A PRESENTATION OF SMART WATER MANAGEMENT

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Internet of Things (IoT) Based Water Quality Monitoring System

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ABSTRACT : In the coastal area of Bangladesh drinking water is short supply at everywhere for its complex hydro-geological forms. Furthermore, natural disaster, trans-boundary river issues make safe water supply difficult as compared to other portions of the country. Toxins from industrial sources may involve worry against accomplishing all-inclusive and impartial access to protected and reasonable drinking water for the coastal areas. it very well may be said that drinking water supply near the house is essential human right and fundamental for leading healthy life. To lessen the water related illnesses and prevent water contamination, we need to quantify water parameters, for example, pH, Turbidity, Temperature, Dissolved Oxygen, Salinity. For exact observing of water quality, we built up an IoT based water quality measurement system which is low cost and sustainable. In this work we proposed a smart sensor interface device that can sense the water quality parameters and effectively generate data in an online system for showing real-time measures of water quality parameters. It integrates drinking water quality measurement by different types of sensors. These sensors relate to Arduino for the purpose of monitoring the parameters of water quality. For transmitting the values, we create a serial communication between Arduino and NodeMCU which will show the data on an online system (web interface). A QR code will be attached with every water source for accessing it easily by any user. They can scan the QR to get sure whether the water is safe to drink or not. The Government can use this system to get information of area's water quality. This system can be also implemented on agriculture related applications and in industrial fields. The design, development and implementation of an IoT based system will help the authorities take the necessary steps to perform proper solutions for the affected area.

KEYWORDS - IoT, Water Quality Monitoring, Real-time system, Turbidity, pH, Temperature, Dissolved Oxygen, Salinity, Arduino, NodeMCU.

I. INTRODUCTION

With rapidly rising population in Bangladesh, Fresh Water Management is very much essential which demands an increase in agricultural, industrial and other requirements. The quality of fresh water is characterized by "chemical, physical and biological" content. Monitoring the water quality helps in detecting the pollution in water, toxic chemical and contamination. The traditional method still in vogue entails collection of water samples, analyzing it in lab and advice for any water treatment and so forth. Current water pollution monitoring method takes place in 3 main steps

- ✓ Water sampling
- ✓ Testing samples
- ✓ Investigative analysis.

All these 3 steps are very expensive, difficult, time-consuming, need expert advice and less efficient. So, with the advent of technology, automation can be brought in water quality monitoring in taking action appropriately rather than relying on manual process. So, in automating the water quality monitoring some amount of technological innovation has creeped in which would help in monitoring the quality of water rather than relying on manual process [9]. The quality of the shallow aquifers in and around the textile, bleaching and dyeing units, which use a wide variety of chemicals and dyes at Dhaka, Narayanganj and Gazipur and their environs are highly polluted due to the indiscriminate discharge of untreated effluents in the nearby low-lying lands and rivers and found unsuitable for all purposes. The riverbank and they are using water from the river and discharging the treated and untreated effluents. The people living in the downstream are using the water for their irrigation, drinking and other domestic activities. There is need of developing better methodologies to monitor the water quality parameters in real-time [1].

We developed the model for testing the water sources and the data is uploaded over the internet are analyzed. This is based on wireless communication system. Such communication systems have a very significant commercial value, with wireless sensor networks continuing to grow, more and more countries showing great interest [6]. The system will also warn the remote user, when there is a deviation of water quality parameters from the pre-defined set of standard values. The aim of this paper is twofold. One is to present a basic model of system which is low cost and less complex. Second, is to analyze the data to compare with Water Quality Index (WQI)[8].The nature of water is assessed dependent on its physical, concoction, and organic boundaries. With the target of giving an overall representation of the water quality dependent on all estimations, exertion has gone into creating Water Quality Indices (WQIs) [14] A Water Quality Index (WQI) is a measure by which water quality can be estimated for various purposes. WQI can be used to predict whether the water is suitable for drinking purpose, agriculture purpose or aquatic organisms etc. WQI can be measured on the scale 0 to 100.

