IoT based Water Quality Monitoring and Flow Control of Tank Water

M Ramprasath[1], AK Vijay Varman[2], J Sanjay[3], M Sheik Abdul Kather[4]

[1,2,3,4]*Student, Department of IT, SRM Valliammai Engineering College, Tamilnadu, India*

---***---

Abstract – *Water is an essential need for human survival but due to rapid pace of industrialization and greater emphasis on agricultural growth combined with latest advancement, agricultural fertilizers and non-enforcement of laws have led to water pollution to a large extent. In order to ensure the supply of quality water, monitoring in real time needed. This can be done using IoT. The internet of things (IoT) has the potential to turn anything to smart. IoT facilitate the remote monitoring and manipulating components simply using an interface. This project represents a system which can performs water quality monitoring, inform user about the statues of water and prevents user from using quality less water. This system calculated the value of potential of hydrogen and Nephelometric Turbidity unit. Other than that, this system detects water level, amount of water released from tank and object detection. Passive Infrared sensor is used for detecting objects such as entry of solid substances like leaves, feather or even animals that may try to open water tanks. The sensed values from the sensors can be prepared by the Arduino UNO. Finally, the sensor data can be viewed on MQTT using Wi-Fi system. If any values reach the threshold, the valves will close automatically and this will prevent user from using quality less water.*

***KEYWORDS:* pH sensor, Turbidity Sensor, Flow sensor, Arduino UNO, MQTT, IR sensor, level sensor, solenoid valve and nodemcu.**

1. INTRODUCTION

Human life can't exist without quality water. Serious health abnormalities are occurred due to intake of impure water. Nearly 21% of the diseases are related to impure water as reported by WHO. The motivation of this project is to prevent the user from taking debased water. So, a component for checking nature of water is required. In present day world, the populace development expands step by step so the consumption of water also increasing at huge rate. We use water for the household and industrial purposes. The water quality is affected due to various causes such as limited water resources, global warming, growing population and pollution. Because of the absence of water quality numerous issues happen, for example, cholera, looseness of the bowels, typhoid, hair fall and skin infections (Acne, dermatitis, seborrheic dermatitis). Thus, to forestall the utilization of low-quality water and control its utilization in private and business zones there is a requirement for better methodology. This task speaks to an ongoing observing framework dependent on IoT for water quality checking of Tank water. pH sensors are utilized to gauge alkalinity and corrosiveness of water and turbidity sensor quantifies the suspended particles in water. This framework gauges the Level, Flow and identify the interruption of items in the water tank utilizing Level sensor, Flow sensor and IR sensor separately. If any object intrusion occurs the solenoid valve get closed to avoid the use of poor-quality water. And the output can be viewed using the MQTT application.

2. LITERATURE SURVEY

Vaishnavi V. Daigavane and Dr M.A Gaikwad, "Water Quality Monitoring System Based on IOT" Advances in Wireless and Mobile Communications, ISSN 0973-6972 Volume 10, Number 5 (2017), pp. 1107-1116 © Research India Publications. The system proposed here facilitate the real time monitoring of water quality and measure of temperature, level and flow of water. This system is used for drinking water monitoring. The sensors are connected to the Arduino ATmega328P. The values received are viewed in the Arduino ide through serial monitoring. The user can view the received values in BLYNK application installed in android mobile of the user. [1]

Fei yuan, Yi-fan Huang, Xin Chen and En Cheng, "A Biological Sensor System using Computer Vision for Water Quality monitoring", Citation information DOI 10.1109/ACCESS.2018.2876336, IEEE Access. In this system, monitoring of water quality for fish culture is done. This system involves the detection of pollution in fish culture medium and the behavior of fishes in polluted water. The fish behavior is monitored in a camera. Their movement is analyzed using a machine learning algorithm. The movement velocity, rotation angle, spatial standard deviation and body color that characterizes the fish. The LSTM (Long Short-Term Memory) neural network is used to classify the future parameters data of the fish behavior in different water quality environments.[2]

Manish Kumar Jha, Rajni Kumari Sah, Rashmitha M.S, Rupam Sinha, Sujatha B, Suma K. V. (Dept. of ECE Ramaiah Institute of Technology) "Smart Water Monitoring System for Real-time water quality and usage monitoring" International Conference on Inventive Research in Computing Applications (ICIRCA 2018), IEEE Xplore. This system is smart water quality meter which checks the purity of portable water that the consumer receives, by measuring the five qualitative parameters of water. The parameters are pH, Turbidity, Temperature, dissolved oxygen and Conductivity. If any violations in either the usage limit or water quality is immediately notified to the consumer and authority via SMS and an alert signal generate by the system.[3]

Albert Joshy Varghese, Abin Thomas Jolly, Astile Peter, Bhavana P Rajeev, Sajitha K S, Deepa Elizabeth George (Dept.

