Portable Drinking water Quality Measurement System for Implementation of Smart Villages

Polaiah Bojja, Pamula Raja Kumari, Peraka Mony Preetham, P. Raga Sai Nikhila, P. Akhila, P. Rupanjani

Abstract: ***The Indian science and technology recognized that the need for brewing technical solution to the lack of water shortage in the smart villages. The challenges relating to water scarcity can be dicover to several causes , such reasons are ,(a)Decreasing a part form availability of fresh water ,(b)Loss of quality of available fresh water on account of contamination and poor management practice ,(c) excessive and insufficient use of water in village human activities ,(d)In ability to use available water on description of natural contamination by few chemicals and their reactions etc.***

The main aim of the project work is to design an instrument called portable drinking water quality measurement and monitoring system. This instrument can be carried to any drinking water distribution system in a village and asses the quality of drinking water. To avoid impurity water with alarm indications are provided for the violating parameters.

Therefore, the prototype system has been implemented and bring up the standard of people living in the community are particularity , in the Guntur district of Andhra Pradesh ,India.

Index Terms: Safe Drinking Water, Quality Parameters, Sensor Electronics, Internet of Things, Cloud, Smart Village.

I. INTRODUCTION

The Water Technology Initiative launched by the government of India aims at accelerating R&D activities for providing safe drinking water at low cost and in adequate quantity at rural areas using appropriate Science and Technology for various water challenges in different parts of the country. Quality is the main consideration of drinking water for community health and welfare. In the of directives of Honorable Supreme Court, Technology Mission on Winning, Augmentation and Renovation (WAR) for Water has been launched in August 2009 to undertake research-led solutions, through an approach, to come out with better idea and options relaterd to technology. The solution to the problem of high quality drinking water scarcity is being attempted on a war footing nowadays.

Nearly 70% of city water supply predominantly uses surface and ground water drinking water requirements in rural India are met by ground water, where as the quality of ground water, doesn't matches the level of drinking water requirements. Often ground water is either brackish or saline or contaminated with excess fluoride, arsenic, iron etc or microorganisms. At few locations, contamination is due to multiple species. Most of ground water contamination of geological in it is quite likely that locations in adjacent areas are affected by similar contamination. Water challenge in such areas may be similar in character. In order to augment the available /accessible water, it is necessary that suitable drinking water quality measurement systems are to be developed to asses weather the community is consuming safe drinking water or not. It is predicted that climate change may lead to 20% of drinking water scarcity and balance 80% scarcity may arise due to growth of population increase.

It is proposed to develop a Portable Drinking Water Quality Measurement System at affordable cost is developed in order to ensure better health conditions in a community system. About 14 parameters that are immediately affecting the quality of safe drinking water are bring measured with the help of suitable sensors and methods, these parameters are (i) pH (ii)Turbidity (iii) Residual Chlorine (iv) Salinity (v) Odour (vi) Taste (vii) Colour (viii) Fluoride (ix) Nitrate (x) Lead (xi) Chromium (xii) Arsenic (xiii) Pesticides (xiv) Ion Specific Measurements (ISE) with appropriate sensors/ transmitters/ measurement methods.An electronic Data Acquisition System is planned with Internet of Things (Io T) and Cloud for communicating the information and violations to authorities concerned. In order to test and verify the concept of proof, a pilot system is planned to be developed at KL University. Water samples from the Krishna district of Andhra Pradesh where people are getting highly affected by the usage of unsafe drinking water is chosen for system study and field trials developed experimental of the unit. Moreover, the system can be taken to any drinking water distribution network in villages and the safety of drinking water in that area can be analyzed.

Thus, the project forms part of the Smart Village concept being implemented by the government. The final unit will be developed with necessary casing and tested to the satisfaction of authorities. Necessary manuals will be

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prepared for the technical procedures of measurement, monitoring, communication and limitations. The technology will be transformed to any of the industries for societal use.

II. RESEARCH SIGNIFICANCE

The main objective of the proposal is to develop a Portable Drinking Water Quality Measurement

System which can monitor the quality of drinking water in a community water distribution network for ensuring good human health. The Guntur district in Andhra Pradesh is considered for trial of the Pilot system where people are affected by various diseases due to poor quality of drinking water. Following are the objectives to be met while developing the system.

1) Design and development of a prototype system with necessary sensor electronics, data communication and acquisition system
2) Testing and Evaluation of different physical and chemical parameters at prevailing drinking water distribution system for the local communities at Krishna district, Andhra Pradesh, India.
3) Develop a full-fledged monitoring system and display the drinking water parameters with approved specifications for human and animal consumption.

III. TYPES OF PARAMETERS

A. Taste

Measured by Electronic Tongue , manufactured by CDAC, Kolkota. It gives 4-20mA signal. Cost Rs. 2 lakhs. Just like measuring the taste of tea.