II. RELATED WORKS

Before going into the details of our Intelligent IoT based Water Quality Monitoring system, we will review some of the existing system in vogue pertaining to Water Quality. In the traditional water quality monitoring system, different instruments been used to monitor the quality of water which include “Secchi disks (measure water clarity), probes, nets, gauges, meters”, etc. The traditional method is just not enough to measure water quality and identify any drastic changes in it. In the 21st century, there were lots of inventions, but at the same time the water pollution problem is also formed widely specially in coastal areas. Nikhil Kedia entitled “Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project.” Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper features water quality observing strategies, sensors, and data dissemination method, role of government, organize administrator and locals in guaranteeing legitimate data dispersal. It likewise investigates the Sensor Cloud space. While consequently improving the water quality isn't possible now, effective utilization of innovation and financial practices can help improve water quality and mindfulness among individuals. [1]

Jayti Bhatt, Jignesh Patoliya entitled “Real Time Water Quality Monitoring System”. This paper portrays to guarantee the safe supply of drinking water the quality ought to be observed progressively for that reason new approach IOT (Internet of Things) based water quality checking has been proposed. In this paper, we present the design of IOT based water quality observing system that screen the nature of water progressively. This system comprises a few sensors which measure the water quality parameter, for example, pH, turbidity, temperature.[2]

Sokratis Kartakis, Weiren Yu, Reza Akhavan, and Julie A. McCann entitled “Adaptive Edge Analytics for Distributed Networked Control of Water Systems”. This paper shows the burst location and confinement plot that joins lightweight pressure and inconsistency discovery with diagram topology examination for water distribution networks. We show that our methodology altogether diminishes the amount of communications between sensor devices and the back-end servers. Our results can save up to 90% communications compared with traditional periodical reporting situations. [3]

Zhanwei Sun, Chi Harold Li, Chatschik Bisdikian, Joel W. Branch and Bo Yang entitled “QOI-Aware Energy Management in Internet-of-Things Sensory Environments”. In this paper an efficient energy management framework to provide satisfactory QOI experience in IOT sensory environments is studied. Contrary to past efforts, it is transparent and compatible to lower protocols in use and preserving energy-efficiency in the long run without sacrificing any attained QOI levels. [4]

III. PROPOSED SYSTEM AND METHODOLOGY

Recent advances in the innovations of detecting, technology, and Internet of Things (IoT) have prompted critical advancement in the uses of environmental telemonitoring. In the field of aquatic monitoring, static stations or floats with capacities of computerized estimating, data logging and wireless transmission have been broadly structured by research institutes [11,12]. In this paper we focus on several parameter. Like pH, Turbidity, Temperature, Dissolved Oxygen, Salinity. We measure this parameter because WQI mostly depends on those parameters. Firstly, we connect sensors (pH, Turbidity, Temperature, Dissolved Oxygen, and Electrical Conductivity.) to Arduino and interface with it. Analog sensors data is converted to digital data (real life data) known as ADC (analog to digital converter). This data is processed through Arduino. All processed data then send to NodeMCU with a serial communication with Arduino and NodeMCU. We send data through character by character transmission. Then separate whole string data into individual data. Processed parameters data then send to firebase Realtime database. In our own web domain, we export data as json format from firebase cloud store and show it in our website. Statistic and decision parts are done in web system.

Fig. 1. System model

In this section we discuss about several components working procedure
1) Arduino
2) NodeMCU
3) pH Meter
4) Turbidity Sensor
5) Dallas Temperature Sensor
6) Analog Dissolved Oxygen Sensor
7) Salinity Sensor (EC)
8) Logic Level Converter
9) Serial Communication
10) Firebase Connection
11) Processing data and send data to cloud

Arduino Uno : Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL).

Fig. 2. Arduino Uno

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (For prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers can be programmed using C and C++ programming languages. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project [5].

Node MCU : NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module Later, support for the ESP32 32-bit MCUwas added. NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

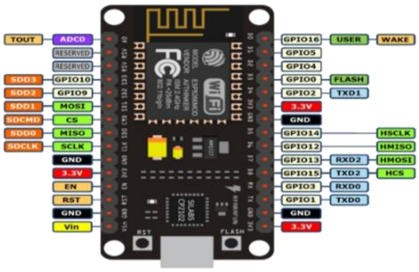

Fig. 3. NodeMCU with pin diagram

pH Meter : The pH sensor Module consist of pH sensor also called as pH probe and a signal conditioning board which gives an output which is proportional to the pH value and can be interfaced directly to any Micro-controller. The pH sensor components are usually combined into one device called a combination pH electrode. The measuring electrode is usually glass and quite fragile. Recent developments have replaced the glass with more durable solid-state sensors. The preamplifier is a signal conditioning device. It takes the high-impedance pH electrode signal and changes it into a low impedance signal which the analyzer or transmitter can accept. The preamplifier also strengthens and stabilizes the signal, making it less susceptible to electrical noise. pH and ORP probes are both used for measuring the acidic intensity of liquid solutions. A pH problem measures acidity on a scale from 0 to 14, with 0 being the most acidic and 14 being the most basic. Similarly, an Oxidation-Reduction Potential (ORP) probe returns a voltage proportional to the tendency of the solution to gain or lose electrons from the substances which is linked directly to the pH a substance.