Electronics and Communication Engineering Toc H Institute of Science & Technology), "IoT based Disaster Monitoring and Management System for Dams", 2018. This system consists of sensors such as Temperature, Rain fall, gate level, Flow, Level sensors and microcontrollers. It makes a proper monitoring and regarding the opening of the shutters thereby management system for maintaining a safe water level in dams. The data gathered from the sensor that are placed on various parts of the dam are sent using the internet connection. The water level of dams is calculated for analysing. The SMS alert is given to the consumer of the locality and SOS to rescue operation in case of adverse weather conditions.[4]

3. OVERALL SYSTEM ARCHITECTURE

In this proposed system, all the components and functionalities in the existing system are implemented along with mechanisms such as detection of object intrusion, Intimation to user about the statues of water and to avoid the use of quality less water. The detection of object intrusion is done using Passive Infrared Sensors. The user is alerted about the condition if water though MQTT (Message Queueing Telemetry Transport Protocol) app installed in his device (mobile/laptop). The alert is sent to the user only if the sensors reach the threshold value. The code for MQTT is dumped in the Nodemcu. The sensor related code is dumped in Arduino UNO. The usage of the quality less water is avoided by closing the valves automatically. For automatic closing of valves is done using solenoid valves. When the threshold of any sensor is triggered then the valve is automatically closed.
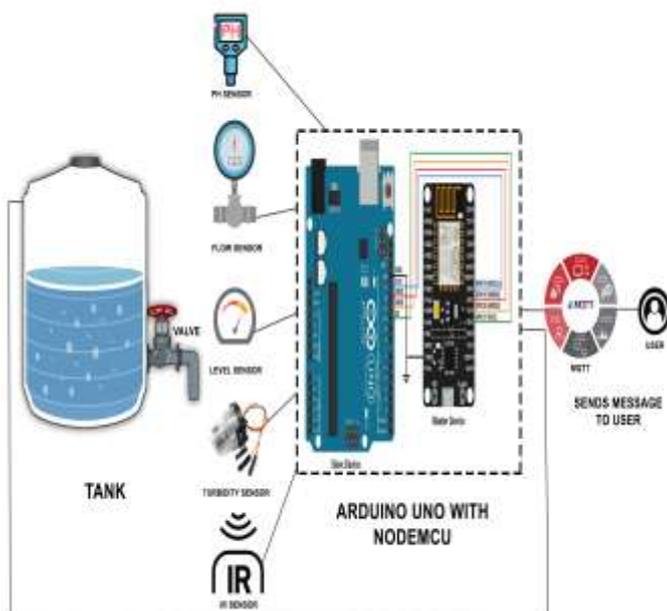
Fig-1 Architecture Diagram

A. ARDUINO UNO BOARD

Fig-3.1 Arduino UNO

The Arduino Uno is based on the ATmega328 and it is microcontroller board. It has 20 virtual input/output pins (of which 6 may be used as PWM outputs and six may be used as analog inputs), a 16 MHz resonator, a USB connection, a strength jack, an in-circuit machine programming (ICSP) header, and a reset button. It incorporates the whole lot had to guide the microcontroller; genuinely join it to a laptop with a USB cable or power it with an AC-to-DC adapter or battery to get commenced. Microcontrollers and your widespread motive laptop are the sheer amount of memory available. The Arduino UNO has simplest 32K bytes of Flash reminiscence and 2K bytes of SRAM.

B. pH Sensors

Fig-3.2 pH Sensor

PH sensor senses the potential of hydrogen in water. The pH ranged from 0 to 6.9 indicates the acidity, 7 is neither acidic nor alkaline and 7.1 to 14 indicates alkalinity of water. The lesser the value the more acidic the water has become and the higher the value more alkaline the water has become. This sensor uses a input supply of 5.5 volt.

C. Turbidity Sensors

Fig-3.3 TS300B

Turbidity sensor can sense the particle presence in water i.e. cloudiness of water. The sensor is capable of sensing values between 0 NTU to 200 NTU. The sensor uses light of 890 nanometer to sense the transparency of water. The safe water possesses 0 - 5 NTU. This sensor works in a voltage of 5 V. The ±2 NTU for water below 25 NTU and ±5 NTU for water above 25 NTU.

