NodeMCU and Blynk aided Advanced Water Quality Monitoring Set-up

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Abstract- The aim of this paper was to come-up with the advanced technique of Water Quality Monitoring. This intended approach helped to replace the former way of manual testing by updating the sensors information over an application's platform. Here, we measured the various chemical parameters of water like pH and total dissolved solids as well as physical parameters of water like turbidity and temperature to monitor the supplied water quality.

The former method included visiting the site, recording the various readings on routine basis, updating the data-sheet manually and then arriving at some conclusion on basis of data recorded by the technician. The data collected and examined through this way took a large amount of time and thus the changing technology demanded a new technique to overcome all such limitations and make this task a user-friendly one. Therefore, our proposed method worked to erase out all such lacunas with help of new emerging technology of machine-user relationship wherein the data updated over any setup could be communicated to a human being at his fingertips.

This technique helped an individual to keep track of minute variations that happened in parameters of supplied water with time. The latest parameter's data was hosted on Blynk application with help of ESP8266 an in-built Wifi-module in NodeMCU. The advanced setup including NodeMCU, Blynk and various meters proved to be the time and effort-saving method which could definitely take place of the traditional way of analyzing the water quality.

Index Terms- Blynk Android Application, Efficient Water Quality monitoring, NodeMcu, ESP8266, pH meter, Turbidity sensor, Temperature and TDS (Total Dissolved Solids) meter,

I. INTRODUCTION

Water is an extremely sacred resource for the existence of mankind on earth. It carries nutrients to all cells in our body & oxygen to our brain. About 71% of earth is covered with water, but only 2.5% of it is drinking water. With increase in pollution, population and climate change, it is expected that by 2025 we will experience eternal water shortages. But in the 21st century, research has proved the fact that people are reaching a point where water will be more expensive as compared to mineral oil. [3]
In today's world, billions of people are still living without safe water. India is facing a water crisis and millions of lives and livelihoods are under threat, this is the worst water crisis our country has ever been through. Currently, 500 million Indians are facing extreme water strain and about two lakh people die every year due to insufficient access to safe water. The crisis is only going to get worse. India ranks 120 amongst 122 countries in the quality of water. 14 crore households are still depleted from this resource. We are having extreme rainfall periods and then enormous dry and drought periods. Till 2021's summer, mostly 21 cities will be facing drought situations. This is a situation a number of larger cities of India will face.

The main purpose of this paper is to reduce wastage of the most valuable resource, termed as "WATER". This is one of the major aims of the **Government of India,** to provide safe drinking water to every household till the year **2024**. [10] The water must not be wasted as till now near about **14 crore households in India** have water shortage. To access clean and potable water to people. To raise our Country's ranking in Water Quality Indexing as well as Safe drinking water availability.

Monitoring water quality in the 21st century is a developing challenge because of the large number of chemicals used in everyday lives that can make their way into waters. Water quality is the measure of the suitability of water for a particular purpose based on specific physical, chemical and biological characteristics. [1] Monitoring provides the required objectives to make sound decisions on managing water quality today and in the future. Real-time water quality monitoring helps us to provide the alert about current, ongoing, and originating problems, taking care of our potable water as per the drinking water standards, and to protect other beneficial uses of water. [13] Assessments based on monitoring data help lawmakers and water managers to analyze water policies, determine if water quality is getting better or worse, and creating new policies to better protect human health and the environment.

Several research works have been conducted in recent times to develop intelligent and efficient systems to identify and monitor water parameters. For real time monitoring of water quality and delivery, setup based on sensors is proposed. The recommended setup focused on the low cost, lightweight implementation. This setup is appropriate for large amount categorizations enabling an approach to water purchaser, water distributors and water supremacists.

Checking the quality of water , can help us answer questions about whether the water is allowable for drinking or not. It also helps the scientists to determine whether the water in a particular system is improving or deteriorating and why. We can use the results of water quality analysis to compare the quality of water from one water body to another in a region, State, or across the whole country. Determining water quality requires the measurement of some specific characteristics which include parameters such as temperature, dissolved mineral contents, pH and turbidity. [7][8] These characteristics are often compared with standards set of values to determine if the water is suitable for a particular use.