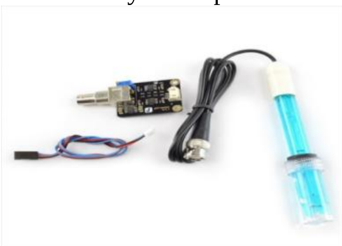

Fig. 4. pH Meter

pH meter is an analogue sensor and send analogue data to Arduino. We convert it to real-world data. pH meter returns voltage (0-5) where 0 indicates water is extremely acidic. Voltage is increased as the acidity level is decreased, and base level is increased. Maximum voltage will be 5 for extremely basic solution. So, here we multiply voltage by 2.8 and get the expected pH range.

Turbidity Sensor : The Turbidity Sensor measures the turbidity of fresh-water or seawater samples in NTU (Nephelometric Turbidity Units, the standard unit used by most water collection agencies and organizations). Its small, sleek design and simple setup make it easy to use at the collection site. In addition to water quality studies, it can also be used to monitor precipitate formation or algae and yeast populations in chemistry and biology classes. The Turbidity Sensor includes high-quality Hach StablCal™ 100 NTU standard for quick calibration and a high-grade glass cuvette for water sample.

Fig. 5. Turbidity Sensor

The turbidity sensor detects water quality by measuring level of turbidity. It is able to detect suspended particles in water by measuring the light transmittance and scattering rate which changes with the amount of total suspended solids (TSS) in water. As the TTS increases, the liquid turbidity level increases.

Interfacing with Arduino : This time we will discuss about how to access the Turbidity Sensor or Arduino water turbidity sensor. We converted the voltage to NTU. The working principle of this turbidity sensor is the same as the proximity sensor because there is a photodiode LED as a transmitter and a photo diode (receiver). And this sensor utilizes the light emitted on the LED which then reflects the results of the light that will be read by the sensor. So, the higher the level of turbidity of the water that will be detected, the level of light reflection received will be less, and vice versa. This Turbidity sensor provides analog and digital signal output modes.
In our experiment we observe that in pure distilled water the voltage level is 3.515 and for extremely polluted water the voltage level is decreased to 0.2. In NTU the range for turbidity is .25 to 100 where 0.25 NTU indicates pure distilled water and 100 NTU indicates extremely polluted water. So, our analog value (0.2 to 3.65) will have to be converted to digital value in NTU (100 to .25). We have to generate a straight-line equation which will be satisfied those value. The equation of straight line passing through two points (x1, y1) and (x2, y2) is

$$\frac{x-x_1}{x_1-x_2}=\frac{y-y_1}{y_1-y_2} \qquad (1)$$

For analogue voltage 0.2 NTU value will be 100 and for voltage 3.7 NTU value will be 0.25.
So, two points are (0.2, 100) and (3.7, 0.25). And the straight-line equation will be

$$\frac{x-0.2}{0.2-3.7}=\frac{y-100}{100-0.25} \qquad (2)$$

y = 105.7-28.5x

Temperature Sensor : The Dallas Temperature Sensor is a 1-wire programmable Temperature sensor from maxim integrated. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from -55°C to +125° with a decent accuracy of ±5°C. Each sensor has a unique address and requires only one pin of the MCU to transfer data so it a very good choice for measuring temperature at multiple points without compromising much of your digital pins on the microcontroller.

Fig. 6. Dallas Temperature sensor

The dallas component allows us to use your DS18b20 (datasheet) and similar One-Wire temperature sensors. To use dallas sensor, first define a dallas “hub” with a pin and id, which you will later use to create the sensors. The 1-Wire bus the sensors are connected to should have an external pullup resistor of about 4.7KΩ. For this, connect a resistor of about 4.7KΩ (values around that like 1Ω will, if we don’t have massively long wires, work fine in most cases) between 3.3V and the data pin. The dallas sensor component (or “hub”) is an internal model that defines which pins the ds18b20 sensors are connected to. This is because with these sensors you can connect multiple sensors to a single pin and use them all at once.