B. Colour

Take a test tube of Drinking water. Add 2 or 3 drops of Orthotoludine chemical solution into it. Water colour becomes yellow proportional to Residual chlorine present in it. Use Arduino TCS230 Colour sensor board to measure colour. Output 4-20 mA. Recommended level: 0-1.5 ppm. Manufacturer CDAC, Trivandrum. Cost Rs.50,000/-. We can measure Residual chlorine as well as colour of Drinking water.

C. Odour

Measured by Electronic Nose, manufactured by CDAC, Kolkota. It gives 4-20mA signal. Cost Rs. 2.5 lakhs. Just like measuring the smell of tea.

D. Flouride

Flouride meters are supplied by Amazon India. Cost Rs.290/-. Recommended level by WHO is max. 2 mg/l. Method-.Reverse Osmosis. Manufacturer Pro Minent Fluid Control Ltd.

E. Nitrate

Nitrate(NO_3) meters are available which an measure Nitrate in ppm. These meters have Ion Selective Membranes.Distillation also can be used. As per WHO standard, we should maintain below 10 mg/l of Nitrate in drinking water. Cost of the meter is approx. Rs. 2000/.

F. Lead

Lead in drinking water is measured by instrument manufactured by M/s. Drill Well LLC using Reverse Osmosis principle. Lead > 15 ppm is harmful to health. The Environmental Protection Agency (EPA) standard is 15 mico gram/litre as reported by their lab. Now, lead testing kits are available which are very cheap less than Rs.5000/-.

G. Chromium

Low cost Chromotography is used to detect Chromium in drinking water. Allowable standard is 0.1 mg/l. Conductivity detection principle can also be used.

H. Arsenics

WHO Standard is 0.02 to 4 ng/m3 .Use IARC monographs or field kits that are portable and low cost.

Pesticides

Domestic measurement of pesticides in drinking water using On-line Solid Phase Extraction method. Chemometry using diode array detector can also be used. Allowable limit is 0.010 micro gram per litre as per EPA analysis

IV. BLOCK DIAGRAM OF RESEARCH WORK

This Fig. 1 shows how the sensors are connected to the micro controller of the system

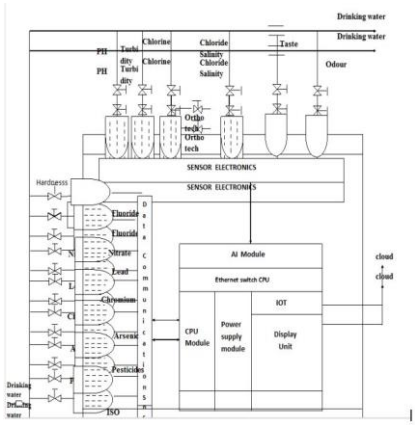

Fig. 1: Sensors are connected to the micro controller of the system.

V. RESULTS AND DISSCUSSION

This Fig. 2 shows how the inputs are connected to the each individual module

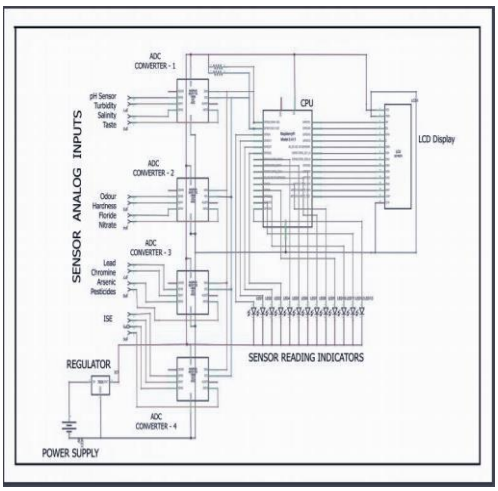

Fig. 2: Inputs are connected to the each individual module

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This Fig. 3 represents the 2-D view of our system.

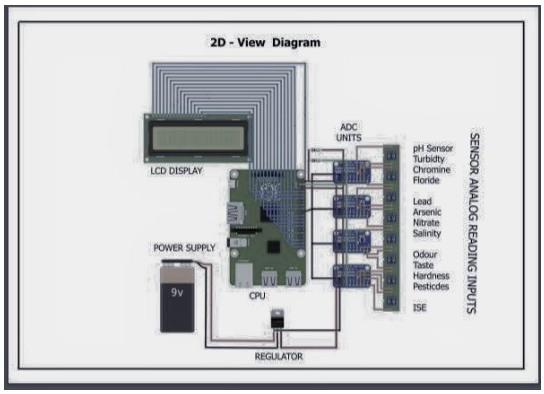

Fig. 3: 2-D view of our system

This Fig. 4 shows prototype of system & how sensors immersed in water tank and displays result.

