A Review of Water Quality Monitoring and Management Based on Wireless Sensor Networks Technology

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Abstract: Water is essential for human survival. Water plays an important role in human daily life such as drinks of human and other uses also manufacturing of product. Diseases related to poor water and sanitation conditions causing million deaths world-wide. However, as cities grow and societies become more urban and Industrialization, modernization had cause problem of pollution to the clean water source for the agriculture and other usage. Therefore, it is important to develop a water quality monitoring techniques which gives real-time water quality monitoring of data for large city area. Although the research of water quality monitoring system is widely done and applied, this work surveys the Water Quality Monitoring and Management based on Wireless Sensor Networks Technology current system is not efficient, not reliable and expensive, small coverage and not user friendly. Moreover, most of the Water Quality Monitoring and Management system developed is not suitable for agriculture application due to the usage of unsuitable sensors. Thus, efficient, large coverage and user friendly wireless water quality monitoring system with suitable sensors is proposed to assist the authority effectively in maintaining the health of the natural water source around the area. Here Various Wireless Sensor Networks Technology based water quality monitoring and Management system techniques suggested by other authors are studied, analyzed and reviewed by considering their system parameter, coverage and energy and security concerns. The work also compares and evaluates sensor node architectures proposed the various authors in terms of monitored parameters, hardware for management and control and wireless communication standards adopted, localization, security implementation, power supply methods, autonomy and potential application scenarios.

Index Terms **- Sensors, Real-time, Remote; Water quality monitoring, Internet of Things, Wireless sensor network**

I. INTRODUCTION

Water consumption around the globe has increased seven times in the course of the last century. The level of ground water is declining by every passing day. It is known that 1.1 billion people across the world live without satisfactory access to clean water. And this huge number results in the death of roughly 2 million people per year due to lack of water related diseases. A stable, cost-efficient system is needed to cover-up this gap in the current world scenario and thus wireless sensor network comes in picture satisfying all the needs to deal with the situation. Since past years Wireless sensor network has proved its contribution in every aspect. Wireless sensor is distributed autonomous sensors used to observe environmental or physical conditions. A Wireless Sensor Network is a collection of multiple sensor nodes which communicate with a gateway or set of gateways to transfer information about their environment. Now a day's wireless network is the most popular services utilized in industrial and commercial applications, because of its technical advancement in processor, communication, and usage of low power embedded computing devices (Mompoloki Pule, AbidYahya, Joseph Chuma . 1997)

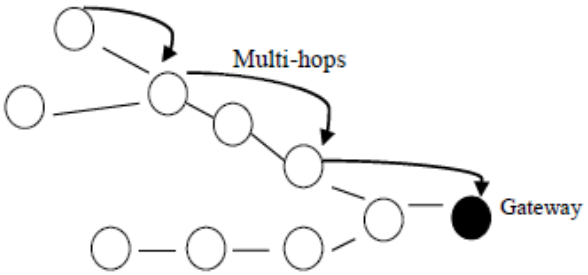

Fig.1 a Typical wireless sensor network (Nidal Nasser, Asmaa Ali, Lutful Karim, Samir Belhaouari. 2013)

A typical Wireless Sensor Network network consists of two main com-ponents namely node and base-station, as shown in Figure 1.A node is a device that is normally equipped with sensing, processing and communication capabilities, and is responsible for measuring the parameters associated with a particular application. A base station is responsible for capturing and providing access to all measurement data from the nodes, and can some-times provide gateway services to allow the data to be managed remotely.

II. WIRELESS SENSOR NETWORKS TECHNOLOGY BASED MONITORING AND MANAGEMENT

For dealing with the current problem review of a system named 'water system management using WSN' using the advance available wireless sensors basic

Goal is to provide real time basis monitoring and controlling identified critical parameters for better decision making and preventive actions here is the survey of design and techniques used for wireless sensor network based monitoring is analyzed . Here an exploration of personal area networks and networking using mesh network system is implemented to detect and sense.

