

# Development of Water Quality Monitoring System

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**Abstract**— Water is one of the vital needs for living beings. Humans need water in many daily activities like drinking, bathing, cooking, etc. If quality of water is not good then it becomes unfit for drinking and other purpose. The quality of water is determined by its physical properties and primary characteristics (primary parameters). Hence it becomes necessary to find the suitability of water for drinking, irrigation, and industry purpose. In this paper, the proposed work is based on the development of low cost water quality monitoring system using different sensors which are capable of measuring primary parameters of water such as pH, temperature, conductivity, oxidation reduction potential and dissolved oxygen. Based on these selected parameters a sensing unit is developed which consists of several Microsystems used for analog signal conditioning, data aggregation, sensor data analysis and a display unit to display the measured readings of each parameter.

**Keywords**— Raspberry pi3, Atlas scientific sensors, sensor decoders, BNC connectors, Display unit.

## I. Introduction:

Ground water, surface water seen in rivers, streams, etc., atmospheric water (like rainwater, snow and hail) and springs are the main source of water available to the people in general. The qualities of these water bodies are varying widely depending upon the location and environmental factors. In this era of 21<sup>st</sup> century, although there are a lot many inventions but at the same time due to increased globalization and industrialization the pollution is also increasing leading to decreased quality of water for drinking purpose. On the other hand maintaining pure supply of water is becoming more challenging day by day. In India mainly in big cities the municipality corporation use lots of chemical to purify the river water then supply that to the people. And we reserved that water is either safe for drinking or not. Therefore, there is a need for an efficient water quality monitoring system to be deployed in the water distribution network and at consumer sites.

## II. Recent problems faced:

1. Indora residents blamed contaminated water for Jaundice:-

At least 50 residents of Indora and adjoining areas in Nagpur Municipal Corporation's (NMC) Mangalwari zone are suffering from jaundice. Residents claimed to be getting contaminated water supply since last couple of days. "Many residents have contracted jaundice with some even being hospitalized" said Dr Vicky Tripude, a physician in Balkrishna Mohalla. Devendra Ramteke, a resident of Balkrishna Mohalla who is suffering from jaundice, fears he might have fallen ill due to contaminated water. The situation has deteriorated with two more family members Preeti and Nimisha contracted jaundice. Now, as a precautionary measure, the family is consuming water was NMC's tap only after boiling it.[3]

{Times of India(26 July'19)}

2. Contamination caused Diarrhoea in Bharat nagar:-

A large number of people in and around Zade Layout in Bharat Nagar have developed symptoms of acute diarrhoea due to suspected contamination of drinking water. "There is a diarrhoea outbreak due to negligence of NMC in prabhag number 14," said Sachin Kale, a resident of the area, who too is down with diarrhoea since the last two days. It is the second biggest case due to supply of contaminated water ever since the Nagpur Municipal Corporation (NMC) started alternate day water supply. It came to know that over 80 families complained of vomiting and loose motion and sought treatment. Kale said all four members of his family are down with the waterborne disease. The residents said they have been receiving muddy and stinking water for a week now. People suffering from severe dehydration have been approaching private hospitals in Nagpur since the last 2-3 days. Many residents, including Kale, have started buying packed water for drinking and cooking purposes.[4]

{Times of India(28 July'19)}

### III. Motivation and Objectives:

Water Pollution is a major global problem which requires ongoing valuation and modification of water resource guiding principle at the levels of international down to individual wells. It has been surveyed that water pollution is the leading cause of deaths and diseases worldwide. In many developing countries, dirty or contaminated water is being used for drinking without any proper former treatment. One of the reasons for this happening is the unawareness of public and administration and the lack of water quality monitoring system which creates serious health issues. Also natural phenomenon such as volcanoes, algae tints, rainstorms, and earthquakes also change the quality and ecological status of water.

