**Real-Time River Water Quality Monitoring and Control System Literature Review**

ABSTRACT:

The need for effective and efficient monitoring, evaluation and control of water quality in residential area has become more demanding in this era of urbanization, pollution and population growth. Ensuring safe water supply of drinking water is big challenge for modern civilization. Traditional methods that rely on collecting water samples, testing and analyses in water laboratories are not only costly but also lack capability for real-time data capture, analyses and fast dissemination of information to relevant stakeholders for making timely and informed decisions. In this paper, a real time water quality monitoring system prototype developed for water quality monitoring in Residential home is presented. The development was preceded by evaluation of prevailing environment including availability of cellular network coverage at the site of operation. It detects water temperature, dissolved oxygen, pH, and electrical conductivity in real-time and disseminates the information in graphical and tabular formats to relevant stakeholders through a web-based portal and mobile phone platforms. The experimental results show that the system has great prospect and can be used to operate in real world environment for optimum control and protection of water resources by providing key actors with relevant and timely information to facilitate quick action taking.

INTRODUCTION:

The environment around consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms.

Among these water is the utmost crucial element for human life. It is also vital for the persistence of other living

habitats [1]. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and

readily available water is the need for public health [2]. So it is highly imperative for us to maintain water quality

balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological

balance among other species [3]. Water pollution is a foremost global problem which needs ongoing evaluation and

adaptation of water resource directorial principle at the levels of international down to individual wells. It has been

studied that water pollution is the leading cause of mortalities and diseases worldwide. The records show that more

than 14,000 people die daily worldwide due to water pollution. In many developing countries, dirty or contaminated

water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the

ignorance of public and administration and the lack of water quality monitoring system which makes serious health

issues [3, 4].

In this paper, we depict the design of Wireless Sensor Network (WSN) [4-7] that assists to monitor the quality of

water with the support of information sensed by the sensors dipped in water. Using different sensors, this system can

collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on.

The rapid development of WSN technology provides a novel approach to real-time data acquisition, transmission,

and processing. The clients can get ongoing water quality information from far away.

Now a day’s Internet of things (IoT) is an innovative technological phenomenon. It is shaping today’s world and

is used in different fields for collecting, monitoring and analysis of data from remote locations. IoT integrated

network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable [7-

12]. Though IoT is still under applied in the field of environment it has huge potential. It can be applied to detect

forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide, and avalanche etc.

Moreover, it can be implemented in the field of water quality monitoring and controlling system [4, 13].

Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous

works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was

to develop an efficient, cost-effective, real-time water quality monitoring system which will integrate wireless sensor

network and internet of things [14]. In this research, we monitor the physical and chemical parameters of water

bodies inside Chittagong city by using an IoT based sensor network.

The environment around consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms.

Among these water is the utmost crucial element for human life. It is also vital for the persistence of other living

habitats [1]. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and

readily available water is the need for public health [2]. So it is highly imperative for us to maintain water quality

balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological

balance among other species [3]. Water pollution is a foremost global problem which needs ongoing evaluation and

adaptation of water resource directorial principle at the levels of international down to individual wells. It has been

studied that water pollution is the leading cause of mortalities and diseases worldwide. The records show that more

than 14,000 people die daily worldwide due to water pollution. In many developing countries, dirty or contaminated

water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the

ignorance of public and administration and the lack of water quality monitoring system which makes serious health

issues [3, 4].

In this paper, we depict the design of Wireless Sensor Network (WSN) [4-7] that assists to monitor the quality of

water with the support of information sensed by the sensors dipped in water. Using different sensors, this system can

collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on.

The rapid development of WSN technology provides a novel approach to real-time data acquisition, transmission,

and processing. The clients can get ongoing water quality information from far away.

Now a day’s Internet of things (IoT) is an innovative technological phenomenon. It is shaping today’s world and

is used in different fields for collecting, monitoring and analysis of data from remote locations. IoT integrated

network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable [7-

12]. Though IoT is still under applied in the field of environment it has huge potential. It can be applied to detect

forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide, and avalanche etc.

Moreover, it can be implemented in the field of water quality monitoring and controlling system [4, 13].

Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous

works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was

to develop an efficient, cost-effective, real-time water quality monitoring system which will integrate wireless sensor

network and internet of things [14]. In this research, we monitor the physical and chemical parameters of water

bodies inside Chittagong city by using an IoT based sensor network.

The environment around consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among these, water is the utmost crucial element for human life. It is also vital for the persistence of other living habitats. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is the need for public health. So, it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological balance among other species. Water pollution is a foremost global problem which needs ongoing evaluation and adaptation of water resource directorial principle at the levels of international down to individual wells. It has been studied that water pollution is the leading cause of mortalities and diseases worldwide. The records show that more than 14,000 people die daily worldwide due to water pollution. In many developing countries, dirty or contaminated water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the ignorance of public and administration and the lack of water quality monitoring system which makes serious health issues. IoT integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable. Though IoT is still under applied in the field of environment it has huge potential. It can be applied to detect forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide, and avalanche etc. Moreover, it can be implemented in the field of water quality monitoring and controlling system. Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was to develop an efficient, cost-effective, real-time water quality monitoring system which will integrate wireless sensor network and internet of things. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IoT based sensor network.