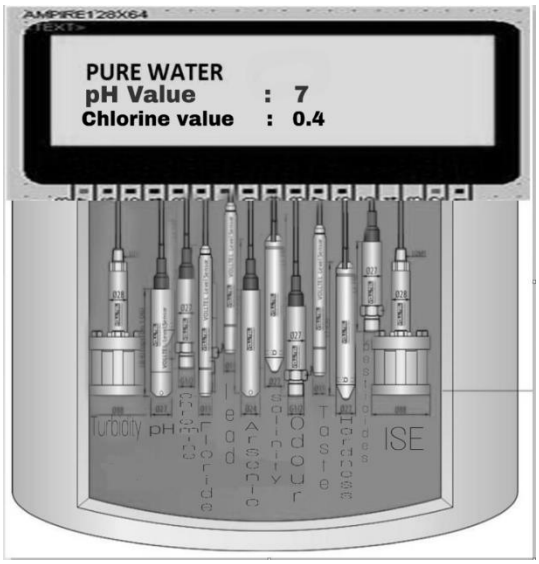

Fig. 4: Prototype of system & how sensors immersed in water tank and displays result

The objective of the proposal is to monitor the quality of drinking water in community distribution system and to ensure human health as per standards. The following 15 parameters are monitored in drinking water and displayed for verification:

1. pH
2. Turbidity
3. Residual chlorine
4. Salinity
5. Flow
6. Pressure
7. Odour
8. Taste
9. Colour
10. Fluoride
11. Nitrate
12. Lead
13. Chromium
14. Arsenic
15. Pesticides

The system measures two categories of parameters in drinking water to ensure its safety before distribution and consumption by people.

1. Physic o chemical analysis
2. Aesthetic parameter
3. Chemical contamination parameters

A. Physic o chemical analysis

It contains the measurement of the following parameters

1. pH
2. Turbidity
3. Residual chlorine
4. Salinity
5. Flow
6. Pressure

Sensors are deployed to measure each of these parameters in the distribution lines or on the consumption end. The signal received from these sensors processed by the sensor electronics system and converted to stand signals compatible to the analog input (AI) modules. Two 8 – channel modules channel to channel galvanic isolation are used.

B. Aesthetic parameters

The Aesthetic parameters inside drinking water parameters such as

1. Odour
2. Taste
3. Colour

Suitable sensor are deployed to measure 3 thee parameters and brought to the sensor electronics system. So that they can be converted to standard input signals compatible to the AI modules.

C. Chemical contamination parameters

We have to measure the following chemical contamination parameter in drinking water in order to ensure proper human health:

1. Fluoride
2. Nitrate
3. Lead
4. Chromium
5. Arsenic
6. Pesticides

Once the analysis of these parameter are carried out with suitable measurement systems, the data communication module convey these information to the central processing unit (CPU) communication port.

D. Monitoring and Display

A high speed Ethernet I provided to communicate all three types of information mentioned above to the display unit. Internet of Things (IOT) is provided for all sensors to communicate the information on drinking water to the cloud. Power supply module is provided to derive power to the total unit. All the 15 parameters of drinking water are brought to the above unit for monitoring before delivery to the consumers, get value are provided for each measurement to isolate it or connect it to measurement system.

A pH value 7 to 8 ensures the water is neither acidic nor base and it is suitable for drinking, the turbidity sensor monitors the foreign materials present in drinking water and as per World Health organization (WHO) standard, it should be less than 1 Nephelometric Turbidity Unit (NTu) the residual chlorine sensor monitors the chlorine present in water to kind the disease germs and it should be the order of 1 to 2ppm. Residual chlorine in water is measured by adding one or two drops of orthotoluoline solution in to a test table which contains the drinking water , the colour of water becomes yellow and the intensity Of yellowness is a measure of residual chlorine in it.

Due to climate change, sea water is penetrating into land portion through rivers. Once such an intrusion takes place, water temperature will be high and the temperature gradient is a measure of salinity of water. Normally, this salinity content should be able to measure the flow and pressure of drinking water as well any point in the distribution system. This is done by a non-intrusive type of flow measurement in the pipe line and static pressure is measured with a transmit any of the openings in the pipe line. Flow indicates weather adequate amount of water is going in for a particed are locality based on population and pressure indicates whether all the hilly areas as well as low-lying area get enough drinking water. Odour sensor, colour sensor and test sensor monitor the aesthetic parameters of drinking water and deliver the signals.

Apart from the above, six more sensors monitor the parameters pertaining to the chemical contamination of drinking water. The goal of fluoridation is to prevent tooth decay by adjusting the concentration of fluoride in public water supplies a tooth decay (Dental caries) is one of the most prevalent chronic diseases worldwide. In most industrialized countries, 60-90% of school children and the vast majority of adults are affected by tooth decay, we have to ensure a fluoride.

CONCLUSION

Water sanitation hygiene and quality of drinking water are very essential in order to ensure human health and safety. Hence, this is the main reason why guide lines for drinking water quality standards, regulations and risk management systems approaches are specified and implemented under the above objectives.

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