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Contamination Detection In Drinking Water

[#1]Prof. P. R. Badadapure, [#2]Devkate Pravin, [#3]Pawar Sandip, [#4]Pawane Ashwini

[2]devkatepravin7@gmail.com
[3]sandippawar7794@gmail.com

[#1]Prof. Department of Electronics and Telecommunication
[#234]Department of Electronics and Telecommunication

JSPM Imperial College Of Engineering & Research, Pune.

ABSTRACT

A low cost and holistic approach to the water quality monitoring problem for drinking water distribution systems as well as for consumer sites. Our approach is based on the development of low cost sensor nodes for real time and in pipe monitoring and assessment of water quality on the fly. The main sensor node consists of several in-pipe electrochemical and optical sensors and emphasis is given on low cost, light- weight implementation, and reliable long time operation. Such implementation is suitable for large scale deployments enabling a sensor network approach for providing spatiotemporally rich data to water consumers, water companies, and authorities. Extensive literature and market research are performed to identify low cost sensors that can reliably monitor several parameters, which can be used to infer the water quality. Based on selected parameters, a sensor array is developed along with several microsystems for analog signal conditioning, processing, logging, and remote presentation of data. Finally, algorithms for fusing online multisensor measurements at local level are developed to assess the water contamination risk. Experiments are performed to evaluate and validate these algorithms on intentional contamination events of various concentrations of escherichia coli bacteria and heavy metals (arsenic). Experimental results indicate that this inexpensive system is capable of detecting these high impact contaminants at fairly low concentrations. The results demonstrate that this system satisfies the online, in-pipe, low deployment-operation cost, and good detection accuracy criteria of an ideal early warning system.

Keywords : **PIC18F4550, Sensors, LCD, Power Supply.**

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I. INTRODUCTION

Clean drinking water is a critical resource, important for the health and well-being of all humans. Drinking water utilities are facing new challenges in their real-time operation because of limited water resources, intensive budget requirements, growing population, ageing infrastructure, increasingly stringent regulations and increased attention towards safe guarding water supplies from accidental or deliberate contamination. There is a need for better on-line water monitoring systems given that existing laboratory-based methods are too slow to develop operational response and do not provide a level of public health protection in real time. Rapid detection (and response) to instances of contamination is critical due to the potentially severe consequences to human health.Traditional methods of water quality control involve the manual collection of water samples at various locations and at different times, followed by laboratory analytical techniques in order to characterize the water quality. Such approaches are no longer considered efficient [1]–[5]. Although, the current methodology allows a thorough analysis including chemical and biological agents, it has several drawbacks: a) the lack of real-time water quality information to enable critical decisions for public health protection (long time gaps between sampling and detection of contamination) b) poor spatiotemporal coverage (small number locations are sampled) c) it is labor intensive and has relatively high costs (labor, operation and equipment). Therefore, there is a clear need for continuous on-line water quality monitoring with efficient spatiotemporal resolution. US Environmental

Protection Agency (USEPA) has carried out an extensive experimental evaluation of water quality sensors to assess their performance on several contaminations.

The main conclusion was that many of the chemical and biological contaminants used have an effect on many water parameters monitored including Turbidity (TU), Temperature and PH. Thus, it is feasible to monitor and infer the water quality by detecting changes in such parameters. Given the absence of reliable, in-line, continuous and inexpensive sensors for monitoring all possible biological and chemical contaminants, our approach is to measure physicochemical water parameters that can be reliably monitored with low cost sensors and develop low cost networked embedded systems (sensor nodes) as well as contamination detection algorithms to fuse these multi-sensor data in order to infer possible contamination events. Even though this approach may suffer from some false alarms, it can be compensated /eliminated by the large scale deployment and the possibility of correlating the decisions from various sensor nodes which is the topic of our future work. There is a clear need for a shift in the current monitoring paradigm and this paper proposes the idea of monitoring the quality of water delivered to consumers, using low cost, low power and tiny in-pipe sensors.

