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LOCATION BASED ANALYSIS OF TRANSPORTATION MATERIAL AND ITS' IMPACT ON POTABLE WATER USING IOT

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Abstract

Distributing andmanaging fresh water supply chain needs multiple channels of water transportation and storage at multiple level and location. During the entire overall process water remains in contact with multiple type of natural and artificial materials like soil, iron, cement, steel, cast iron, rocks, plastic, etc. This contact may remain for long term or short term and this contact may or may not affect the quality of water. Impact due to material contact on water may depend upon different condition of material and vice versa, where first water may damage the material and the damaged material may affect water quality like in case of iron pipes used for water transportation. This is quite serious issues and hence water supply chain needs continuous water quality monitoring system at multiple source or the location. Aim of this paper is to study and identify the impact on water after contact with different material for given time and developing the IoT based solution for centralized water quality monitoring system.

Keywords: *heavy metals, environment, contamination, legal requirements, pollution.*

1. INTRODUCTION

Consumable water distribution is one of the most important responsibilities of Municipal Corporation. Water sources for city consumable water is from natural water sources like Dam, Lakes, Ponds, Aquifers , Rivers and authorities need to deploy the system to pull the water to consumers through different methods like pipelines or the water tanker. While water flowing between different sources through different materials including CPVC, concrete, iron pipes or the plastic pipes may affect the water quality. This problem needs real-time and regular water quality check. After start point of water supply, water nearly flows from pipelines mainly and user will not find the way to detect the water quality in between. Proposed idea is to design and develop in-pipe consumable water quality checking device. This device would be fixed into existing pipeline with its sensor probes dipped in flowing water and its statistics will be monitored through central server using remote communication and software data analytics.

2. LITERATURE STUDY

A general definition for freshwater pollution as per GEMET (General Multilingual Environmental Thesaurus) could be the direct or indirect human alteration of the biological, physical, chemical or radiological integrity of freshwater. [1] Source of water in natural environment can be polluted or contaminated. There is a difference between Pollution and contamination. Excessive release of harmful substances that impacts environment, humans and other living beings is defined as Pollution .[2] Pollutants can be harmful solids, liquids, or gases produced excessively that directly reduce the quality of our environment and human health, causingburden to environmental accomplishments and damageto quality for use of the environment and drop inservices. Contamination is the presence of raised up concentrated substances in the environment above the natural background level for the area and for the organism mainly due to bio-accumulation of non-degradable metals, minerals, chemicals in food chains.[3]Some of the biodegradable contaminants a.k.a. organic pollutants which may trickle in drinking water sources are, polychlorinated biphenyls (PCBs), Dichlorodiphenyltrichloroethane (DDT), polycyclic aromatic hydrocarbons (PAHs), polybrominate diphenyl ethers (PBDEs), pesticides, petroleum and organochlorine pesticides (OCPs) which are released into environment due to humane activities like farming, agriculture mining, dumping, or industrial residual.[4] Arsenic, Cadmium, Barium, Fluoride, Mercury, Selenium, Sodium are called Inorganic pollutants. These are metals, salts and minerals that enter the environment through different human activities such as mining, drainage, manufacturing, casting and production [5] Mildew , Viruses, Molds , Bacteria, Animal dander, House dust, Cat saliva and, mites, cockroaches Termites and Bedbugs and other pests and pollens are Biological pollutants.[6].

Until now we have discussed about the pollution in the source of water, now let us look at the contamination caused due to distribution system.

Most of the water distribution networks across the world are at least 50 years old and the material used to build pipes could be of Iron cast, Steel, Galvanized Iron, Copper, Lead, PVC-PEX, Cement and Asbestos etc. which may contaminate the drinking water.[8]Iron cast , steel, galvanized Iron pipes tend to rust over longer time periods. The rust may accumulate in joints and taps. Though iron-rust poisoning (Tetanus) is highly unlikely, increased levels may cause redness and smell in water.[9]Corrosion of copper pipe can lead to higher levels of copper in the drinking water that exceed health guidelines and cause bitter or metallic tasting water.[10] Plastic – PVC- PEX pipes may leach in drinking water causing bad smell and taste. Micro and Nano-plastics may cross the gut-barrier and enter blood stream. BPA leaching from these pipes is found to be neurotoxic, Carcinogenic and may adversely affect genetic and reproductive health[11]. According to one study conducted in USA in the early 90s, Lead contamination through drinking water was associated with a 37 percent increase in fetal deaths and hundreds of cases of elevated blood lead levels in young children. It's also been found to cause an average 4 point decrease in IQ.[12]Many a times permeation, tuberculation, corrosion and leaching in Cement mortar lined(CML) and asbestos-cement pipes (A-C) cause degradation in water quality in terms of increased pH, turbidity, material accumulation etc. Also there may be some chemical reaction which cause decrease in chlorine residual effectiveness.[13] Thus Pollution and contamination that cause Permeation, Corrosion, Leaching and Tuberculation of water transport system which effective compromises the quality. These mal-effects may surface only at the sinks or outlets and would bypass standard monitoring system authorities.

