Smart water pollution detection system

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ABSTRACT -

As we know water pollution is one of the major fears for the modern times. For ensuring the safe supply of the drinking water the quality needs to be monitor in real time. Here in the following system, we present a design and development of a low cost system for real time monitoring of the water quality and pollution content in IoT (internet of things).The system consist of few sensors which are used to measuring certain quality parameters of the water.

We have focused on the development of a new device suitable to detect and measure methane gas in areas of natural gas storage site. This very device, the Smart Gas Detection system, can measure and detect the water quality. The gaseous parameters measured by the sensors, include CH4 and CO2 gas in water. The another parameter that shall be measured is the turbidity or hardness of the water. The sensors will be receiving the data and transmitting to the online database (Thingspeak), via the wifi modules (Node MCU), thereby remotely accessing all the data. We are using a Quadpcopter on which the water pollution sensing component will be installed. It will be controlled by Arduino UNO Micro controller and thus will provide the necessary mobility and reach, to our system so that distance and terrains are not any concern. It is extremely important to develop mobile devices with the new commercial low-cost sensors to detect and measure pollution content from water bodies, that can severely affect the health of people and animal.

Keywords: Water Quality, IoT (internet of things), Wifi Module, Database, Sensor, Arduino UNO.

INTRODUCTION -

With the tremendous growth all round, particularly in the field of technology, more and more serious concerns of environment have been arising, lately. Water pollution is also being one the major concern. Routinely, the usually monitored parameters to check the quality of water include - temperature, pH, turbidity, dissolved oxygen (DO), gases such as methane and carbon dioxide, ammonia nitrogen, nitrate, phosphate, various metal ions and so on. Generally, the common method involved in order to detect these parameters is to collect samples manually, by approaching the sources and water bodies and then send them to laboratory for the purpose of detection and analysis. This method, however, wastes too much of the time, man power and material resource, and also has the limitations of the samples collection, long-time analysis, the aging of experiment equipment and also some other issues. Sensor is, thus, an ideal detecting device to solve these issues significantly. It converts no power data into electrical signals. It can also easily transfer, process, transform and control signals, and has many significant advantages such as good selectivity, high sensitivity, quick speed of response and so on. According to these advantages and characteristics of the sensors, the monitoring of Turbidity, PH & Temperature of Water is designed and developed. The measured values so obtained from the sensors can be processed by the help of the core controller. Finally, the sensor data can be viewed on internet using cloud computing. Currently, drinking water faces many challenges in the present situation. The drinking water is essential for all human beings. Due to the growing population, aging infrastructure, inadequate water resources many challenges occurred. so water quality methodologies required. Water is an essential fuel of life and no life can exist without water on this planet, at all. The water therefore has to be monitored and checked up regularly using smart technologies.

There are many purification technologies and methodologies being proposed for monitoring of drinking water; but the hazards are mixed with

the drinking water which comes through the industries, urbanization, domestic households, agriculture resources etc. Due to these reasons, the water quality is mandatorily needed to be monitored at different places in one stretch, so as to avoid pollution in the IoT environment. The 'Internet of Things (IoT)' has the potential to modernize the water production, as more and more of its technology is connected to the web. Smart water meters, that are sensor based are a form of Internet of Things, a network of technologies which can efficiently and properly monitor the status of physical objects, capture important info and communicate that over a wireless network to a software application for the purpose of analysis. Conventionally, the samples of water are collected from many different places, and then tested by the scientist at their laboratory by the help of many techniques, in order to determine the water quality.

This paper focuses strictly on checking the Turbidity and certain gaseous components present in water, which can be verified on a daily basis. It includes the description of the needed sensors and its specifications. Plus, we are using a mobile entity, a quadcopter, that will make sure that remote sensing of water parameters happens and that, the terrain and distance are not much of a concern. The mobile pollution detection device should be able to reach even the places which are otherwise not easily reached out by the humans easily. It is quite a new step in developing water quality measuring mobile device, which will be helpful for the new researchers to go through the development of a new improved device for the quality check of water.

Literature survey:

Paper No1: IEEE International Conference Design of Smart Gas Detection System in areas of Natural gas, University of Ferrara Italy(2015).

