Review Paper on Monitoring Water Quality to Improve Public Health using Sensors

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Abstract— Access to safe drinking water is vital as a health and development issue at national, regional and local level. In this paper we present a design and development of a low cost system for monitoring the water quality with IoT (internet of things).The system consists of some sensors used as measuring physical and chemical parameter of the water. In most part of the world, ground water is the only and vital supply for invention of drinking water, particularly in areas where water supply is limited. A sensor is the tool that detects and responds to the external stimulus from the physical atmosphere. The external stimulus contains: motion, light, heat, moisture, pressure or any sudden changes in the atmosphere. The output of the sensors is usually a signal which can be converted into human understandable form. All the sensors are very sensitive to small changes. So, most of the sensors size is very small. In general sensors are classified based on the power or energy supply requirement of the sensors and those are: Active and Passive sensors. Active sensors are sensors that must power supply to be active. On the other side, Passive sensors do not want power supply to work. Bases on the output they formed, sensors may be classified as Analog Sensors and Digital Sensors. Analog Sensors are producing a continuous output signal which is generally relative to the quantity being measured. Digital Sensors produce a digital representation of the quantity being measured.

Key words: pH Sensor, Turbidity Sensor, Temperature Sensor, Flow Sensor

I. Introduction

In the 21st century, there were lots of innovations, but at the same time were pollutions, global warming and so on are being formed, because of this there is no safe drinking water for the world's pollution. Nowadays, water quality monitoring faces challenges because of global warming limited water resources, growing population, etc. Hence there is need of developing better methodologies to monitor the water quality parameters in real time Water pollution is one of the leading uncertainties for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor.

The safety and security of drinking water distribution systems have recently generated significant interest because of the reliable concern that they could be compromised with chemical, biological and radiological contaminants. In order to protect public health, the US environmental protection Agency initiated a program to investigate how changes in water quality parameters, which potentially indicate contamination, can be detected by real or near real time sensors. There are a variety of causes to employ water quality sensors in water distribution systems. Contamination by cross-connections with non-potable water, contaminated water entering the distribution system through leaky pipes in an area of low pressure, or bacterial growth in the distribution system pipes are always management concerns.

The water quality parameters pH measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7pH value, less than 7pH has acidic, more than 7pH has alkaline. The range of pH is 0-14 pH. For drinking purpose it should be 6.5-8.5pH. Turbidity measures the large number of suspended particles in water that is invisible. Higher the turbidity results in higher the risk of diarrhea, cholera. Lower the turbidity then the water is clean. Temperature sensor measures how the water is, hot or cold. Flow sensor measures the flow of water through flow sensor. The traditional method of water quality monitor involves the manual collection of water samples from different locations.

II. Water Contamination

In most part of the world, ground water is the only and important supply for production of drinking water, particularly in areas where water supply is limited. Nearly two- third of all drinking water supply is obtained through groundwater resources worldwide. Groundwater contamination will directly affect human health because excessive amount of contamination in drinking water can produce negative impact of health on human- beings.

A. Need of Sensors

Access to safe drinking water is vital as a health and development issue at national, regional and local level. High rates of humanity and morbidity due to water tolerated diseases are well known in India. Severe poverty of water quality in urban India has often been attributed to unsystematic clearance of sewage and industrial effluents into surface water bodies. Those at greatest risk of water borne diseases are toddlers and young children, people who are fortified or living under insanitary conditions and the elderly. As India is emerging country and it has wide-spread embryonic technologies, there is a need for system for timely help and to monitor water pollution on the total state of the water system. Moreover, proper equipment is necessary for accurate process control and the environmental monitoring turfs need to be developed. For source water and environmental monitoring, process control devices are needed and that can be employed on in-situ and the process is monitored distantly.

Water quality sensors are employed using two main methodologies. They are either used to directly measure constituents of interest i.e. chemical concentrations, solids, etc. in the water, or to measure surrogates. Substitutes are chemical concentrations or solids that may indicate the presence of unanticipated contaminants in the water.

III. SENSORS

Many types of water quality sensors are available. Below is a list of the most common ones in use.

A. Wasp Mote Smart Water

Libelium launched a Smart Water wireless sensor platform to simplify remote water quality monitoring. Equipped with various sensors that measure a dozen of the most relevant water quality parameters, Wasp mote Smart Water is the first water quality-sensing platform to feature autonomous nodes that connect to the Cloud for real-time water control. Wasp mote Smart Water is suitable for potable water monitoring, chemical leakage detection in rivers, remote measurement of swimming pools and health spa, and levels of seawater pollution. The Wasp mote Smart Water platform is an ultra-low-power sensor node designed for use in rugged environments and deployment in Smart Cities in hard-to-access locations to perceive changes and potential risk to public health in real time.

