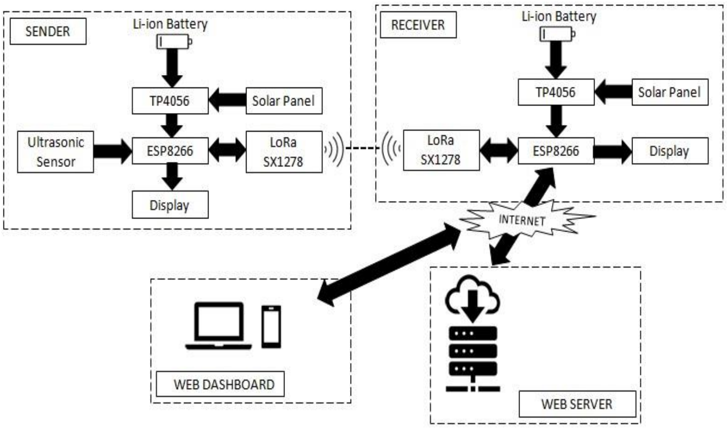

Fig. 1 Block Diagram Of The Project

IV. CIRCUIT DIAGRAM

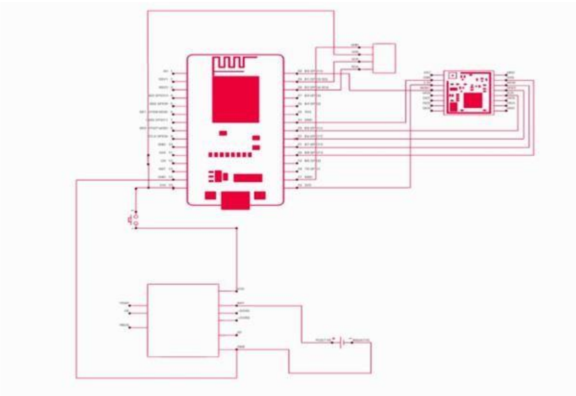

Fig. 2 Circuit Diagram Of The Transmitter

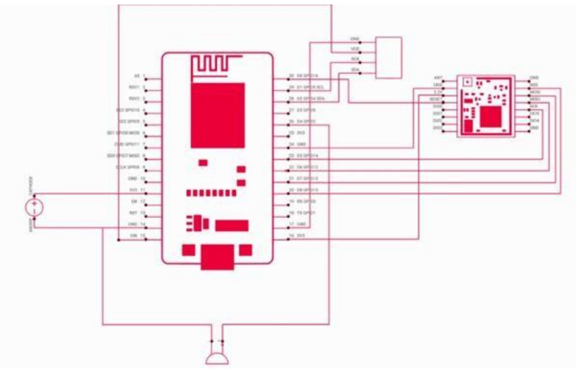

Fig. 3 Circuit Diagram Of The Receiver

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V. HARDWARE DISCTRIPTION

A. LoRa

Low-power wide-area network (LPWAN) uses the LoRa ultra-long-range low-power data transmission technology, which runs at frequencies below 1 GHz (LoRa for short). Long range, with a maximum transmission distance of 20 km, low power consumption, with a battery life of 5 to 10 years, and low rate, with a maximum transmission speed of only a few hundred kbps [1], are a few key characteristics. The goal of LoRa research is low-power (battery-powered), end-node transmission that can send a specific number of data packets in a specific amount of time [2]. The SX1278 device, which the wireless module employs, uses a high spreading factor to transmit tiny capacity data over a wide radio range. It predominantly uses the unlicensed band of frequencies between 137433 and 525433 MHz, including 433 MHz, and has a reception sensitivity of up to -148 dbm. In wide areas, the coverage can reach up to 15 km and more than 3 KM between structures [1].

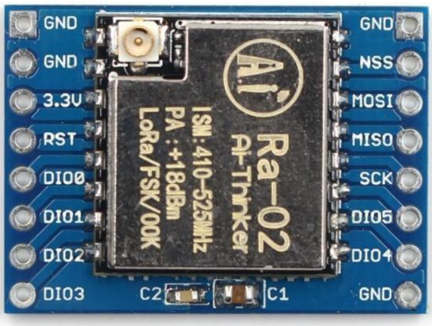

Fig. 4 Image Of Lora Module

B. Ultrasonic Sensor

Both the transmitter and the receiver of the ultrasonic sensor are made of 40 kHz piezoelectric resonant transducers, which are available commercially. When turned on, the transmitter emits a 200 millisecond ultrasonic pulse and then waits for a signal in response. The distance between the sensor and the items is then determined by the receiver's detection of the echoes of the ultrasonic waves that are reflected back from close objects. Due to their inexpensive cost and dependability, ultrasonic sensors are generally utilised in distance sensing applications [7] and [9].