D. Level Sensors

Fig-3.4 ROBODO SEN18

Robodo sen18 is used to measure the level of water in a container(tank). Its working voltage is 3-5V, current is <20mA and sensor type is analog detection.

E. Flow Sensors

Fig-3.5 YF-S201

The flow sensor senses the amount of liquid moves through it with help of pinwheel sensor. It also contains a hall effect sensor that outputs an electric pulse for every revolution. Each pulse represents an outflow of 2.25 milliliters. The working voltage is 5 to 18V DC. The rate of outflow is 1-30 liters per minute. This sensor provides data at an accuracy of ±10 %. The maximum water pressure for reliable working is 2 MPa. This sensor draws a maximum of 15A at 5V.

F. IR Sensors

Fig-3.6 IR SENSOR

An infrared sensor is used to sense certain traits of its environment. It does this via both emitting or detecting infrared radiation. Infrared sensors also are capable of measuring the warmth being emitted thru an object and detecting movement.IR light is invisible to us as its wavelength (700nm – 1mm) is masses better than the visible moderate range. IR LEDs have slight emitting mindset of approx. 20-60 degree and form of approx.

G. Nodemcu

Fig-3.5 ESP 8266

ESP8266Wi-Fi is enabled with an on chip (SoC) module and employs a 32-bit RISC CPU based on the Tensilica Extensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a boot ROM of 64KB, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.The working voltage is 3.3V.

H. MQTT

Fig-3.6 MQTT

MQTT is a simple messaging protocol, designed for confined devices with low-bandwidth. So, it's the right answer for Internet of Things packages. MQTT lets in you to send commands to govern outputs, study and post data from sensor nodes and much extra. Therefore, it makes it virtually smooth to set up a verbal exchange between more than one device. In MQTT there are some simple principles which you want to apprehend: Publish/Subscribe, Messages, Topics and Broker.

MQTT – Publish/Subscribe protocol. The first concept is the put up and subscribe device. In a publish and subscribe system, a device can post a message on a topic, or it may be subscribed to a specific topic to get hold of maximum packet size is 256MB. Small packets have 1-byte packet length field if its packet field is less than 127 bytes less than 16383 will use 2 bytes.

I. SOLENOID VALVE

Fig-3.7 SOLENOID VALVE

A solenoid valve is an electromechanical tool used for controlling liquid or gasoline drift. The solenoid valve is controlled via electrical purpose, it truly is run thru a coil. When the coil is energized, a magnetic region is created, inflicting a plunger inside the coil to move. Depending at the layout of the valve, the user will both open solenoid valve and close the valve. When electric synchronous is eliminated from the coil, the valve will go again to its de-energized state.

4. PROCEDURE

The pH sensor, level sensor, YF - S201, PIR sensor and ESP8622 are connected directly to the Arduino UNO. TS-300B is connected to the Arduino UNO through a comparator. The solenoid valve is connected to Arduino uno through a relay. The Arduino is powered through the laptop or to a battery or an adapter connected to plug point.

The sensors sense the data and them transmits to the Arduino UNO. These data are transmitted to ESP8266. The ESP8266 pushes the data through MQTT. The MQTT (Message queuing telemetry transport) program is dumped in ESP8266. The threshold condition checking is done in both Arduino UNO and ESP8266. The decision-making process is first done in Arduino because the solenoid valve is connected to Arduino UNO only then the condition to close the valve will be received. Then the decision making also done in ESP8266 to alert the user that the threshold of the water is triggered by any of the sensors. This allows the user to view the alert only when threshold is triggered rather than receiving all the sensed values. The user can view the message with an MQTT app installed in his device. The ESP8266 should be connected to Wi-Fi and the details are stored in program. The user can subscribe to the topics that has been configured for each sensor. The alert to user and valve closing is done simultaneously.
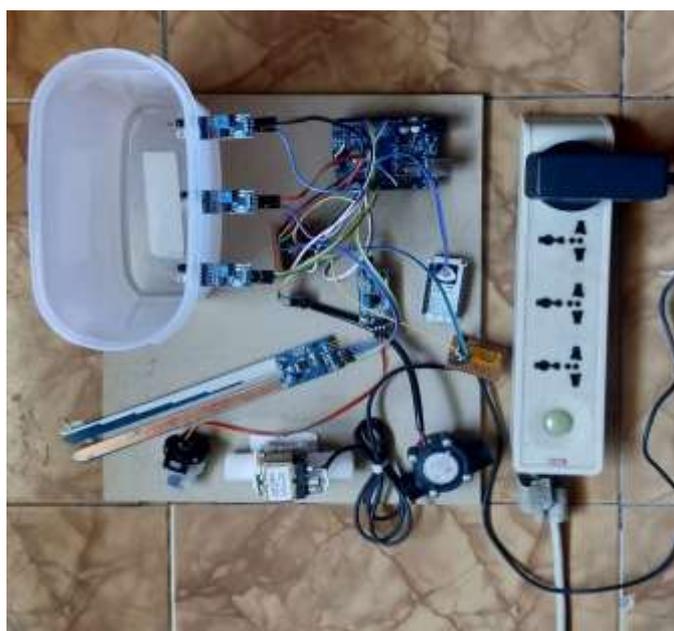
Fig-4 Connection Diagram