### IV. Block Diagram of proposed system :

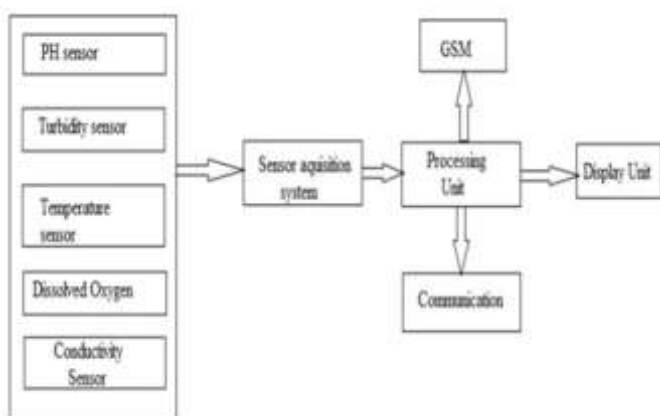


Fig.1:Block diagram

### V. Raspberry Pi 3 Specification:

RASPBerry PI 3 is a development board in PI series. It can be considered as a single board computer that works on LINUX operating system. The board not only has tons of features but also has terrific processing speed making it suitable for advanced applications. PI board is specifically designed for hobbyist and engineers who are interested in LINUX systems and IOT (Internet of Things). With 1.2GHz clock speed and 1 GB RAM RASPBerry PI can perform all advanced functions. Where wireless connectivity is needed. RASPBerry PI 3 has wireless LAN and Bluetooth facility by which you can setup WIFI HOTSPOT for internet connectivity. For Internet Of Things this feature is best suited. Raspberry Pi has dedicated port for connecting touch LCD display

which is a feature that completely omits the need of monitor. Raspberry Pi also has dedicated camera port so one can connect camera without any hassle to the PI board. RASPBerry PI also has PWM outputs for application use.

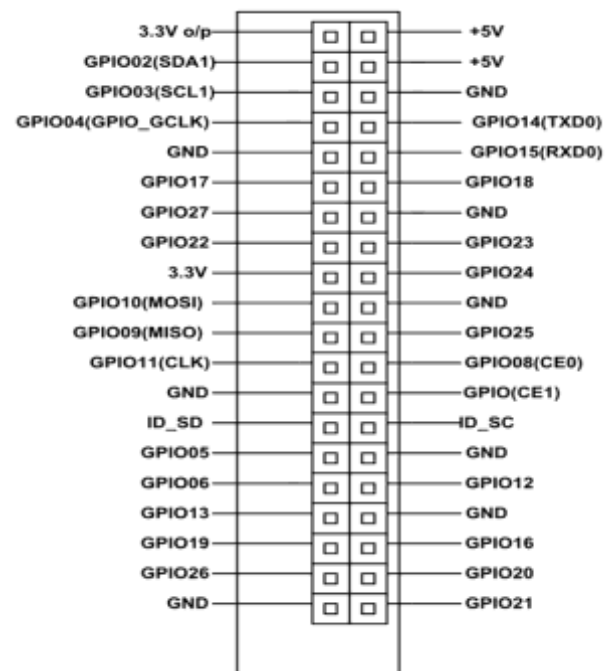


Fig.2: Pin Diagram of Raspberry pi3

### VI. Parameters to be Measured:

#### pH:

pH is really a measure of the relative amount of hydrogen and hydroxyl ions in the water. Water that has more free hydrogen ions is acidic, whereas water that has more hydroxyl ions is basic. Since, pH can be affected by chemical in water, pH is an important indicator of water that is changing chemical. However, very alkaline water can have an unpleasant smell or taste, and it can also damage pipes and water carrying appliances. Acidic water with pH of less than 6.5 is more likely to be contaminated with pollutants, making it unsafe to drink.[5]

#### Conductivity:

The conductivity of water refers to the ability of water to conduct an electrical current. The reason that the conductivity of water is very important is because it can tell you how much dissolved substance, chemicals, and minerals are present in the water. Higher amount of these impurities will lead to a higher conductivity. Even small amount of

dissolved salts and chemicals can heighten the conductivity of water. Pure water has very low conductivity, sea waters comes with very high conductivity. Different water types need to be measured for different reasons. Conductivity is generally measured in terms of uS/cm or mS/cm.[6]

#### Dissolved Oxygen:

Dissolved Oxygen is the amount of gaseous oxygen (O<sub>2</sub>) dissolved in the water. Oxygen enters the water by direct absorption from the atmosphere, by a rapid movement, or as a waste product of plant photosynthesis. The amount of Dissolved Oxygen, or DO, in water is expressed as a concentration. A concentration is the amount of in weight of a particular substance per a given volume of liquid. The DO concentration in a stream is the mass of the oxygen gas present, in milligrams per liter of water. Milligrams per liter, or mg/L, can also be expressed as parts per million, or ppm. Water temperature and the volume of moving water can affect dissolved oxygen levels. Oxygen dissolves easier in cooler water than warmer water.[7]