The network communicated with infrastructure, adaptable to future wireless sensor techniques, which stored sensor data in a database. System included was a user interface to monitor the status of the entire system. Wireless sensor network using the controller platform, including all supporting infrastructure, for a monitoring application. Wireless sensors networks are indeed a viable emerging technology available to engineers for a wide range of applications. This survey shows the benefits and drawbacks of Wireless Sensing applications onto an embedded platform and make recommendations for the future of both commercial sensing applications and application specific platforms system can reduce the hazardous problem faced by the people due to lack of access to clean water and also we can get certain advantages. In the near future the efficiency of each sensor can be increased and more features like end-to end implementation, real time data Collection, real-time control, power conservation. Primary objectives of the wireless sensor design are balancing network energy consumption and extending the entire network lifetime. The analyses the effectiveness of LEACH protocol in cluster-head selection, and proposes an improved clustering algorithm. This new algorithm takes nodes residual energy and location information into account, optimizes the selection method of the threshold for electing cluster-head, improves optimal cluster-head selection strategy that is normal nodes select the optimal Cluster-head based on the cost function. Wireless sensor network covers sensor technology, new network technology, embedded system computing technology and distributed information processing technology. This will be a complete end-to-end implementation of the project system using all available updates and platforms to manage a complete sensor network for a SMART grid for desired applications. Addressing real-life issues by deploying wireless sensors for real-time analysis using available technologies

The network structure is to decrease delay in the data collection processes of wireless sensor networks which extends the lifetime of the network.

III. SENSORS

Wireless Sensor Networks have been achieved largely applicability in water quality monitoring which is cost effective and efficient the author has introduced a network with zigbee based sensors Zigbee is a set of communication protocols using low power radio based on IEEE802.15(Jose M. Barcelo Ordinas and Tarek Alskaif. 2017). All sensor nodes in the WSN are open hardware based on ZigBee. Alarming function is combined into the Web Server since it is required for most monitoring applications. The alarming function could be reused in different WSN-based monitoring applications. The proposed framework can monitor the water quality in real-time and also comprises an alarming section that can quickly give a warning message in case any abnormal event occurs this network proved sufficient enough for solving some of the major issues (Mompoloki Pule, AbidYahya, Joseph Chuma . 1997).

As the sensor Networks plays an important role in monitoring and the efficient management of distributed industrial infrastructure. These are used for monitoring operational status with the potential mechanisms issues early on and the benefits of such monitoring include the possibility of performing at a low cost so financial savings. In the architecture two types are used which are a Semiconductor manufacturing plant and a North Sea oil tanker. Whereas these don't relate to distribution but the findings are relevant as they are presented in terms of general design insights. Important findings include relationships observed between different sensor hardware configurations and their power efficiency. In this water management system all nodes including their sensors and radios are water proof. So every sensor node used here is a GSM modem which is capable of GPRS data connectivity and sensor nodes are battery pack with an limited lifetime. Then the analysis was made using the graph which indicates when the short term failure was there and when long term failure. It also indicates the graph during the rainy season. With some of the failures like the security which is not quite good would be solved in the coming years.

Water quality monitoring has become a crucial question around the whole world. Traditionally, remote water sensing based on satellites is widely used to monitor the water quality for rivers, lakes, seas and oceans However, satellites only offer a macro view of the water quality. With the development of communication technology and sensor technology, especially the concept of wireless sensor network and Cyber-Physical System (CPS), many efforts have been made toward building new water quality surveillance technologies based on wireless (Zhenan,Kai and Bo:Li,Wang and Liu 2013).

Sensors deployed underwater. Sensors have been developed for underwater environment that are able to collect accurately several water quality parameters such as; temperature, chemical substances, water density etc.