Salinity Sensor (EC) : Salinity is the measurement of saltiness in water. This is usually measured by following formula

$$Salinity = (g\ salt/kg\ sea\ water)$$

Salinity can be measured by passing an electric current between the two electrodes. The electrical conductivity of water is influenced by the concentration of dissolved salt. Salts increase the ability of a solution to conduct an electric current. So, a high EC value indicates high salinity level. High salinity level means saltiness of water is high. It is an analog sensor which returns analog voltage value. Analog voltage must be converted to digital value. The higher the saltiness, the higher the conductivity.

Fig. 7. Salinity Sensor

Analog Dissolved Oxygen Sensor : The dissolved oxygen (DO) is a dissolved oxygen in water. The oxygen dissolves from the ambient air through diffusion; water aeration that has tumbled over falls and rapids; and as a photosynthesis waste product. A simpler formulation is given below

Carbon dioxide + Water ------> Oxygen + Carbon-rich foods

This sensor is Compatible with Microcontrollers like Arduino. It is used to measure dissolved oxygen in water, to reflect the water quality. It is applied in many applications and fields such as agriculture, aquaculture, environment monitoring and so on. There is an old saying about fish conservation, "Good fish deserves good water." For aquatic species good water quality is very critical. One of the essential parameters for representing the water quality is the dissolved oxygen. Low dissolved oxygen in water may cause breathing problems for aquatic species, which can endanger their lives.

Logic Level Converter

Fig. 8. Dissolved Oxygen sensor

logic level converter features four bi-directional channels, allowing for safe and easy communication between devices operating at different logic levels. It can convert signals as low as 1.5 V to as high as 18 V and vice versa, and its four channels are enough to support most common bidirectional and unidirectional digital interfaces, including I²C, SPI, and asynchronous TTL serial. As digital devices get smaller and faster, once ubiquitous 5 V logic has given way to ever lower-voltage standards like 3.3 V, 2.5 V, and even 1.8 V, leading to an ecosystem of components that need a little help talking to each other. For example, a 5 V part might fail to read a 3.3 V signal as high, and a 3.3 V part might be damaged by a 5 V signal. This level shifter solves these problems by offering bidirectional voltage translation of up to four independent signals, converting between logic levels as low as 1.5 V on the lower-voltage side and as high as 18 V on the higher-voltage side, and its compact size and breadboard-compatible pin spacing make it easy to integrate into projects.

Fig. 9. Logic Level converter

We need to connect HV and GND pin to high voltage device (Arduino). LV and GND pin will be connected to low voltage device (NodeMCU). Lefts pin will be connected for serial communication between two devices.

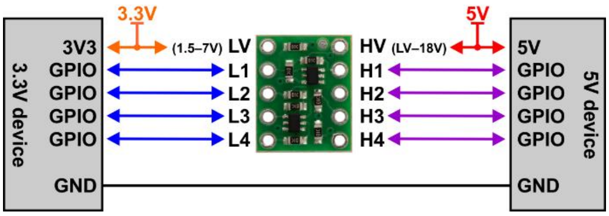

Fig. 10. level converter interfacing

Serial Communication: We need to create a serial communication between Arduino and NodeMCU for transmitting data to firebase through Wi-Fi protocol. NodeMCU is much faster than ESP8266. So, here we use NodeMCU for transmitting data. And thus, serial communication is needed. In serial communication the sender device sends data character by character. Here we are formatting a string to transfer data to receiver device (NodeMCU). For serial communication we use level converter between sender and receiver because of voltage difference. Software Serial allows serial communication on other digital pins using software to replicate the functionality. Here we are using Software Serial to start Serial at 9600 Baud. In general case, the serial will start at 115200 Baud Rate because NodeMCU works on that rate.

Firebase Connection : We use firebase real-time database for cloud server. Here all processed data will be uploaded to firebase cloud server. Furthermore, we will analyze those data for make decision and statistical representation.