Fig. 5 Image Of Ultrasonic Sensor

These transducers, which are often employed in anti-theft systems, are inexpensive and easily available in water-resistant canisters. The resulting signal has a period of 25 seconds, which corresponds to a wavelength of about 9 mm at 20 degrees Celsius. To provide the necessary uncertainty, a subwavelength detection is therefore necessary [7].

Measurement of the time required for a signal to travel from the transmitter to the receiver is the aim of ultrasonic rangefinders. The signal's propagation rate is known. In this paper, the HC-SR04 ultrasonic rangefinder is examined. The sensor consists of nodes that support the module's normal operation in addition to an ultrasonic wave-generating transmitter, an echo-perceiving receiver, and support nodes [8].

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An ultrasonic wave that is travelling at around 344 m/s (sound wave velocity) hits an item and is reflected back to the sensor [9].

C. ESP8266

A microcontroller with low power consumption is the ESP8266. Additionally, the ESP8266 features wireless tools that may be connected to internet networks. This capability enables data sensors to communicate with web servers and mobile applications to warn of flooding alerts [9].
Although low power consumption is important, communication is only effective when it is within range, forcing a trade-off between communication range and transmission power. The focus of this research does not extend to a thorough analysis of this trade-off, but we are interested in determining the feasible communication range in low power indoor settings, such as a factory [10].
A built-in antenna in the module makes it especially well suited for incorporation into compact gadgets. With a toroidal geometry rotating around the module and an axis perpendicular to the antenna longitudinal direction, these antennas exhibit a relatively nonuniform emission pattern [11].

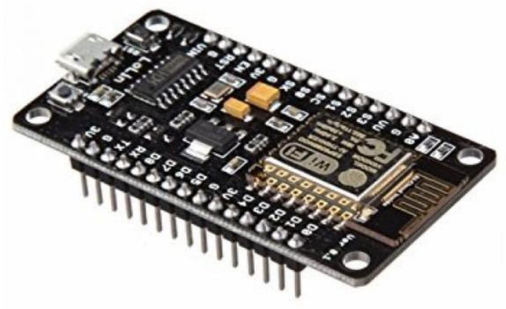

Fig. 6 Image of ESP8266

D. TP4056

The TP4056 is a linear charger made specifically for lithium-ion batteries with just one cell. It is perfect for portable applications due to its tiny SOP container and minimal external component count. The integrated PMOSFET architecture prevents negative charge current and does away with the requirement for a blocking diode. In times of high power operation or high ambient temperature, the charger controls the charge current to prevent the die from becoming too hot. The charge voltage is fixed at 4.2V, and a single external resistor can be used to programme the charge current. After the final float voltage is attained, the TP4056 ends the charge cycle when the charge current reaches 1/10th of the specified value. Additionally, it has features like automated recharging, under voltage lockout, current monitoring, and two status pins that show input voltage and charge termination. The TP4056 features a preset 4.2V charge voltage with 1.5% accuracy and can charge single cell Li-Ion batteries straight from a USB port. Soft-start limitations are also included to reduce inrush current. An optional radiator that must be linked to GND is offered with the TP4056 in an 8-lead SOP package [16].