Drinking such water may cause adverse effect on internal organs specifically kidney and may surface only when the patient is at the verge of organ failure. Monitoring authorities must consider infrequent, stable, non-toxic treatment and uninterrupted corrective methods for in-pipe safety and quality of drinking water. [14]

3. PROBLEM STATEMENT

Municipal companies manage the distribution and supply of drinking and usable water in various regions using traditional methods. During this time, various laboratory and field tests present various problems related to water quality and quantity control. In addition to water leaks, poor distribution or height of the earth; pipes and materials used for transporting water may affect water quality. Another source of water supply is a well or open well, which is considered a reliable source of water after basic purification. To provide this process with technological support and enable IoE technology to monitor the full quality and quantity of the water distribution process, numerous studies, fieldwork and analysis are required. The purpose of this research is to use various quality test sensors, electronically controlled valves and a quantity measurement tool with IoE technology to analyze the water distribution supply chain to improve the efficiency and efficiency of this complete process as part of smart city initiatives. This comprehensive study covers several stages from the design and development of a remotely monitored quality sensor, collecting statistics on water samples in multiple locations, understanding and mapping various sources of drinking water based on GIS and finally suggesting a new improved version of the process of water distribution. The study also covers the development of a mapped GIS and a cloud-based system for monitoring municipal pipeline statistics and the impact on outgoing water of various types of pipelines used for water supply.

4. OBJECTIVE OF PROPOSAL

Potable water supply chain needs to flow water from multiple channels from its natural source to end user destination. While transportation water needs to process or store at multiple level like artificial reservoir, storage tanks or the transportation tanks. It need checking of water at multiple level as it changes its contract point and the locations. Checking water quality could not be a periodic job and it has to be done while distribution of water to end user every time. Testing water for its quality could be a manual work at multiple location but it could be very difficult and manual intervention may result in poor testing methods. Water cannot be compromised to be abnormal and this is why security of water supply chain is major government concerns. It is proposed here, every transportation pipe should have some in pipe water quality testing mechanism which will keep track of the water quality at real time and could alert in case of major abnormality in water. This implementation need at multiple location and also system needs a multiple water storage impact at the end point or the water release point of every storage. Water need testing at every delivery to consumer as consumer rarely concern about water quality as he is aware of the fact concern authority is taking care of the water supply chain. It's not about the fixing of water likewise water can affect any material this could happen with utilized sensors and the electronics component so every device may need calibration and checking for its accuracy on regular interval. Figure 1.0 illustrates the proposed system product model and the external view with its visible components.

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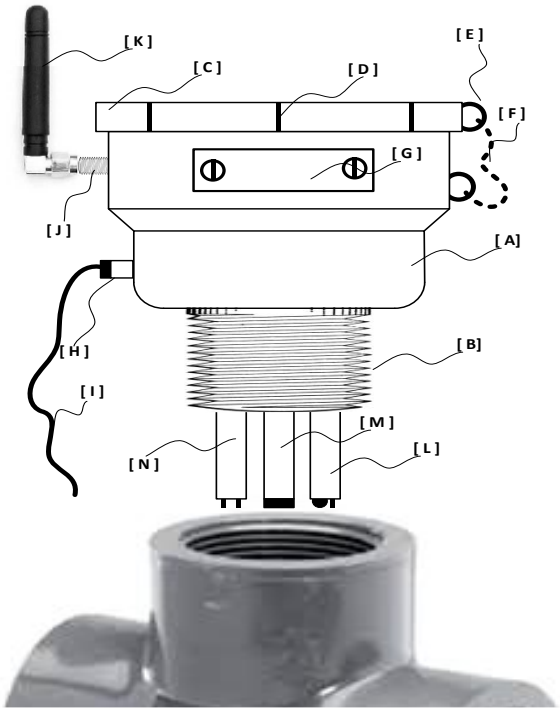

Fig. 1 Proposed system external components

Proposed model have following visible components with its functionalities,

[A] Main enclosure or the body of the proposed product, which is holding the entire component and the electronics part involved the system.

[B] Since the whole model is designed in such a fashion, so that it can be connected or coupled with T-type junction block of supportable size pipes having threads, hence these are the metal threads utilized for the same.

[C] In order to make the device water resistant its display section of the operational section need to pack with transparent lid, so this part is a transparent lid fixed using threaded method.

[D] These are the embossed grips that will assist to create grip while opening the upper lid of the product.

[E] To upper lid connected with the product body part this notch could be use to fix chain or thread inside and connected to the product body.

[F] Upper lid holding metal chain or the nylon thread.

[G] Optional maintenance lid for internal electronics repairing or other required access to internal modules.

[H] Electronics component required power connection from external source. This is water resistant seal for wire connection.

