Realtime Monitoring System for Surface Water Quantity and Analyzing of Water Quality Using Microcontroller

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Abstract

In India, water contamination is a serious environmental issue. Untreated sewage is typically the main cause of water contamination in India.Protecting water quality for sustainable livelihoods and poverty reduction becomes a greatest challenge with the technological change and population growth. Measurement of Water Quantity and Real Time Monitoring becomes mandate to advance the water stewardship. In this paper, to keep track of the quality, smart water quality monitoring system(Ph, temperature, turbidity) and analysing of water quantity (flow or level) based on IOT is proposed for the study area of Okkiyam Maduvu, watershed in Chennai. This system is implemented using various sensors to measure the water quality like Ph, temperature, turbidity sensor and for analysing water water quantity used flow or level sensors. All these sensors are controlled by using the microcontroller - Arduino ESP32. This proposed system is placed in the study area Okkiyam Maduvu watershed to monitor water quality and quantity and visualized those sensed data using the IOT platform through Blynk App. This helps to know the water level and its quality of Okkiyam Maduvu watershed and it helps to take necessary precaution if the water quality is reduced and its level raised beyond the level.

Keywords: Water Quality and Quantity Measurement, Blynk App IOT Platform, Real Time Monitoring.

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INTRODUCTION

Globalization leads to water scarcity and polluted water. It is important to monitor the water quality and quantity in real time. This is helps to take necessary precaution whenever there is a problem which helps to have green globalization. The manual testing of water quality and quantity i.e., through chemical or laboratory test will consume more time and it is not possible to monitor continuously and also, it cost more. And moreover, manual measurement will not lead us to measure continuously. Submerged system architecture helps to measure the water quality and quantity continuously using wireless communication. But the cost of implementing this architecture is more. In-order to implement real-time monitoring in low-cost, it is mandate to use IoT platform. This measurement can be achieved by using various sensor like Ph, temperature, turbidity sensor for water quality and for analysing water water quantity used flow or level sensors.

STUDY AREA

Okkiyam Maduvu watershed which is situated in Old Mahabhalipuram Road, Karapakkam Chennai which is 2.8km long waterways. It connects through the Pallikaranai marsh land.

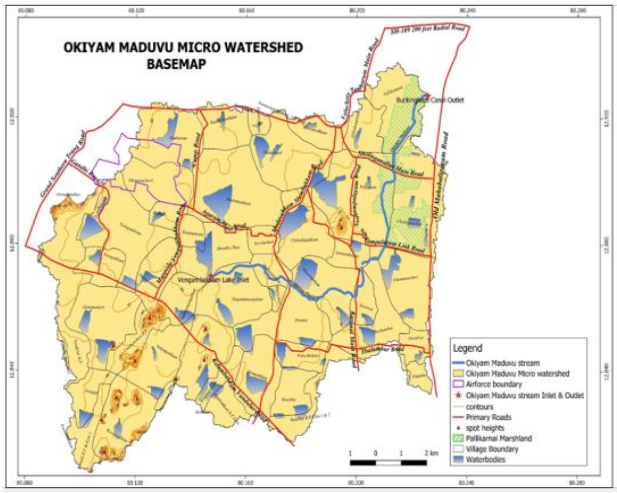

Fig. 1 Study Area- Okkiyam Maduvu Watershed

The Fig. 1 shows the Okkiyam Maduvu watershed which passes through Buckingham Canal and connected to Bay of Bengal through Muttukadu. These waters are used by several house, civilians who are all living around it are using the water for daily necessaries. To avoid the health issue of the civilians and contamination of water, we have proposed a solution by measuring the water quality and quantity. Water quality in the sense pH, Temperature and Turbidity are measured and in the quantity, water flow is measured using different sensors. From this the quality of water is measured which will help the civilians from using untreated water bodies.