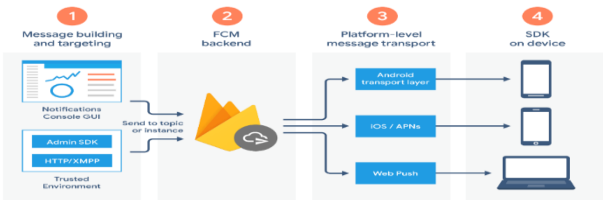

Fig. 11. Firebase data flow diagram

Method to Measure The Suitability of Water

TABLE I. STANDARD VALUE

Parameters	Unit	Range
pH	pH Units	6.5-8.5
Turbidity	NTU	0-5
Temperature	C	10-25
Dissolved Oxygen	mg/l	4-6
Salinity	mg/l	0-900

Processing Data and Send Data to Cloud : Finally, all processed data is sent to firebase cloud server. Here signal processing is done in Arduino and by serial communication it is sent to NodeMCU. Then NodeMCU is connected with firebase cloud server through Wi-Fi protocol [10]

IV. SCHEMATIC CIRCUIT WITH ITS WORKING

4.1 Circuit Diagram: Circuit Diagram is given below.

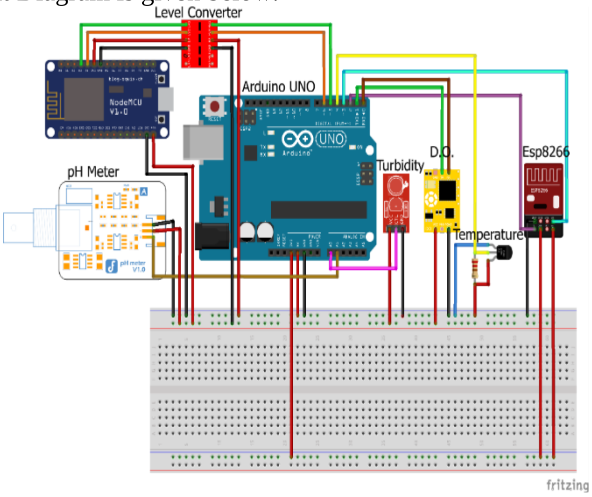

Fig. 12. Circuit diagram of the system

4.2 Implementation of the System: The system implemented with required sensors and other necessary equipments are operated in real and the figure of the project is given below.