In the modern world the problem of the efficient water supply is extremely important because the water resources are widely exploited and water is used in different fields of human activities. Water is an essential need for human survival and therefore there must be mechanism put in place to forcefully test the quality of water that made available for drinking in town and city. In this paper, we present a setup for Water Quality Monitoring System based on Internet Of Things that continuously measures the water parameter i.e. pH, turbidity, temperature and total dissolved solids.[2][5] Four sensors are connected to NodeMCU to measure the water parameters. Extracted data from the sensor is sent to the android application i.e. BLYNK and according to the pre-defined set of standard values, if there is a mismatch in water parameters system will generate an alert message to the remote user. The data updated on the application can be accessed or get back at your fingertips. [4][6]

II. Methodology

Requirement of frequent site visits, quality technicians for resolving issues related to collected water samples, were a great deal to be dealt with. Our new approach towards water quality monitoring reduced down these required traits to a greater expansion than by the former method.

Our technique provides the detail regarding water parameters straight at the user's fingertips.

The introduced set-up is able to extract the data from water samples by sensors through the NodeMCU and analyze them using the coding. The recommended block diagram of water quality monitoring in Fig 1. consists of 4 different sensors connected with NodeMCU to measure different physical parameters like turbidity & temperature as well as chemical parameters like pH & total dissolved solids. pH sensor is used to measure the amount of alkalinity and acidity in water samples. To measure the turbidity of water turbidity sensor module is used which provides accurate reading between 0-1000 NTU. A TDS meter is used to indicate the total dissolved solids of a sample,i.e. the concentration of dissolved solid particles.

Nine different water samples have been collected from nearby tap, filter, and other sources. The extracted data from these sensors are accessed by the controller NodeMCU and transfer them to the Blynk application.