Literature Survey

Jaytti Bhatt et.al., proposed a system which will monitor the water quality using IoT. They proposed the device which consists the water quality sensors which measures pH, turbidity, conductivity, dissolved oxygen and temperature. The measured values are monitored by microcontroller (Raspberry Pi) using Zigbee protocol and data can view on internet application using cloud [1]. Geetha S and Gouthami S proposed a device which is a in-pipe water quality monitoring based on IoT technology. The sample of water was tested and the data was uploaded in Internet which works with low power and but the implementation is complex [2]. Kumar RK et al. implemented a solar based water quality monitoring system which monitors the quality of water over different sites using Wireless Sensor Network (WSN) and zigbee technology. It is used to connect the different sites which are referred as nodes and it powered through solar panel. Using simulation tools, all the sensed data are analyzed and displayed visually to take the necessary action. This is implemented with low power consumption, and it is more flexible to deploy at remote site [3]. Henry et al. have proposed a system which is called as smart water consumption measurement system using IoT, it has pre-processed the data in gateway and sent to the cloud for analyzing. If the flow of water is constant the value coincide with the last two value and it check whether it has received any negative value. Finally it verifies whether there is any high consumption outside then the given value [4].ZulhaniRasin and Mohd Rizal Abdullah have proposed a water quality monitoring system using Zigbee based on WSN. The following water quality parameters were measured in real-time pH level, temperature and turbidity. The data collected from the sensors are are monitored in base station. This will avoid labor cost and provides flexibility [5]. Goib Wiranto et.al., have developed na online data measurement and automatic water quality monitoring system using microcontroller. They used pH and Dissolved Oxygen sensors and PCDuino is used as a microcontroller. The sensed data are collected by the PCDuino and then transmitted to the ZigBee. The automatic sampling unit is done based on comparison of the measured values against certain threshold values. The data measured from the sensors are displayed on a PC [6]. Bhupendra Singh Rawat et al. have proposed a system using zigbee based WSN which measures water temperature, dissolved oxygen, pH value, water pressure, depth, conductivity and other factors are the factors for water quality analysis. They have selected the high walls as nodes which provide high stability and low cost [7]. Yashwanth Gowda K.N et al. have developed a real time water quality monitoring system by using essential water parameters such as temperature sensor, pH sensor and turbidity sensor mainly they have used ultrasonic sensor which will send EM waves to surface of water and receive back the wave after touched the surface of water. From this the distance of the water in the container is measured by measuring the time taken into send receive the EM waves. Arduino MegaBoard is used as a microcontroller and using Arduino IDE software the program coe is dumped to the microcontroller. This system has main advantage of accuracy and fast response[8]. Ali J.Ramadhan et.al., have developed smart water monitoring system based on IoT platform. They aimed to ensure water conservation by tracking amount of water consumed by the household and informing the user and the authorities [9]. The Mithila Barabde et.al., proposes a system which is based on ARM controller using various nodes as a monitoring station or study area, a base station and a remote station and all these stations are connected through a wireless communication link. Each nodes collects the pH, turbidity, conductivity, etc., These data are analyzed using ARM controller, and analyzed by using MATLAB and compared with the standard values if there is an any abnormality, an SMS alert is sent to the authorized person for necessary action [10]. Guna selvi et.al., developed an IoT based water quality monitoring system for smart cities by using arduino microcontroller. The microcontroller connected to water leakage sensor, pH sensor, turbidity sensor, and water level sensor. Arduino is connected to Wi-fi module to monitor the data in real-time. And we can also access the data on the web application using personal android phones [11]. Joy Shah has presented an IoT based model using raspberry pi microcontroller for smart water distribution system which consists of pH sensor, temperature sensor, water flow sensor and conductivity sensor. This was implemented only to know the distribution of water and water control valve. The disadvantage of the system is that they are not use water level sensor, so the availability of water in the tank will be unknown [12]. Sayali Wadekar et al. have proposed a system using CC3200 simple link Wi-Fi module. They used energia IDE software to control the system and if the water level is low the system will turn on automatically and if the water level is high it will turn off. The disadvantage of the system is no water quality monitoring is performed, so even for water is available in the tank, without performing water quality check, water will be supplied [13]. Nageswara Rao Moparthi et al. have developed a system using arduino

microcontroller, zigbee and GSM module. GSM module is used for message technique they use a led display and to have continuous observation on water parameters. The main drawback of the system is that it only measure the pH in this system [14,18]. Krishna.S et al. have proposed a system using EXO module. It is based on IoT based water parameter monitoring which have used pH sensor, ORP sensor, turbidity and pressure sensor. And mainly they have used Exo-sonde is a multi-parameter monitoring device which suspects all parameters and records the data in it. The data collected by each sensor through the ADC which is given to controller using the UART in the EXO module. The UART is used to transmit the data from the EXO Sonde. The major drawback in this setup is that the cost of Exo-sonde is very high approximately $445[15]. Kulkarni Amruta M et.al., proposed a system which is a water quality measurement based on solarusing wireless sensor network. All the water parameters are sensed and the sensed data controlled to get a improved water quality. Solar power is used to switch on the system continuously. It also used Zigbee technology and the sensed data are visualized using MATLAB [16]. Nithin Halkara et al. have proposed a system which is based on managing the water and measure the water utilization based on IoT based platform water quality monitoring system. There study found that the water management implies to maximize the use of water and minimize wastage of water [17,19].