Fig. 13. System Implementation

4.3 Data Flow Diagram

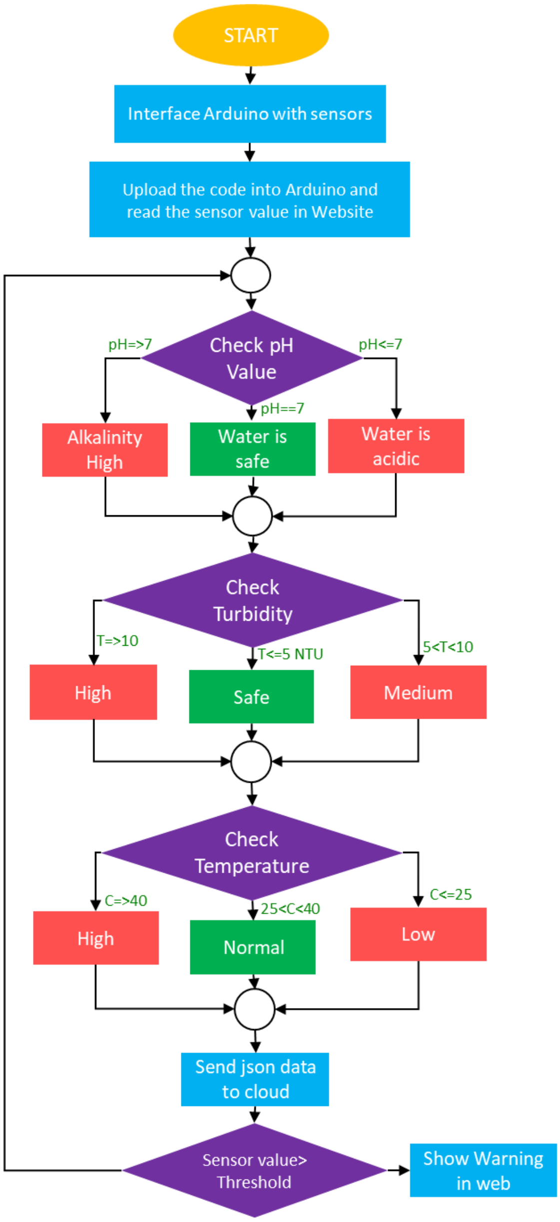

Fig. 14. Dataflow diagram

V. WEB APPLICATION OVERVIEW :

Over the past few years, technology has witnessed massive growth, and it is continuously happening. It has contributed a IoT for the betterment of human lives and has created limitless multifunctional devices. Internet of things (IoT) was experienced by everyone who has mobile phones, laptops, wearables, washing machine, smart speaker, and electronic gadgets connected with the Internet. The Internet of Things (IoT) idea is born, which consists of providing object communication. This provides a smart service, by integrating Internet with a sensor network. Simply put, it is an interdisciplinary piece of work that not only gets people but also related objects [7]. We have developed a website which is not dependent on any specific platform. So, everyone can access the application from any device that supports browser. We used firebase for real-time system. This is a product of Google and the security is also high.

5.1 Web Architecture : First, we achieved data from sensor and send it to Firebase through NodeMCU. The Firebase process the data and prepare into JSON format for showing into the section in Website. The Model is given below,

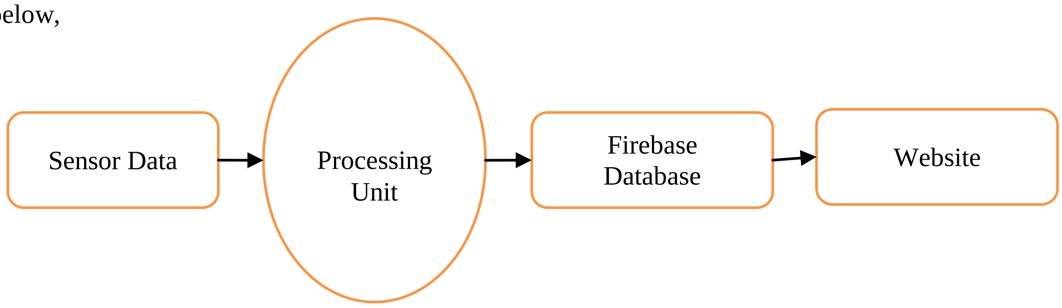

Fig. 15. Diagram of System to Web Dataflow

We are going to discuss about how firebase database work in Real-time and we used the technologies which is more efficient even in slow data rate. The quick organization system must be quick and simple to convey and keep up [13]

5.2 Implementation of Firebase : Firebase provides a real-time database and back-end as a service. The service provides application developers an API that allows application data to be synchronized across clients and stored on Firebase's cloud. The company provides client libraries that enable integration with Android, iOS, JavaScript, Java, Objective-C, Swift and Node.js applications. The database is also accessible through a REST API and bindings for several JavaScript frameworks such as AngularJS, React, Ember.js and Backbone.js. The REST API uses the Server-Sent Events protocol, which is an API for creating HTTP connections for receiving push notifications from a server. Developers using the Realtime database can secure their data by using the company's server-side-enforced security rules.

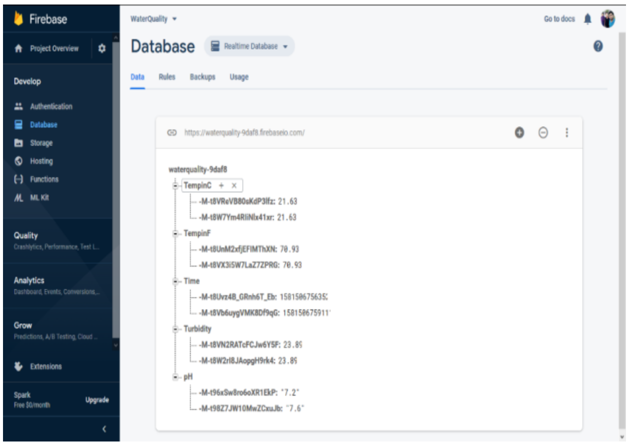

Fig. 16. Firebase Database

5.3 Realtime Data Analyzing with JavaScript : Alongside HTML and CSS, JavaScript is one of the core technologies of the World Wide Web. JavaScript enables interactive web pages and is an essential part of web applications. The vast majority of websites use it for client-side page behavior, and all major web browsers have a dedicated JavaScript engine to execute it. As a multi-paradigm language, JavaScript supports event-driven, functional, and imperative programming styles. It has application programming interfaces (APIs) for working with text, dates, regular expressions, standard data structures, and the Document Object Model (DOM). However, the language itself does not include. Any input/output (I/O), such as networking, storage, or graphics facilities, as the host environment (usually a web browser) provides those APIs. We use JavaScript because the browsers don't need refreshing again and again to show the real data.5.4 Web Application Interface We have developed a user-friendly Interface to showing the real-time data. Used latest technology of languages and scripts to build this system. CSS and JavaScript are mainly having two important roles in frontend and backend.