There is a need for better on-line water monitoring systems. Rapid detection (and response) to instances of contamination is critical due to the potentially severe consequences to human health. Traditional methods of water quality control involve the manual collection of water samples at various locations and at different times, followed by laboratory analytical techniques in order to characterize the water quality. Such approaches are no longer considered efficient.Although, the current methodology allows a thorough analysis including chemical and biological agents.

II. LITERATURE SURVEY

Water is essential for the survival of humans, animals and plants. Water is also home to a very wide range of micro flora and micro fauna, creating a fascinating environment of extreme biological importance, but which attracts too little attention. Fresh water is emerging as one of the most critical natural resource issues facing humanity. Water is, literally, the source of life on earth. The human body is 70% water. Human beings can survive for only a few days without fresh water. It is estimated that 31 countries, accounting for fewer than 8 % of the world population, face chronic fresh water shortages. By the year 2025, however, 48 countries are expected to face shortages, affecting more than 2.8 billion people -35% of world's projected population. Among countries likely to run short of water in the next 25 years are Ethiopia, India, Kenya, Nigeria, and Peru. Parts of other large countries, such as China, already face chronic water problems (WHO, 1997). In most parts of the world polluted water, improper waste disposal, and poor water management cause serious public health problems. Such water-related diseases as cholera, typhoid, and schistosomiasis harm or kill millions of people every year. Overuse and pollution of water supplies also are taking a heavy toll on the natural environment and pose increasing risks for many species of life. The quality as well as the quantity of water is deteriorating globally as a result of rapid urbanization, population growth and industrialization. Most countries however currently are aware of the necessity of fresh water as a requirement for survival. Fresh water needs to occupy highest priority, on the international agenda.

Moreover, the supply of the freshwater that is available to humanity is shrinking, in effect, because many fresh water resources have become increasingly polluted or dried. In some countries lakes and rivers have become receptacles for a vile assortment of wastes, including untreated or partially treated municipal sewage, toxic industrial effluents, and harmful chemicals that leached into surface and ground waters from agricultural activities. Caught between finite and increasingly polluted water supplies on one hand and rapidly rising demand from population growth and development on the other, many developing countries face uneasy choices (Crossette, 1995). The lack of freshwater is likely to be one of the major factors limiting economic development in the decades to come, warns the World &k (Serageldin, 1995a). Scarce and unclean water supplies are critical public health problems in much of the World. Polluted water, water shortages, and insanitary living conditions kill over 12 million people a year (Davidson etal, 1992). Pollution is pervasive. Few countries, whether developing or industrialized, have adequately safeguarded water quality and controlled water pollution.

Many countries do not have proper legislation to control water pollution adequately, while others cannot enforce water quality standards. International development agencies are often urging the developing countries devote more attention to protecting and improving water quality. The developed world also must spend more and do more to clean up degraded waterways, or economic development will stall and the quality of life will fall (Falkenmark and lindh, 1993).

III. PROPOSED SYSTEM

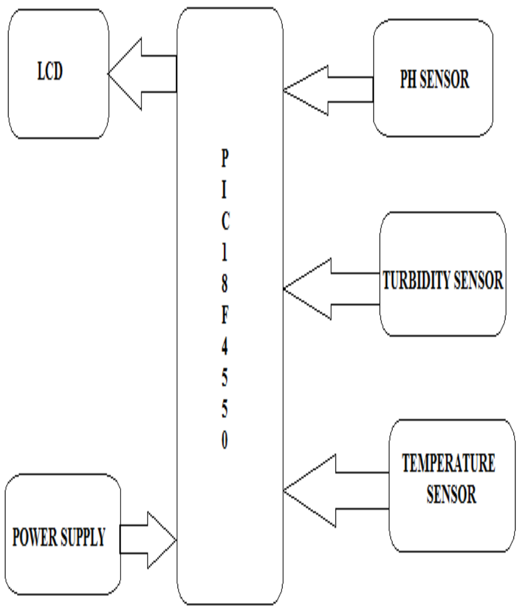

Fig 1. Block diagram

PIC18F4550 is used in which the pH sensor shows the acidic value on LCD and also we have used the temperature sensor to determine the temperature of water , the turbidity sensor determines the presence of amount of turbidity present in water which is also displayed on LCD. In input we have provided power supply of 5v which works only on 5v.