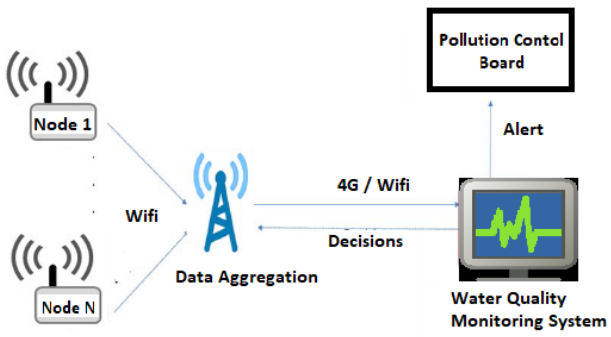

Fig.2 Water quality monitoring system architecture

IV. IMPLEMENTATION METHODS

We can get the proper system for managing the water supplies and can efficiently save water and fight with the crisis in near future. The system designed by the author can manage and control the flow of water the author in his project has introduced 2 modes 1- running mode and 2- filling mode bot the modes have different functions and this are communicating via sensors and thus we can conclude that we are getting real time updates and we can monitor and control the flow of water without any mechanical effort the author has initially used this concept for societies but this can be taken to a large scale too where a large amount of water is wasted. User is pre-alarmed when more than optimum water amount is being dispensed The proposed design is a strategy which will also help the user to keep a check on the amount of water leaking from the faucet, promoting smart planning for healthy and sustainable water management. Faucet add-on device is efficient, easy to operate and cost-effective and can also be used to keep a check on the amount of water leaking from the faucet. Furthermore, the modes in the device can be made to be more activity specific like dedicated modes for brushing, bathing, washing hands, etc.

From this literatures we can clearly understand that the available prototypes are not capable enough to check the soundness of water the main focus of author is for urban areas the author has briefly discussed about the consequences due to soundness of water the author has also mentioned some figures stating the deaths over a decade due to drinking of contaminated water and thus this system's importance and value can be realized. author succeeded in building a system that links an integrated management system with unit systems of management such as metropolitan reclaimed water management systems, urban water supply management systems, urban pollutants.

Management systems, distributed rainwater management systems, and river and lake ecosystems management systems and collects data from those systems in real time. The author has successfully carried out research and covered some of the important issues related to water in urban areas. The author's research and research parameters can prove useful to us to increase the efficiency and add more features to the model proposed by us.

This research done by the author is very impactful in today's society as we know people are becoming more prone to digitalization and thus this research can help in controlling the waste of water through a cell phone basically an android application the sensors are smartly used and we can get the real time update on our application as the water will rise as Sensor wires in the overhead tank will detect the level of water and when a particular water level will be sensed and the corresponding level will be send to the ARM cortex M-4 microcontroller in the CC3200 Launch pad, it will upload the corresponding level of water on the cloud. This data on the cloud will be fetched by the android application and will be displayed to the end user. In this android application recent and previous water levels will be displayed along with date and time. This feature or concept introduced by author can prove very helpful for us and the working process is also described in the article very clearly.

In this paper (Prachi Dutta , Uzvl Sai Gopinadha Varma Dontiboyina. 2016) we could see that the Wireless Sensor Networks which basically advances the system as it has the ability to monitor environmental and crop conditions in real time has allowed growers to decrease costs while improving crop quality. However, for growers to recognize these benefits they must be able to interpret, understand, and act on the data provided. Whereas here the main role is also being played by the base station component of the system, i.e., the part in which data is collected, viewed and further given which also allows the users to control their crop. As it consists of two main components which are the computer and radio The computer which runs the Ubuntu Linux software as i is very important to note that the systems are using laptops with relatively small memory requirement the easiest way to improve system performance is by upgrading to a faster computer. This system supports several radio modules including the Digi DigiMesh 900 MHz and 2.4 GHz modules and the Digi XSC radio operating at 900MHz.

The base module is responsible for all node communications. The user interface is designed using the Ruby on Rails web framework. This RoR framework provides us the direct database access and allows for an object oriented approach to the data and then a communications between the node and the base station which provides more security and reliability. Thus this finally concludes us with the design which has been very effective at providing reliable data handling and node communications and the user interface to make a bold move.