#### Temperature:

Temperature is a critical water quality and environmental parameter because it governs the kinds and types of aquatic life, regulates the maximum dissolved oxygen concentration of water, and influences the rate of chemical and biological reactions. It affects the dissolved oxygen level in water, photosynthesis of aquatic plants, metabolic rates of aquatic organisms and the sensitivity of these organisms to pollution, parasites, and disease. If stream temperature increase, decrease or fluctuate too widely, metabolic activities may speed up, slow down, malfunction, or stop altogether. There are many factors that can influence the stream temperature. It can fluctuate seasonally, daily, and even hourly, especially in smaller sized stream.[8]

#### ORP:

Oxidation Reduction Potential is a measure of the oxidising or reducing potential of a water body. Reduction potential is measured in volts or millivolts. The ORP level in a river or treatment plant will govern which reactions are prevalent. ORP measures an aqueous system capacity to release or accept electrons from chemical reactions. When system tends to accept electrons it is an oxidising

system. When it releases electrons is reducing system. ORP measurements are used to control disinfection with chlorine or chlorine dioxide in water bodies. Bacteria's life span in the water is very much determined by ORP level. In waste water bodies, ORP measurement is used frequently to control treatment processes that employ biological treatment solutions for removing contaminants. Most water has positive ORP readings, so it is oxidising. Generally, tap water has ORP from +200 to +600mV. Bottled water tends to have high ORP levels of more than +400mV.[9]

#### VII. Working of the system:

The process includes water distribution system as shown in above fig., to monitor the quality of water to be supplied to the public/consumer. The Atlas Scientific sensors present in the system analyze various water quality parameters such as pH, temperature, conductivity, ORP and dissolved oxygen. Each sensor consist of a probe and its corresponding decoder. These sensors were calibrated using its standard buffer solutions, provided in Atlas Scientific's kit. Each probe senses the water and gives analog data decoders were used to convert analog data to ASCII values which are further converted into its corresponding decimal values using a code. This data is aggregated by using a processing unit (Raspberry pi3) and the quality of the water is detected by the values which are displayed on the display unit. The resulted values are compared with the standard parameters given below in the table.

Table.1: Standard Parameters

Sr. No.	Parameters	WHO
1.	pH	6.5-8.5
2.	ORP	200-400mV
3.	Conductivity(S/m)	600
4.	Dissolved Oxygen	5mg/lt

#### VIII. Advantages of proposed system:

- 1.Real time system.
- 2.Portable and secure.
- 3.Consumes less power and energy.

4.Low cost.

5.Light weight.

**IX. Applications of proposed system:**

- 1.Drinking water analysis in rural and urban areas.
- 2.To determine the quality of water in rivers and lakes for healthy aquatic life.
3. For agricultural and industrial purpose.

**X. Result:**

1.Electronics Ground floor:-



**Fig. 3: Readings of EN Ground Floor**

2.Electronics First floor:-



**Fig. 4: Readings of EN First Floor**

3. Table of Practical values:-

**Table.2: Experimental values of Primary Parameters from various departments of college**

SAMPLES	PARAMETERS				
	TEMPERATURE (Degree Celsius)	pH	ORP (mV)	DO (mg/l)	CONDUCTIVITY (uS/m)
EN ground floor	28.47	8.69	214.3	8.6	184
EN first floor	29.09	8.7	208.3	8.5	189
EN second floor	27.87	8.64	204.8	8.9	170
EN third floor	28.19	8.71	170.7	8.2	186
EE ground floor	28.41	8.4	231.7	7.7	221
EE first floor	28.45	8.51	240.4	7.4	194
INDUSTRIAL second floor	28.03	8.66	227.8	7.7	193
MECHANICAL third floor	28.18	8.65	243.5	8	195

**XI. Conclusion:**

In our project we have tested total 8 samples of water and thus, efficiently monitored all primary water quality parameters. This method offers low power consumption with high reliability as sensors work on low operating voltages and the current drawn is in the range of micro Amperes. The system displays different water quality parameters such as Temperature, Dissolved Oxygen, pH, Oxidation-Reduction potential and Conductivity. This information can be checked by the experts for further treatment.

Another important fact of this system is the easy installation. Water quality monitoring system is easy to use, reliable, portable, secure, real time system, consumes less power and energy. This system is a light weight and of low cost and uses an efficient, fast and precise notification on our display system or can be displayed in monitor too. Hence it can be concluded that our system can solve many important water quality problems.