EXISTING WORKS:

[1] Pasika and Gandla proposed a monitoring system which consists of a number of sensors used to measure several quality parameters like turbidity, pH value, water level in the tank, dampness of the adjoining environment and temperature of the water. The sensors are interfaced with the Microcontroller Unit (MCU) and additional processing is executed by the Personal Computer (PC). The acquired data will be directed to the cloud by means of Internet of Things (IoT) based ThinkSpeak application for monitoring the quality of the water under test. As a future directive, work should be extended for analyzing some other parameters such as nitrates, electrical conductivity, dissolved oxygen in the water and free residual chlorine.

[2] Mukta et al. developed an IoT based Smart Water Quality Monitoring (SWQM) system which helps in incessant measurement of quality of water on the basis of four different parameters of water quality i.e., pH, temperature, turbidity and electric conductivity. Four different sensors are coupled to Arduino Uno in order to sense the quality parameters. The data collected from all the four sensors are communicated to a desktop application which is developed in .NET platform and the extracted data are matched with the standard values. On the basis of the collected data from sensors, the developed SWQM model will efficaciously examine the water quality parameters by employing fast forest binary classifier for classification of the sample of water under test is whether potable or not.

[3] Konde and Deosarkar proposed a method for developing a Smart Water Quality Monitoring (SWQM) system with reconfigurable sensor interface device using IoT environment. Sensors, Field Programmable Gate Array (FPGA) board, Zigbee based wireless communication module were used in the proposed model. Six different water quality parameters like turbidity, pH, humidity, water level, water temperature and carbon dioxide (CO2) on the surface of water were considered in real-time. The proposed method will provide assistance in guarding the safer and balanced environment of water bodies. The SWQM system reduces the cost and time in determining the quality of water in water resources as part of managing environmental and ecological balance. In the suggested future work, WSN network will be developed involving of additional number of nodes to encompass the coverage area.

[4] In 2007, Stephen Brosnan investigated a wireless sensor network (WSN) to collect real time water quality parameters (WQP).

[5] In 2010, Quio Tie-Zhn developed online water quality monitoring system based on GPRS/GSM. By means of GPRS network information was sent, which helped to check remotely the WQP.

[6] In 2011, Kamal Alamehpresented web based WSN for monitoring water pollution using ZigBee and WiMAX networks. The system measured various WQP and collected, processed measured data from sensors, and directed through ZigBee gateway to the web server by means of WiMAX network to monitor quality of water from large distances. This System was also capable of monitoring water pollution in real time.

[7]. The remote sensor was based on ZigBee network. WQP tested by WSN and sent data to Internet using GPRS. Information was gathered at remote server, with the help of Web.

[8] In 2013, Kulkarni Amruta created solar powered WQM utilizing remote sensor network. Base station gathers the information from distant remote sensors. Also the BS associated with ZigBee module was powered by sunlight baseboard (Energy harvesting).

REFRENCES:

[1] Sridharan, S. (2014) Water Quality Monitoring System Using Wireless Sensor Network. International Journal of Electronic Communications Engineering Advanced Research,3,399-402

[2] Losilla, F., Garcia-Sanchez, A.-J., Garcia-Sanchez, F., Garcia-Haro, J. and Haas, Z.J. (2011) A Comprehensive Approach to WSN-Based ITS Application. Sensors, 10, 10220-10265.

[3] Mo Deqing, Zhao Ying, Chen Shangsong, “Automatic Measurement and Reporting System of Water Quality Based on GSM,” 2012 International Conference on Intelligent System Design and Engineering Application.

[4] Nikhil Kedia, Water Quality Monitoring for Rural Areas- A Sensor Cloud Based Economical Project, in 1st International Conference on Next Generation Computing Technologies (NGCT2015) Dehradun, India, 4-5 September 2015. 978- 1-4673-6809-4/15/$31.00 ©2015 IEEE

[5] Jayti Bhatt, Jignesh Patoliya, Iot Based Water Quality Monitoring System, IRFIC, 21 feb, 2016.

[6] Michal lom, ondrej priby & miroslav svitek, Internet 4.0 as a part of smart cities, 978-1-5090- 1116-2/16/$31.00 ©2016 IEEE

[7] Zhanwei Sun, Chi Harold Liu, Chatschik Bisdikia\_, Joel W. Branch and Bo Yang, 2012 9th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks

[8] Gouthaman.J, Bharathwajan Prabhu. R & Srikanth.A “Automated urban drinking water supply control and water theft identification system” Proceeding of the 2011 IEEE Students' Technology Symposium, IIT Kharagpur pp.87-91, 2011.

[9] S.Leirens, C. Zamora, R.R. Negenborn, and B. De Schutter “Coordination in urban water supply networks using distributed model predictive control” Proceedings of the 2010 American Control Conference, Baltimore, Maryland, pp. 3957–3962, 2010.

[10] Hen Hui, Zhou Wenchao and so on, “Design of the embedded remote meter reading system based on Ethernet”, Electronic Design Engineering, vol. 20 pp. 184-186, 2012.

[11] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[12] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data," Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018

1] K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends

and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

[2] B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data,"

Int J Environ Res Public Health, vol. 15, Mar 23 2018