For Leak Detection: The application of piezoelectric is in the area of resonators , ultrasonic transducers , sonar, , electric filters, accelerometers and delay lines to detect failure at joint connections with factors like corrosive environments, soil layer movement, loading and vibration all can contributing to pipe deterioration over time and eventual leakage(Milad Golshan. Aidin Ghavamian. Ali Mohammed .2016) . The most commonly used method for find leaks in water distribution systems comprises using sonic leak-detection equipment, which identify the sound of water blow up from a pipe. The research is based on detecting and instantaneously processing acoustic signals inside and outside pipes in leak detection. Acoustic correlation method is more complicated over direct sound measurements method where two sensors are used. The sensors in bracket the outflow and the flow time during the acoustic signals detected by the two sensors detect and locate the leak. Deduction of the leak signal, while it moves along the pipe, is not linear, i.e. deduction factors of varying frequencies are different depending on material of pipe and the flow parameters. For power considerations: Sensor hubs are normally battery-powered, yet evolving batteries is now and again unthinkable for covered sensor hubs. The battery needs to give enough power to the sensor hub amid the whole working time. The wide band sensor can sense an wide scope of frequencies, hence, it can differentiate numerous sorts of leak however it has power limitations. There are numerous sorts of acoustic sensors with diverse shapes, sizes and sensitivities. All these sensors have varied advantages and thus varied applications but in all these are very hard for remote sensor hubs and remote installation because it obliges low power utilization, effortlessness, and cost proficiency. The power generator assurances that the sensor hub has enough power for its operational lifetime.

V. PROTOCOL:

This paper offered a vision of the Water Quality Monitoring System for Inland Lakes and aims to reflect the trend of inland lakes environment quality by making full use of advantages of remote sensing data, combined with ground-based observation data(ZHOU and ZHAO Zheng and Yuanling. 2017). The traditional monitoring methods had many shortcomings, such as long cycle, discontinuities in time and space, higher cost and so on but no specific method seems to be mentioned. This is a good way to analyse the quality of water, we had carry dynamic management and monitoring on water quality to detect the change in the information of the lake in time. It's an automatic system hence less man work is required and the system is incomplete without ground based sensors as not all types of remote sensors are available. The system flows the frame work of 4 subsystems 1) Data management subsystem 2) Data pre-processes subsystem 3) Water quality monitoring subsystem 4) Mapping and Visualization subsystem. Data layer achieve amounts of spatial data and attribute data to realize integrated management of data in the system. Data layer includes ground-based observation of database, remote sensing image database, environment background database, geographic information database, and so on. Application layer provides the operational platform to realize the functions of the system. It receives requirements of users and calls the data of data layer to complete the function and output data products. Presentation layer is an environment in which data and products of the system are visualized by a variety of forms (ZHOU and ZHAO Zheng and Yuanling. 2017). IoTs concept leads to the requirement of inter-communicability and inter-operability of wirelessly communicating sensor nodes. These nodes are manufactured by different companies that practice awide variety of communication protocols such as Zigbee, ANT+, Bluetooth Low Energy (BLE) backward compatible Bluetooth 3.0 and WiFi and this concept introduced by the author proved very useful and also the gap in the prevailing prototypes in sensor to sensor communication is filled by using this Multi trans receiver protocol Each individual sensor cell that makes up a complete related system needs to communicate between each other for better decision making. There will be a need for a common communication mechanism for the nodes to relay the rooms current characteristics compared to the required characteristics for the nodes to work together in achieving the common goal. Nodes utilizing multiple communication protocols were used for the experiment to assess and prove the capability of the multiprotocol receiver to receive, segregate and process the data from multiple nodes communicating with different communication protocols and programmed for different applications in centralized manner.

VI. CONCLUSION

Wireless sensor networks offer a promising infrastructure to municipal water quality monitoring and management system. Their greatest benefit comes from affordability and the ability to con-duct measurements remotely and in real-time. However, these sensor networks have resource limitations in terms of processing power, memory, communication bandwidth and energy/power. If not addressed properly, these limitations can hinder the effectiveness and efficiency of employing Wireless sensor networks in monitoring applications .Most of the previously adopted Wireless sensor networks based water quality monitoring architectures had limited range capabilities, and to improve their coverage they had to employ repeater nodes and complex routing protocol and algorithms while others relied heavily on the GSM network. Even so, such approaches introduced additional networking and computational costs which put a burden on resource limited Wireless sensor networks nodes. Some architectures employed cloud computing for remote access to water quality data but did not discuss the security concerns. Nonetheless, this approach threatens the reliability of the system as it leaves sensor data vulnerable to different cyber-attacks.

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