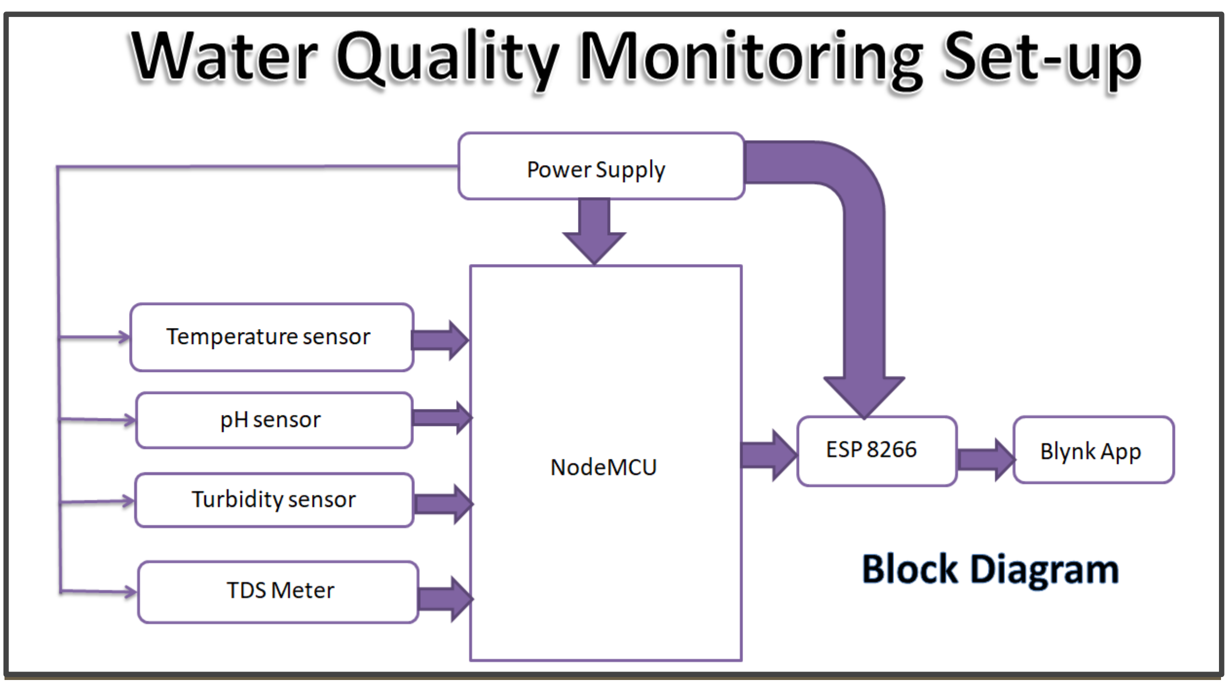

Fig1:Setup for water quality monitoring

1.pH:
The pH value is a good index of whether water is hard or soft. The pH of pure water is 7. In general, water with a pH lower than 7 is considered as an acidic solution, and with a pH greater than 7 is considered as an alkaline solution. The range for pH in surface water systems lies between 6.5-8.5, and the pH range for groundwater systems is between 6 and 8.5.The ideal pH level of drinking water should be 6 to 8.5, the human body maintains pH balanced on a constant basis and will not be affected by water consumption. For example, our stomachs have a naturally low pH level of 2 which is an advantageous acidity that helps us with food digestion**.**

2.Turbidity:
Turbidity is a measure of the degree to which the water loses its clarity due to the presence of suspended particulates. The more total suspended solids in the water, the dull it seems and the higher the turbidity. Turbidity is considered as one of the best parameter to measure water quality. The WHO (World Health Organization), found that the turbidity of drinking water should not be more than 5 NTU, and should ideally be below 1 NTU.

3.Temperature:

It is important to measure the temperature of water. By doing so, we can see the attributes of the water such as the chemical, biological and physical. Water temperature is an important factor in determining whether a body of water is acceptable for human consumption and use. Temperature is a critical water quality and environmental characteristic because it governs the kinds and regulates the maximum dissolved oxygen concentration of the water. At the same time it also influences the rate of chemical and biological reactions.

4.TDS(Total Dissolved Solids)

Water is a good solvent which dissolves every type of impurities in itself easily. Dissolved solids denote any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) consist of inorganic salts and some small amounts of organic matter that are dissolved in water. The total dissolved solids concentration is the sum of the cations which is positively charged and anions which is negatively charged ions in the water. Hence the total dissolved solids test provides a qualitative measure of the amount of dissolved ions.

5. NODEMCU

NodeMCU is an open source firmware that plays an important role in designing IoT product. NodeMCU is a device for which open source prototyping board designs are available. It comprise of firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware, which is based on the ESP-12 module. It is an Interactive, Programmable, Low cost, Simple, Smart, WI-FI enabled device.

A. Use of Simulation software-Blynk
Blynk made complex IoT technology simple. It can actuate hardware remotely, it can display sensor data, it can store data, visualize it and it could be explored more according to the application.

There are three major components in the platform:

- **Blynk App -** It enables the user to create amazing interfaces for their projects using various widgets provided by them.
- **Blynk Server -** It is responsible for handshaking between the smartphone and hardware. Users can use Blynk Cloud or run private Blynk server locally. It's open-source and could handle multiple devices and can even be launched on development boards like Raspberry Pi and Arduino.
- **Blynk Libraries –**It is used over the hardware platforms that enables communication with the server and process all the incoming and outgoing commands.
- **Create a Blynk Account**

After downloading the Blynk App, a user has to create a New Blynk account. This account is different from the accounts used for the Blynk Forums, he has already created. The recommendation provided by the Blynk forum is to use real email address for simplification.

a) **Create a New Project**

After a user successfully logged into their account, they can start by creating a new project.

b) Choosing Hardware

Select the hardware model which is required by the user.

c) Auth Token

Auth Token is a unique identifier which is needed to connect the hardware to a smartphone. Every new project created by the user will have its own Auth Token. The user receives the Auth Token automatically on their email after project creation. A user can also copy it manually. Click on the devices section and select the required device.

d) Add a Widget

In the very first step up project canvas is empty. User has to tap anywhere on the canvas to open the widget box. All the required widgets are located here. Pick a required button.