METHODOLOGY

Smart water monitoring system has been gaining more importance in advanced communication technology. The Fig 4.1 shows the proposed methodology using NodeMCU (ESP32) microcontroller. The proposed system is implemented in Okkiyam Maduvu watershed to monitor the surface water quantity and water quality using sensors and it can be monitored in real time by using IoT platform. pH, temperature and turbidity of the water is sensed using the sensor to know the water quality sensor and used flow or level sensor to measure the water quantity. A solar panel is used to sense the data without any power interruption. The NodeMCU microcontroller collects all the sensed data and hosts web server which will control GPIO pins based on configurations done in the program. The change in status and existing status will be displayed in the web server. IoT-based technology using Blynkapp is proposed for real-time monitoring. These IoT-based system is used to aggregate, visualise, and analyse live stream data. Monitoring and analysing surface water quality and quantity in real time has become mandatory to advance water stewardship. This proposed smart system is installed in the Okkiyam Maduvu watershed study area – muttukadu to palikarnai – for monitoring water quantity and examining water quality. The device will be positioned in such a way that once the data exists, we will be able to analyse how much water flows from the watershed's inlet to its outlet and identify the water quality parameters. These devices can be attached to a floating buoy in the study area, to measure the parameters continuously and monitor in real-time through IoT. The continuously monitored data is sent via an IoT-based system to software called Blynk app. This will show the measured data as a graph and it can be downloaded any time for any analysis. The Fig. 2 shows the proposed real time monitoring system block diagram which includes various hardware and software.

(i) Software - Arduino and Blynk app

In the proposed system, we used Arduino open source software which is controlled by microcontroller. For real time monitoring, it is connected through an IoT platform called Blynk app. It helps to keep track of the sensed data which is measured from the study area. In order to transmit the data need to set the serial baud rate as 9600 bits per second. This helps to receive the data in constant speed and graphs are plotted in the Blynk app. This supports by connecting the Wifi and Wificlient header file. The Blynk app is enabled by using BlynkSimpleEsp32 header file and the temperature sensor is included by calling onewire header file. The Blynk app can receive the sensed data by calling virtualWrite (). Before writing the sensed data need to run the Blynk app by using the command Blynk.run().