**XII. Future Scope:**

1. In order to monitor quality of water in various sites, future work of integrating more number of sensors that includes DO and Conductivity sensor. The system is capable for monitoring water quality of different large water bodies.
2. The wireless data acquisition from remote water bodies and the acquired database can be used for further research studies like soil content analysis.



3. Acquired information can be used to decide the quality of water using data of different parameters.
4. The system can be used to determine the quality of water in rivers and lakes for healthy aquatic life.
5. The proposed system can be used for water analysis in rural and urban areas. Also for agricultural and industrial purpose.

### XIII. References:

- [1].International iResearch iJournal iof iEngineering iand iTechnology i(IRJET) i[Accessed ion: i2020/02/23] i i i <http://www.irjet.net>
- [2].Panguluri iS, iMeiners iG, iHall ij i& iSzabo ijG, i“Distribution iSystem iWater iQuality i i i i iMonitoring: iSensor iTechnology iEvaluation iMethodology iand iResults”, iU.S. iEnvironmental iProtection iAgency, iEPA/600/R-09/076, i(2009).
- [3].Times iof iIndia i- iIndora iresidents iBlamed iContaminated iWater ifor iJaundice. i[Accessed ion i2019/08/09] [https://m-timesofindia-com.cdn.ampproject.org/v/s/m.timesofindia.com/city/nagpur/indora-residents-blame-contaminated-water-for-jaundice-outbreak/amp\\_articleshow/70385120.cms?amp\\_js\\_v=a3&amp\\_gsa=1&usqp=mq331AQFKAGwASA%3D#aoh=15912667173461&referrer=https%3A%2F%2Fwww.google.com&amp\\_tf=From%20%251%24s](https://m-timesofindia-com.cdn.ampproject.org/v/s/m.timesofindia.com/city/nagpur/indora-residents-blame-contaminated-water-for-jaundice-outbreak/amp_articleshow/70385120.cms?amp_js_v=a3&amp_gsa=1&usqp=mq331AQFKAGwASA%3D#aoh=15912667173461&referrer=https%3A%2F%2Fwww.google.com&amp_tf=From%20%251%24s)
- [4].Times iof iIndia i- iContamination iCaused iDiarrhoea iin iBharat inagar. i[Accessed ion i2019/08/09] [https://m-timesofindia-com.cdn.ampproject.org/v/s/m.timesofindia.com/city/nagpur/water-contamination-triggers-health-scare-in-bharat-nagar/amp\\_articleshow/70411929.cms?amp\\_js\\_v=a3&am p\\_gsa=1&usqp=mq331AQFKAGwASA%3D#aoh=15912668638667&referrer=https%3A%2F%2Fwww.google.com&amp\\_tf=From%20%251%24s](https://m-timesofindia-com.cdn.ampproject.org/v/s/m.timesofindia.com/city/nagpur/water-contamination-triggers-health-scare-in-bharat-nagar/amp_articleshow/70411929.cms?amp_js_v=a3&am p_gsa=1&usqp=mq331AQFKAGwASA%3D#aoh=15912668638667&referrer=https%3A%2F%2Fwww.google.com&amp_tf=From%20%251%24s)
- [5].pH isensor i[Accessed ion i2019/10/10] [https://www.atlas-scientific.com/files/pH\\_EZO\\_Datasheet.pdf](https://www.atlas-scientific.com/files/pH_EZO_Datasheet.pdf)
- [6].Conductivity isensor i[Accessed ion i2019/10/10] [https://www.atlas-scientific.com/files/EC\\_EZO\\_Datasheet.pdf](https://www.atlas-scientific.com/files/EC_EZO_Datasheet.pdf)
- [7].Dissolved iOxygen isensor i[Accessed ion i2019/10/10] [https://www.atlas-scientific.com/files/DO\\_EZO\\_Datasheet.pdf](https://www.atlas-scientific.com/files/DO_EZO_Datasheet.pdf)
- [8].Temperature isensor i[Accessed ion i2019/10/10] [https://www.atlas-scientific.com/files/EZO\\_RTD\\_Datasheet.pdf](https://www.atlas-scientific.com/files/EZO_RTD_Datasheet.pdf)
- [9].ORP isensor i[Accessed ion i2019/10/10] [https://www.atlas-scientific.com/files/ORP\\_EZO\\_Datasheet.pdf](https://www.atlas-scientific.com/files/ORP_EZO_Datasheet.pdf)