Drag-n-Drop - Locate the Widget by tapping and holding it from the menu.

Widget Settings - Newer widgets can be explored with their respective settings. Users have to tap on the widget to get to them.

The pin is the most important parameter to set in. The list of pins reflects physical pins defined by hardware.

e) Add an Eventor

Eventor widget allows users to create simple behavior rules or events. With Eventor users don't need to write the code. The only need is to send the value from the sensor to the server. Eventor comes handy when users need to change conditions on the fly without re-uploading new sketches on the hardware. Users can create as many events as they need. Eventor could be triggered from the applicant side. Users just need to assign the widget to the same pin as their Event within Eventor. Eventor doesn't constantly send events.

f) Run The Project

When users are done with the Settings they have to press the PLAY button. This will switch user from EDIT mode to PLAY mode where they can interact with the hardware. While in PLAY mode, users won't be able to drag or set up new widgets. So for this user has to press STOP and get back to EDIT mode. [11][12]

All these steps are illustrated in the following flow-chart:

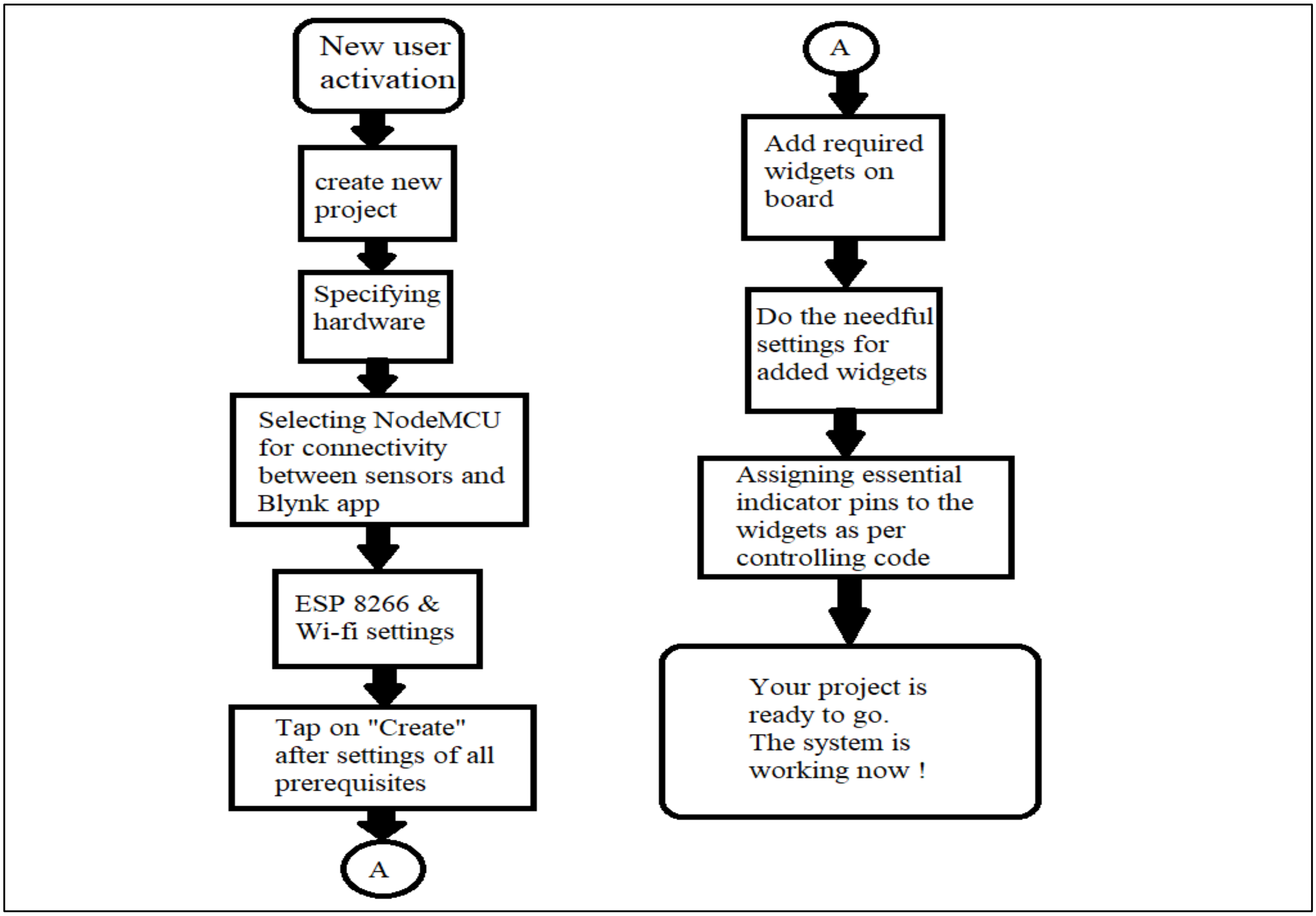

Fig 2: Flow diagram for Blynk Project creation

III. Results/Discussions/Findings:

Water samples from different water sources were tested to build a reference on the parameters for each type of sample. The chosen sample of water belongs to tap water, surface water, pool water, etc.

The nine water samples were tested all together at indoor ambient temperature. Readings were taken simultaneously. For security reasons the systems were not installed in the specific areas of interest, instead water samples were collected and tested in a safe controlled environment. As we tested nine different water Samples, according to that we got some results.

This very first figure (fig 4.), gives us the update about current pH count and Turbidity level.

The second figure (fig 5.) is of an alert message on user's android application wherein as soon as the water goes below 5.5, this message gets displayed.

This third figure (fig 6.) shows us the warning message regarding turbidity level. As per the permissible standards, whenever turbidity crosses 7 NTU it generates this pop-up on user’s application

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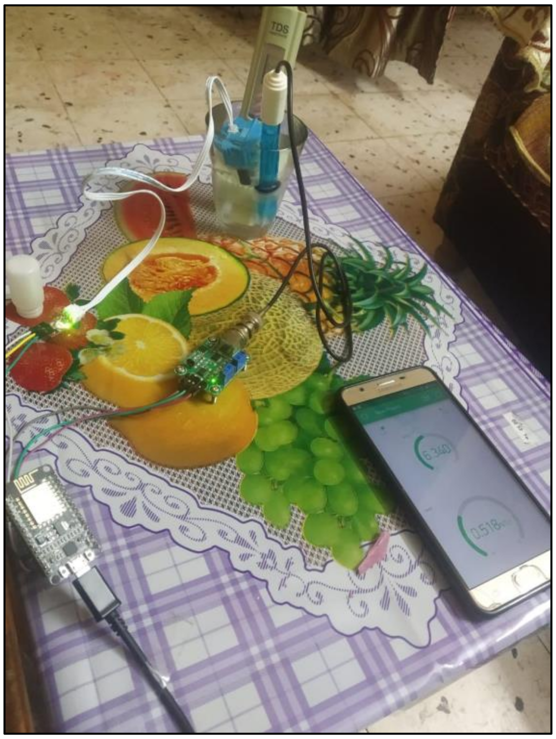