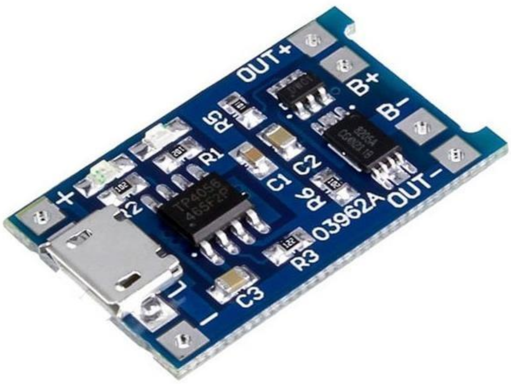

Fig. 7 Image Of Charging Module

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E. OLED

In comparison to conventional LCD displays, an OLED (Organic Light Emitting Diode) Display is a tiny, lightweight, and flexible display technology that offers brighter and more vivid colours. Popular OLED displays, like the 128x64 OLED Display Module, are frequently seen in a range of electronic products, including digital cameras, cell phones, and portable media players. Images on this OLED display module are clean and clear thanks to its 128x64 pixel resolution. It is built with a controller IC (SSD1306) that enables simple I2C or SPI interface communication with microcontrollers. Additionally, the display has an integrated voltage regulator that allows it to function with a supply voltage ranging from 3V to 5V, making it compatible with a variety of microcontrollers and development boards. The OLED display module has a quick response time and good contrast ratio, making it perfect for showing images and animations. Additionally, it has a broad viewing angle, ensuring that the display is viewable from all directions. The display also uses little power, thus it can be utilised in battery-operated devices without having a substantial impact on battery life. The 128x64 OLED Display Module is an all-around adaptable and budget-friendly display option for a variety of electrical products. Electronics enthusiasts and amateurs frequently choose it since it is simple to incorporate and produces vivid, clear visuals [17].

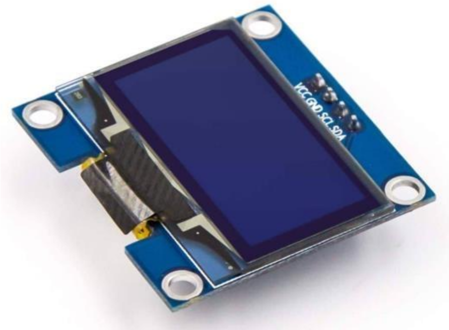

Fig. 8 Images Of OLED Display

F. Li-Ion Battery

Rechargeable Li-ion batteries are quite popular because of their high energy density, low self-discharge rate, and lengthy cycle life. A Li-ion battery with a nominal voltage of 3.7V and numerous recharging cycles is known as a 3.7V Li-ion cell [18]. The standard components of a 3.7V Li-ion cell rechargeable battery are a lithium cobalt oxide cathode, a graphite anode, and an electrolyte composed of lithium salts dissolved in organic solvents. During charging and discharging cycles, these parts cooperate to enable the passage of lithium ions between the cathode and anode [19]. These batteries are frequently found in portable gadgets like laptops, tablets, and smartphones as well as electric cars and alternative energy sources. It is crucial to remember that Li-ion batteries can overheat and cause fires if not handled properly, among other safety problems [18].

Fig. 9 Li-On Battery Image

VI. WORKING

Your initiative sounds worthwhile and intriguing. An inventive solution that can assist in monitoring water levels and averting any potential catastrophes brought on by the rise in water levels is a smart water dam management system. You may manage and control all of the hardware attached to the NodeMCU ESP8266, including the ultrasonic sensor and the Lora module for data transfer. An accurate and trustworthy method to gauge water levels is to use an ultrasonic sensor to detect the distance between the water surface and the sensor itself. An ultrasonic pulse is transmitted from the ultrasonic

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level transmitter located on top of the dams down into the dams, where it is reflected back to the transmitter from the liquid surface. The computer estimates the distance to the liquid surface based on the measured time delay between the broadcast and received echo signals, providing real-time information on the water level. Without an internet connection, the Lora module is a great option for long-distance data transmission. It has a 4 kilometre data transmission range, which is more than enough for your project. The Lora module may transmit the data gathered from the ultrasonic sensor to the server, where it can be stored and retrieved as required. Anyone who requires it can utilise the LCD monitor to see the water level's distance in real time. However, you have advanced the concept by including a user-friendly application that enables the user to inquire about the water level from the neo dams. The user's smartphone screen will display the real-time data that has been downloaded from the web server. Users now have an effective and practical way to keep track of water levels, avoiding any potential dangers. Your alert system is outstanding since it enables users to check on the state of the water level, and the ESP8226 Wi-Fi module will gather data from the sensor. The data will be transferred over Wi-Fi and the internet and stored on a server before being translated by backend programming into a Telegram bot message reply. Users now have a simple way to quickly and effectively receive the information they require.

VII. CONCLUSION

An application has been conceptualised and partially developed. Based on the condition of the dam, our programme will offer real-time information on the water level. We have applied engineering knowledge to examine the issue of interior designing of healthcare systems, village offices, and to take care of reservoirs, etc. Our application will inform the villagers in risky conditions. The application was then divided into two sections. In order to learn about fresh upgrades and solutions, we looked into the applications that were already available. For the creation of our application and the implementation of the device, we used a hardware Lora (long-range radio) modern tool. While presenting projects at various project management contests and conferences, we used professional ethics and appreciated the value of teamwork and communication. For lifelong learning, this approach can be built at a generalised level for various industries.

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