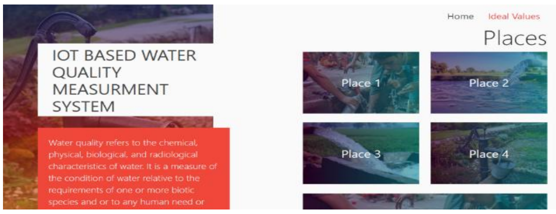

Fig. 17. Homepage

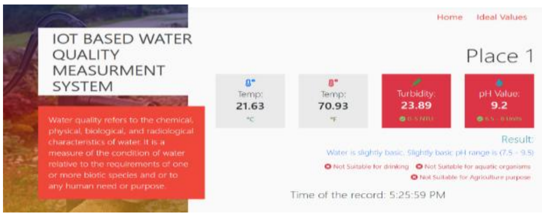

Fig. 18. Result Page

5.4 Accessing Web Application with QR Code : A QR code consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, and processed using Reed–Solomon error correction until the image can be appropriately interpreted. The required data is then extracted from patterns that are present in both horizontal and vertical components of the image. We used QR code on every water source which consists of the link of the website. If anyone wants to know if the data is safe or not all he can do is to scan the QR code from any device connected with internet. He can get the real-time data.

Fig. 19. QR Code For Proposed System

VI. RESULT AND DISCUSSION

After implementing the system on some water resources, we have achieved data and their suitability. In this Project, we have tested four water samples. Those are water from purifier source, water from pond, water mixed with lemon and water mixed with calcium hydroxides. If the pH value is above basic (means higher than 7.5) water is alkane. If it is below 6.5 the water is acidic.

6.1 Measurement of WQI : The calculation of the WQI was done using weighted arithmetic water quality index which was originally proposed by Horton (1965) and developed by Brown et al (1972) . The weighted arithmetic water quality index (WQIA) is in the following form:

$$WQIA = \frac{\sum_{i=1}^{n} w_i q_i}{\sum_{i=1}^{n} w_i} \qquad (3)$$

Where n is the number of variables or parameters, w_i is the relative weight of the ith parameter and q_i is the water quality rating of the ith parameter. The unit weight (w_i) of the various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters. According to Brown et al (1972), the value of q_i is calculated using the following equation:

qi= 100 [(Vi – Vid) / (Si – Vid)]

where V_i is the observed value of the ith parameter, S_i is the standard permissible value of the ith parameter and V_{id} is the ideal value of the ith parameter in pure water. All the ideal values (V_{id}) are taken as zero for drinking water except pH and dissolved oxygen (Tripaty and Sahu, 2005). For pH, the ideal value is 7.0 (for natural/pure water) and a permissible value is 8.5 (for polluted water). Therefore, the quality rating for pH is calculated from the following equation:

qpH = 100 [(VpH – 7.0) / (8.5 – 7.0)]; where VpH = observed value of pH.

6.2 Result Analysis

We measured water quality for four sample water

1) Normal purified water
2) Lemonade water
3) Lime water
4) Polluted water

6.3 Examined Result

TABLE II. RESULT TABLE

Sample	**pH**	**Turbidity**	**Temp in C**	**Temp in F**
Normal Water	6.8	2.5	22	71.6
Lemonade Water	5.5	13.5	23	73.4
Lime Water	10.7	55	35	95
Polluted Water	5.9	91	24	75.2

6.3 WQI Calculation of Examined Result

Normal purified water WQI value can be measured as followed,

qpH= 100(6.8-7)/ (6.75-7) =80

qtur=100(2.9-0.25)/ (3.5-0.25) =81.5

qtemp= 100(22-35)/ (20-35) =86.6

qsalinity=100(800-450)/ (850-450)=87.5

qDO= 100(4.5-4)/(4.7-4)=71.4

TABLE III. WQI MEASUREMENT

Parameter	**Observed Values(v_i)**	**Unit weights (w_i)**	**Quality Rating (q_i)**	$w_i q_i$
pH	6.8	2	80	160
Turbidity	2.9	2.5	81.5	203.75
Temperature	22	1	86.6	86.6
Salinity	800	2	87.5	175
Dissolved Oxygen	4.5	1	71.4	71.4
		$\sum w_i \sum w_i = 8.5$		$\sum w_i q_i \sum w_i q_i = 96.75$