Figure 3: Original setup of our project

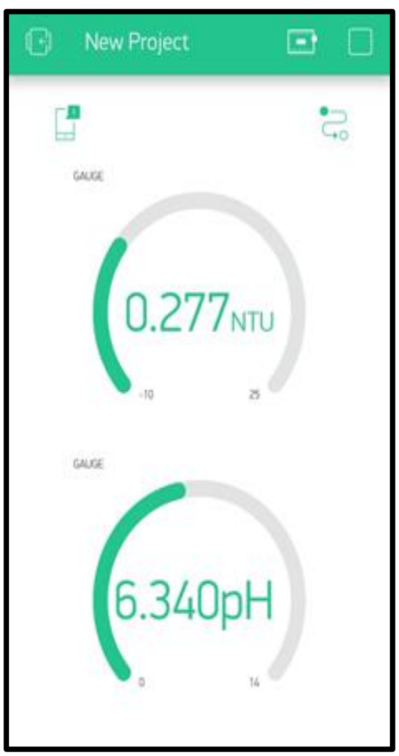

Figure 4: The update about current pH count and Turbidity level.

Figure 5: An alert message on user's android application wherein as soon as the water goes below 5.5, this message gets displayed.

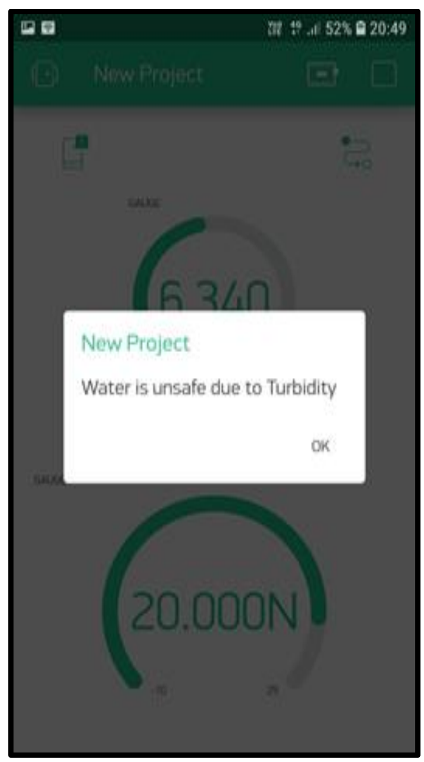

Figure 6: The warning message regarding turbidity level. As per the permissible standards, whenever turbidity crosses 7 NTU it generates this pop-up on user's application.

TABLE 2. SUMMARIZED RESULTS

Sr no	Water samples	pH	Turbidity (in NTU)	TDS(in ppm)	Water Temperature(in Celsius)
1	Drinking water	7.819(6.5-8.5)	0.459	141	22.8
2	Surface water	7.665(6.5-8.5)	0.751	489	22.0
3	Ganga jal	6.925	0.148	232	22.9
4	Rain Water	6.211	17.7	15	24.3
5	Boiled water	7.726	0.277	59	21.9
6	Washing water	4.398	0.749	234	22.9
7	Pool water	7.5	0.55	1700	24
8	Bathing Soap water	7.172	4	226	22.9
9	Hair Shampoo water	6.978	6	228	22.8

IV. CONCLUSION

The main purpose of this work is to observe the quality of water samples by designing an intelligent water quality monitoring setup implemented in IoT platform that can detect water's physical and chemical parameters. The interfacing is done between the system and the sensor network on a single chip solution wirelessly. For the monitoring process, the system is achieved with reliability and feasibility by verifying the four parameters of water. The time interval of monitoring might be changed depending upon the necessity of water resources .The time is reduced, and the cost is low in this environmental management.

The water samples were collected from nearby areas in Nagpur city, during the winters. A general study over these parameters was done once we compared our sensor values with the standard values defined by WHO for Indian outskirts. Further advancements could be done in areas of using the history of these hosted values to form a chart in order to apply data science algorithms to deal with the varying trends in near future as per the previous records. The various parametric measurements were being verified with the standard parametric values stated by WHO, as follows:

Table.1-Drinking Water parameter Standards by WHO [9]

Sr. No.	Parameters	Units	Desirable-Maximum limit
1.	pH	-	6.5 - 8.5
2.	Turbidity	NTU	5 - 10
3.	Total Dissolved Solids (TDS)	mg/L	500 - 2000

*

V. Acknowledgment

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