[I] External 5V-12V power supply wire required to start the device.

[J] This is threaded SM connector for external GSM antenna.

[K] External GSM network antenna.

[L] pH sensor detection custom build probe.

[M] Oxygen sensor detection custom build probe.

[N] TDS sensor detection custom build probe.

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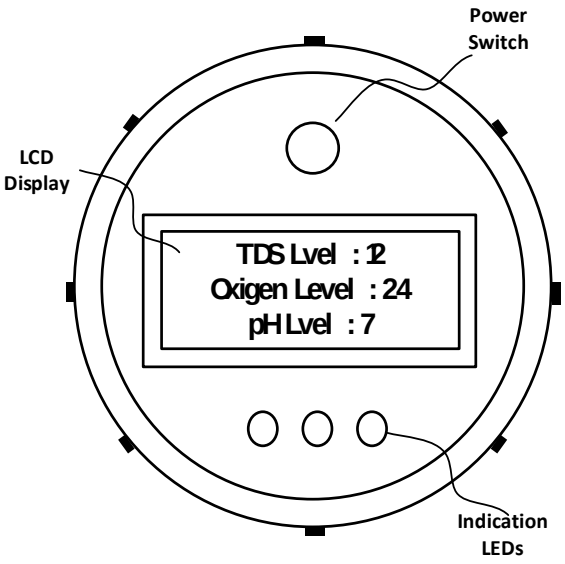

Fig.2 System user control console

Figure 2.0 illustrates the parameter display, user control console and upper lid.

- Power on/off and reset switch.
- Different working status indication LED.
- LED display for locally showing sensor readings.

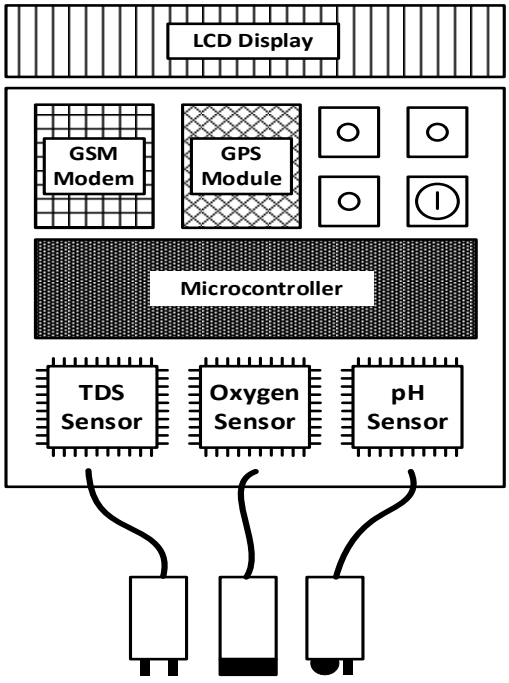

Fig.3 Proposed system electronics modules

- Main microcontroller or the logic processor to control all the internal functionality and the product logic.
- pH sensor processor chip or the IC.
- Multi core sensor connectivity copper cable.
- pH sensor detection custom build probe.

- Oxygen sensor processor chip or the IC.
- Oxygen sensor detection custom build probe.
- TDS sensor processor chip or the IC
- TDS sensor detection custom build probe.
- GSM modem module for data exchange and communication with cloud server using data service.
- GPS module for detection of geo-location at real-time of individual remote node. This will helpful in case of shifting nodes at different location and this will help in creating the virtual map of the pipeline and the water quality monitoring at different location.
- LCD display to show sensor value locally to user. This can be used for different user communication.
- LED indication for module working or the communication status.
- Power on/off or reset switch.

5. CONCLUSION

Various quality test sensors, electronically controlled valves and volume measurement devices with IOE technology to analyze the water distribution supply chain to improve the performance and efficiency of this entire process have been studied asPart of smart city initiatives like Nagpur. Design and development of remotely monitored quality sensors is proposed, for the collection of data from water samples at multiple locations, understanding of various consumable water sources and GIS-based mapping and in the end suggests a new improved version of the water distribution process. This investigation is also concerned with the development of a system for monitoring urban mapping and cloud-based GIS data, and the effect on the outgoing water of various types of pipes used for water supply. An IoT device based water pipeline volve is proposed to identify the gap between the actual water supply and the quality of water received by the consumer and finally prepare the report to understand where user need to improve the existing system or come up with new implementation in order to improve water quality

6. DISCLAIMER

Both Authors(Rohini Deshpande Awale and Dr. M.N. Quadri)hereby declare that the information assimilate and presented herewith is purely to support the proposed IoT based device for water quality monitoring. Authors accept full responsibility for the content of this research work. Authors hereby confirm that the article has not been published or sent for publication elsewhere. Authors have approved the final article, and agree to be accountable for all aspects of the work and acknowledge that all those entitled to authorship are listed as Authors.

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