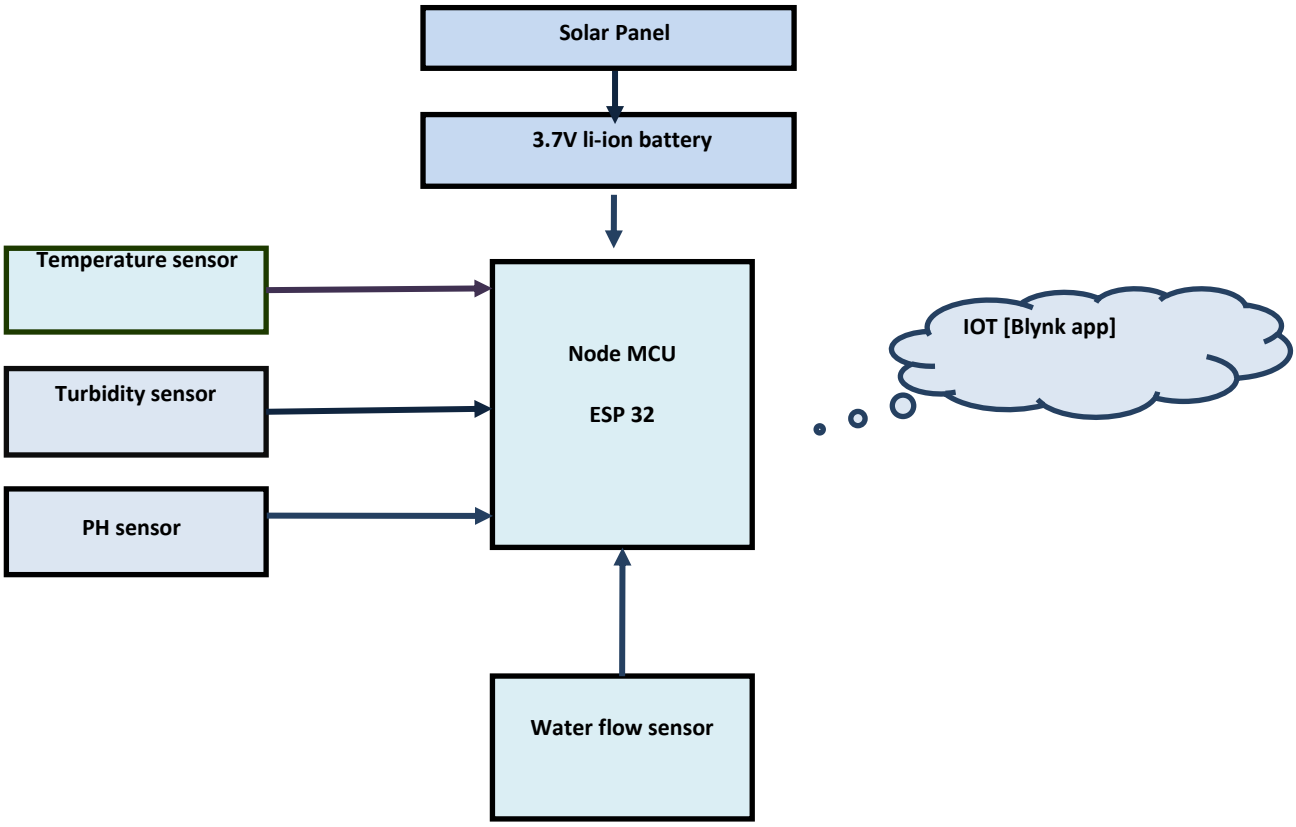

Fig. 2: Block Diagram

(ii) Hardware – Microcontroller, Water Quality and Quantity Measurement Sensor

To measure the water quality and quantity various sensors are used to develop the device. A pH meter helps measures the acidity and alkalinity level of the water. The pH meter is calibrated regularly to maintain the accuracy of sensed data. Measurement of turbidity using a sensor helps to measure the optical property of water which is determined by the quantity of light dispersed and immersed by colloidal and suspended particles. It is measured in the units of FNU, FTU, NTU, etc. DS18B20 is a 1-Wire interface temperature sensor which helps to sense the water temperature and it can be done in two different configurations. One such configuration is TO-92 package which is like a normal transistor. The other takes the form of a waterproof probe, which is useful in measuring something far, underwater, or underground. Water stewardship is mandate since the number of factories and commercial and residential buildings are increasing day by day as the population and technology increases. To monitor the amount of water supplied and consumed, it is necessary to measure the flow rate of water. This is achieved by using a water flow sensor. In the proposed system, it is places in the proposed study area watershed which measured in the unit of litres per hour or cubic meters. Solar panel (3V-Lion) is one of the most popular solar cells in recent years. Solar energy is becoming more and more widely available. These PV systems generate electricity to offset the consumption of property access and feedback overproduction to the grid. Lithium-ion batteries are widely used and versatile. These rechargeable batteries are found in mobile phones, automobiles, power tools and a variety of other electronic devices, and also power material handling and airport ground equipment. Due to their distinct advantages and environmentally friendly advantages, lithium-ion batteries are an excellent choice.

IMPLEMENTATION

The proposed system was developed by using NodeMCU ESP32 microcontroller board. The water quality and quantity are measure by connecting various sensors to the microcontroller. The system was powered continuously by using solar panel. This proposed system was kept in the study area to sense the Okkiyam Maduvu watershed water quality and water quantity. It was continuously monitoring by programming the microcontroller and connecting to the IoT platform called Blynk app. The following water quality parameters were sensed using the sensor pH, temperature and the turbidity of the. And to recognize the water amount we used water glide sensor. The pH sensor encompass a

measuring electrode while lifted with inside the water it'll display a number of the pH values gift with inside the water. If the pH is under 7 it method the water is acidic in nature if above 7 it method it's miles alkaline in nature. The DS18B20 temperature sensor was to measure the temperature where it is a 1-cord temperature sensor that is extensively used to degree the temperature in various environments. Purity of the water is measured by using turbidity sensor. Flow sensor is used to sense the water flow in the mentioned watershed. Icalculate the velocity and distance of the water in a stream/lake. These values from all of the sensors might be analyzed, evaluated, and transmitted and additionally saved in an IoT primarily based totally device that is an internet primarily based totally utility named Blynk the usage of Wi-Fi module.