The pH sensor shows the acidic and basic value determining the water. It ranges from 6.5 to 8.5. It is analog by PIC18F4550 and digital by LCD output. Also we have the temperature measuring sensor which gives the data of water temperature to the PIC18F4550 and displayed out on LCD screen , the turbidity sensor determines whether water is clean or turbid which ranges from 0 to 5 also measures the level of turbidity with help of PIC18F45550 and display over LCD as well. The whole combinations are powered by 5v power supply by which it can run smoothly.

Temperature Sensor:-

For Temperature measurement we can use thermister, thermocouple or LM35 .In this design LM35 is use as a temperature sensor. Here we use LM35 temperature sensor for sensing Temperature in water. Here in this sensor we have three pins one for the voltage (Vin), ground (GND), other for Output.

Temperature Measurement:

For Temperature measurement we can use thermistor, thermocouple or LM35 .In this design LM35 is use as a temperature sensor. .

Turbidity:

According to the Environmental Protection Agency (EPA), turbidity is “The cloudy appearance of water caused by the presence of suspended and colloidal matter”. Turbidity measurement is used to detect the clarity of water. Turbidity is nothing but an optical property of the water which is based on the amount of light reflected by particles which are suspended in the water. In our project we are using turbidity sensor to measure the turbidity which shown below. The sensor contains two parts one is transmitter and second one is receiver .both are arranged as shown in the below fig.2. the transmitter always transmit the light and the light should be reflected by the water the reflected light is received by the receiver so when the water turbidity increases the light intensity received by the receiver also increases in this condition we will get maximum output from the receiver Hence the output of the turbidity sensor is proposal to the water turbidity.

Turbidity Measurement:

Number of instruments are available in the market which will measure the turbidity ,but most of them are costly and not feasible for in pipe application and for WSN. The aim here is to develop cheaper and easy to Use sensor for turbidity measurement which can be mounted in the water distribution pipe .The measurement principle used here is based on the fact that when there are suspended particles in the water and if we shine the light source through it then not all light will pass straight through the water ,some light will get reflected from the suspended particles.

Here the infrared light is transmitting form light emitting diode (LED), when this light hits the particles the light will reflect back and receives by the photo-diode sensor. This sensor sends these values to the microcontroller for further process.

PH Sensor:

PH is a measure of the basicity or acidity or of an aqueous solution. Solutions which have a pH value less than 7 are said as acidic and solutions which have a pH greater than 7 are basic or alkaline. Here by this sensor we can determine whether the water solution is base or acid To be more exact, pH is the measurement of the hydrogen ion concentration, [H+]. Every water solution can be measured to determine its pH value. This value ranges from 0 to 14 pH.

pH measurement:

For pH measurement pH probe is used. Different types of pH probes are available in the market. In this design combined Electrode type pH probe is used. PH MEASUREMENT The PH sensor is made with glass which contains Probe. The probe is a main part in this sensor. While we are measuring the PH value we need to dip this probe completely into water.

IV. ADVANTAGES AND APPLICATION

Advantages:

1) Low cost sensor nodes for real time and in pipe monitoring.
2) This inexpensive system is capable of detecting these high impact contaminants at fairly low concentration.
3) Low deployment operation cost and good detection accuracy.

Application

1) This unit can be used at municipal sectors. Where water is distributed with help of tankers etc.
2) Through this unit it will help to detect the turbidity, pH values, and other substances from which people’s health can be save from polluted water.
3) And also measure the quality of water continuously monitor by the use of turbidity sensor, PH sensor and Temperature sensor.
4) In small scale drinking water manufacturing enterprises or companies to check the quality of water.

V. CONCLUSION

Up till now we have completed 30% work of our project. In which designed PCB layout of this project. We design power supply of 5v which is requirement of our project except ARM7 controller.ARM7 is required 3.3v supply which is also designed. We conclude that, theoretical calculation and practical output values are approximately equal.

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