Fig. 1: Wasp Mote Plug & Sense! Smart Water model

B. Chlorine Residual Sensor

Measuring chlorine residual in drinking water treatment plants and distribution systems is a shared process and has been necessary as long as chlorine has been used in water treatment. Chlorine is the most far and wide used sanitizer because of its efficiency and cost. Chlorine sensors measure free chlorine, monochloramine, and total chlorine. The primary application is drinking water sterilization, although total chlorine is also often measured in treated wastewater, counting reclaimed wastewater.

C. TOC Sensor

Total organic carbon (TOC) is an vital parameter for water quality analysis. It is used as a direct indicator and a surrogate for many water quality determinations. There are two different TOC measurement devices available on the market: TOC analyzers and TOC sensors. If the planned use is for regulatory reporting, managing an important process control variable, real-time release, or other critical-to-quality product attributes, instrument accuracy is vital. If the proposed use is for general TOC monitoring—not for making critical quality decisions—then other characteristics may be more important than accuracy. Sensors are typically used to monitor a process and the data composed from them is used for information only.

Fig. 2: TOC Sensor

D. Turbidity Sensors

Turbidity sensors measure suspended solids in water, typically by measuring the amount of light transferred through the water. They are used in river and stream gaging, wastewater and effluent measurement, drinking water treatment process and control, control instrumentation for settling ponds, sediment transport research, and laboratory measurements.

Fig.3 Turbidity Sensor

E. Conductivity Sensor

Conductivity measurements are carried out in industrial processes primarily to obtain statistics on total ionic concentrations (e.g. dissolved compounds) in aqueous solutions. Widely used applications are water purification, clean in place (CIP) control, and the measurement of concentration levels in solutions. The measuring system consists of an appropriate inline sensor directly inserted or in housing, a cable connected to a transmitter converting the received signals to a measurement result.

F. pH Sensor

pH is an key parameter to be measured and controlled. The pH of a solution indicates how acidic or basic (alkaline) it is. pH sensor components are usually shared into one device called a combination pH electrode. The measuring electrode is frequently glass and quite fragile. Recent developments have replaced the glass with more durable solid-state sensors. The analyzer or transmitter has a man-machine interface for calibrating the sensor and configuring outputs and alarms, if pH control is being done.

Fig.4 pH Sensor

G. ORP Sensor

ORP sensors measure the Oxygen-Reduction Potential of a solution. Used in tandem with a pH sensor, the ORP measurement provides insight into the level of oxidation/reduction reactions occurring in the solution. The ORP Sensor requires a compatible interface and software to collect data.

Fig. 5: ORP Sensor

For many system applications these sensors provide a signal of water quality conditions. A properly designed water quality monitoring system can provide valuable information to operators and engineers that can be used to regulate their hydraulic models, predict formation of regulated substances, provide compliance data and track the change in quality over time which in turn helps system operators make significant decisions about water treatment unit processes and operational conditions. When used in tandem with a modern SCADA system these sensors become the eyes and ears of system operators, providing real time legal information that can be used to maintain and optimize the water quality in distribution systems.

IV. PARAMETERS EXAMINED

Upon the widespread experiments carried out by US Environmental Protection Agency (USEPA), resolved that both chemical and biological waste has an adverse effect on many water monitoring parameters such as pH, Turbidity (TU), Electrical Conductivity (EC) and Oxidation Reduction Potential (ORP). In order to detect the water contamination, it is enough to determine the changes in above parameters. In many bodies of water, contamination of herbicides, pesticides and heavy metals may also be taken into account while calculating the water quality measurement.

V. PROPOSED SYSTEM

Online Water Quality Monitoring System is divided into three sub-systems:

A. Data Collection

Through sensors all the water-quality related data are collected and stored in the local-Controller.

B. Data Transmission

Once the local-Controller receives the data; it then transferred to the Cloud for analyzing the data.

C. Data Management

Cloud storage acts as a bridge between Data Transmission Layer and the Data Management Layer. Through Cloud storage, the data will be transferred to the end-user.

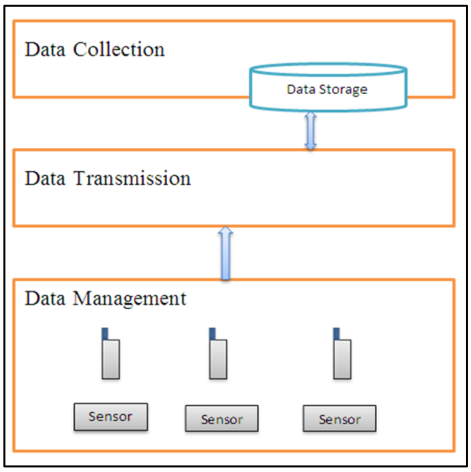

Fig. 6: Monitoring Water Quality by Sensors

VI. CONCLUSION

The main objective of this paper is to show the role of sensors for the advancement of water quality in order to obtain a hygienic environment. According to the research, drinking water obtained from both groundwater and surface water; must satisfy the principles for safe drinking water. This paper gives a clear view about what is a sensor, different types of sensors, parameters to identify quality of water, and stages to create online water quality management system.

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