RESULTS AND ANALYSIS

The hardware components are connected to the microcontroller as mentioned in the block diagram. The system is powered through a solar panel which is attached with a 3.7v battery that is used for giving strength deliver to the device. The sensed values from all of the sensors can be analyzed, evaluated, and transmitted and additionally saved in an IoT primarily based totally device that is an internet primarily based totally utility named Blynk the usage of Wi-Fi module. The Fig 3. Shows the implementation of real time monitoring of IoT based water quality and quantity in OkkiyamMaduvu watershed.

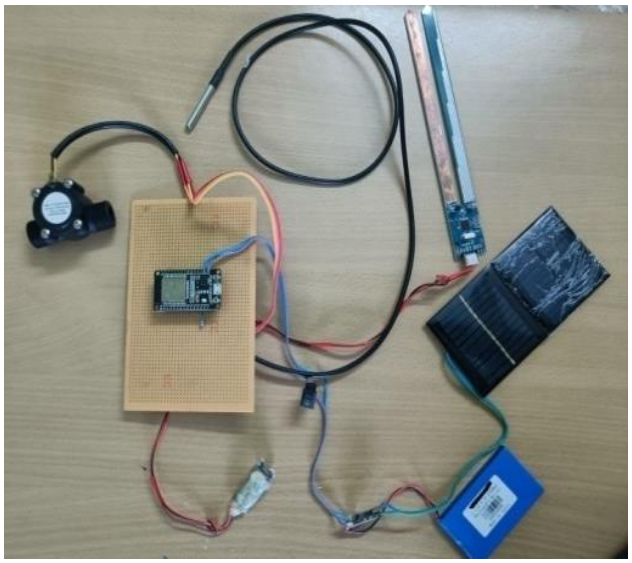

Fig. 3 Real Time Monitoring of Water Quality and Quantity System

It can be placed in the watershed as a floating water buoy with inside the observe vicinity for real-time tracking via Blynk app. The solar panel is connected to offer the strength deliver to the board for real-time tracking. We implemented this system in arduino open source software by including various header files called Wifi, Wificlient and BlynkSimpleEsp32.h to include the IoT platform. The Blynkapp can be run using the command called Blynk.run() and write the various sensed data in the Blynk app. The Fig 4 shows how to link the Blynk app in arduino software

Fig 4 – Implementation of BlynkApp in arduino

As a pilot study, implemented this system in our domestic region and monitored the sensed statistics via Blynk app. The values of the 3 sensors pH, Temperature, Turbidity and water float are measured in our domestic area. The sensed data was observed in Blynk App. The Fig. 5 shows the measured data from our domestic through Blynk App. The sensed data are monitored in regular interval and it can be monitored as a graph in Blynk App. Later, the system was placed in the Okkiyam Maduvu watershed and observed location and monitored the sensed data via Blynkapp and downloaded the facts and analysed. The sensed and monitored actual time facts fee from the app is for the watershed is shown in the Fig. 6. The values of the three sensors pH, Temperature, Turbidity and water flow are measured in our domestic.

Fig. 5 IoT monitored Data through Blynk App in Domestic

Fig. 6 IoT monitored Data through Blynk App in Okkiyam Maduvu Watershed

CONCLUSION

The proposed system helped to measure real time water quality and quantity based using Blynk app in the Okkiyam Maduvu Watershed. The ultimate goal of this system is to monitor the quality and quantity of surface water, which is achieved through microcontroller and various sensors. In terms of irrigation, residential use, industry, and so on, this is a significant factor. This technology can easily detect water pollution and assist in its control. In this paper, we had shown the measured data only for a day, in future we can float this system in the study area continuously and monitor the sensed data. This helps to analyse the water quality and quantity of the chosen study area Okkiyam Maduvu.

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