pH sensor measures on a scale of 0 to 14. The Ideal value is set between 6.5 to 8.5. If the value exceeds or succeed the Ideal value then the solenoid value will close and an alert will be sent to the user. Turbidity sensor measures turbidity between 0 to 200 NTU. The Ideal value is less than 5 or 5 NTU. So, the threshold is set as 5 NTU. The threshold value for level sensor is set as per water tank size. The threshold value is user's choice. The threshold for flow sensor is set as per the user requirement. The passive infrared sensor will be triggered when an intrusion of object is made. The programming for this project using Arduino ide in embedded c language.

5. RESULTS

Fig-5.1 Output on Arduino Serial Monitoring

Fig- 5.2 Output on MQTT

6. Conclusion

Here in this project we represent suitable implementation model that consists of different sensors and other modules, their functional architecture is shown in figure. In this implemented functional model, we used Arduino UNO (R3) with ESP8266 module for wireless connectivity. Inbuilt ADC and ESP8266 module connect the embedded device to internet. Sensors are connected to Arduino UNO board for monitoring, ADC will transform the sensor reading to its digital value and from that value the corresponding water parameters (pH, NTU) and other parameters (level, flow and object detection) will be validated. After sensing the data from different sensors, which are placed in particular area of interest, he sensed data will be automatically sent to the user via MQTT, when a proper connection is established with server node.

7. Future Work

The oxygen level sensor for measuring amount of oxygen in water. Addition of more valves helps to choose the outlet for desired quality water. Water of different quality can be used for different purposes using many solenoid valves. If water of certain quality detected then the certain valve is opened and others are closed. Presence of certain salts in water such as chlorine can be detected using chlorine sensor and many other individual salt contents can be detected using appropriate sensors

REFERENCES

[1] Vaishnavi V. Daigavane and Dr M.A Gaikwad, "Water Quality Monitoring System Based on IOT" Advances in Wireless and Mobile Communications, ISSN 0973-6972 Volume 10, Number 5 (2017), pp. 1107-1116 © Research India Publications.

[2] Fei yuan, Yi-fan Huang, Xin Chen and En Cheng, "A Biological Sensor System using Computer Vision for Water Quality monitoring", Citation information DOI 10.1109/ACCESS.2018.2876336, IEEE Access.

[3] Manish Kumar Jha, Rajni Kumari Sah, Rashmitha M.S, Rupam Sinha, Sujatha B, Suma K. V. (Dept. of ECE Ramaiah Institute of Technology) "Smart Water Monitoring System for Real-time water quality and usage monitoring" International Conference on Inventive Research in Computing Applications (ICIRCA 2018), IEEE Xplore.

[4] Albert Joshy Varghese, Abin Thomas Jolly, Astile Peter, Bhavana P Rajeev, Sajitha K S, Deepa Elizabeth George (Dept. Electronics and Communication Engineering Toc H Institute of Science & Technology), "IoT based Disaster Monitoring and Management System for Dams", 2018.

[5] Nikhil Kedia, Water Quality Monitoring for Rural Areas- A Sensor Cloud Based Economical Project, in 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India, 4-5 September 2015. 978-1-4673-6809-4/15/$31.00 ©2015 IEEE.

[6] Jayti Bhatt, Jignesh Patoliya, Iot Based Water Quality Monitoring System, IRFIC, 21 feb, 2016.

[7] Akanksha Purohit, Ulhaskumar Gokhale, Real Time Water Quality Measurement System based on GSM, IOSR (IOSR-JECE) Volume 9, Issue 3, Ver. V (May - Jun. 2014).

[8] Mithaila Barabde, shruti Danve, Real Time Water Quality Monitoring System, IJIRCCE, vol 3, June 2015.