Water Quality Index (WQI) = $\sum w_i q_i \sum w_i q_i / \sum w_i \sum w_i$ = 696.75/8.5 = 81.97. Which is good water quality in WQI. We have calculated the other water samples using above method. We get the values, 60.55 for lemonade water, 35.65 for lime water and 22.46 for the polluted water sample.

VII. DISCUSSION

The optimum value for purifier water is near 7 always. As it is the same as the pH in human eyes and mucous membranes. Low pH value in water mixed with lemon is harmful for human health because it can cause skin irritation and eye burn if it goes into our eyes. As a result of this low pH value and other disinfectants won't be as effective as it was for higher value. On the other hand, pH value higher than 7.5 is basic water. The water mixed with calcium hydroxides is Extremely Basic which is not safe for human. We also get the value of turbidity parameter which showing us that the turbidity is also a big factor for human and aquatic organisms also. The value which is less than 5 NTU is safe to drink. We observed the water from the purifier is about 2-3 NTU always. So, we can say it's safe to drink. But the water which has greater value of turbidity 5 NTU is very unsafe and mixed with other components, The Temp. of water is also a big factor for human body and also agriculture and aquatic organisms. We can see the regular temperature is 17-30 degree Celsius.

VIII. CONCLUSION AND FUTURE SCOPE

Conclusion: Water quality monitoring has become necessary work in environmental protection. Automating monitoring and telemetry is a trend for improving the ability of water quality monitoring system. With the help of sensors, we can check the water quality by use of Wi-Fi module. Since the system is automatic therefore it is low in cost and does not require manpower so time and powers both are save. It has widespread application and extension value.

Future Scope : This platform is open and modular: further (bio) electrochemical sensors can be added in the future (such as novel types of pH sensors or specific sensors for trihalomethanes, a common toxic byproduct of disinfection by chlorine). The huge benefits of high-resolution sensors miniaturization and dissemination in the water distribution network are evident. The existence of Arsenic in water source can be measured by adding more features and by the combination of sensors.

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Hardware Required:
1. Raspberry Pi (any model)
2. Ultrasonic distance sensor (HC-SR04)
3. Breadboard and jumper wires
4. LEDs (optional)
5. Resistors (optional)
6. Wi-Fi dongle (if not using Raspberry Pi 3 or later models)

Software Required:
1. Raspbian OS installed on Raspberry Pi
2. Python 3

Source Code:

```python
import RPi.GPIO as GPIO
import time

# Set GPIO mode and pins
GPIO.setmode(GPIO.BCM)
TRIG_PIN = 23
ECHO_PIN = 24
LED_PIN = 18

# Set GPIO direction
GPIO.setup(TRIG_PIN, GPIO.OUT)
GPIO.setup(ECHO_PIN, GPIO.IN)
GPIO.setup(LED_PIN, GPIO.OUT)

def measure_distance():
# Send ultrasonic pulse
GPIO.output(TRIG_PIN, True)
time.sleep(0.00001)
GPIO.output(TRIG_PIN, False)

# Measure pulse duration
pulse_start = time.time()
while GPIO.input(ECHO_PIN) == 0:
pulse_start = time.time()
```

```
pulse_end = time.time()

# Calculate distance
pulse_duration = pulse_end - pulse_start
distance = pulse_duration * 17150
distance = round(distance, 2)

return distance

def send_notification():
# Add your code to send a notification (e.g., email
 or SMS) here
print("Low water level detected!")

try:
while True:
distance = measure_distance()
print("Distance:", distance, "cm")

# Check water level
if distance < 10:
GPIO.output(LED_PIN, True) # Turn on LED
send_notification()
else:
GPIO.output(LED_PIN, False) # Turn off LED

time.sleep(1)

except KeyboardInterrupt:
GPIO.cleanup()
```

Output:
- The code will continuously measure the distance using the ultrasonic sensor and print it on the console.
- If the distance (water level) is less than 10 cm, it will turn on an LED and
Please enter your question