This paper focuses on the development of a new device and suitable to detect and measure gas in areas of natural gas storage site. Also it highlights the entire air quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain. While automatically improving the air quality is not feasible at this point, efficient use of technology and economic practices can help improve air quality and awareness among people.

Paper No 2: The Low-Cost Turbidity Sensor for Low-Power Wireless Monitoring of Fresh-Water Courses

This paper reports on a low-cost turbidity sensor design for continuous on-line water quality monitoring applications. The measurement of turbidity by agricultural and environmental scientists is restricted by the current cost and functionality of available commercial instruments. Although there are a number of low-cost turbidity sensors exploited within domestic 'white-goods', such as dishwashers, the lack of sensitivity, and power-usage of these devices make them unsuitable for freshwater quality monitoring purposes..

Paper No 3: A Wireless Sensor Network Environment Monitoring System Based on TinyOS," Electronics, no. Iceoe, pp. 497-501, 2011.

This paper involves the monitoring of the sensor environment measures like temperature, air quality etc. The expenses of the system were not quite high but the system was complex and not portable.

Paper No 4: Detection of Salt and Sugar Contents in Water on the Basis of Dielectric Properties Using Microstrip Antenna-Based Sensor

This paper presents a microstrip antenna-based sensor for detecting salt and sugar in water. The patch antenna is low-cost and low-profile and is modeled to transmit and receive an electromagnetic signal. The presented antenna consists of a crescent-shaped patch and slotted partial ground. The compact size of the antenna is 32 mm 22 mm. High-frequency structure simulator and computer simulation technology are used to simulate and analyze the characteristics of the antenna. The presented antenna achieves a 10 dB return loss from 2.50 to 18 GHz with 6.10 dBi of maximum gain, considerable efficiency, and consistent radiation patterns. The presented antenna is used as a sensor to detect salt and sugar in water in terms of reflection coefficient based on the dielectric

properties of the solution. The percentage of salt and sugar in water changes the dielectric properties of the solution and the reflection coefficients subsequently.

Paper No 5: Reconfigurable Smart Water Quality Monitoring System in IoT Environment.

This Paper effective and efficient system of water quality monitoring (WQM) are critical implementation for the issue of polluted water globally, with increasing in the development of Wireless Sensor Network (WSN) technology in the Internet of Things (IoT) environment, real time water quality monitoring is remotely monitored by means of real-time data acquisition, transmission and processing. This paper presents a reconfigurable smart sensor interface device for water quality monitoring system in an IoT environment. The smart WQM system consists of Field Programmable Gate Array (FPGA) design board, sensors, Zigbee based wireless communication module and personal computer (PC). The proposed WQM system collects the five parameters of water data such as water pH, water level, turbidity, carbon dioxide (CO2) on the surface of water and water temperature in parallel and in real time basis with high speed from multiple different sensor nodes.

Paper No 6: A Biological Sensor System Using Computer Vision for Water Quality Monitoring.

Water pollution has seriously threatened our life, so an effective water quality monitoring mechanism is the most important part of water quality management. Most studies use biological monitoring methods to monitor water pollutants, such as pesticides, heavy metals, and organic pollutants. However, there are still many difficulties at present. Few methods consider the influence of illumination and complex background in the monitoring environment, and the characteristics parameters extracted in the systems are single. In addition, the results of using shallow neural networks for water quality classification are often not ideal. In order to solve the above problems, we design a water quality monitoring system combined with the computer image processing technology and use computer vision to analyze the fish behavior in real-time for monitoring the existence or not of water pollution.

Paper No 7: Implementation of Electrochemical Sensors in Arsenic-contaminated Areas of West Bengal in India toward Rapid and Point-of-Use Detection of Arsenic in Drinking Water.

The difficulty of detecting small quantities of arsenic in water currently threatens the health of millions of people worldwide, as long-term exposure to arsenic has been associated with both cancerous and noncancerous health risks. Existing technologies make it possible to very accurately quantify arsenic levels in water; however the expense, extensive training, and off-site analysis required by these methods impede wide scale-use. Electrochemical detection offers many advantages, such as portability, minimal use of instrumentation, and ready integration with electronics. Toward a solution to water quality interventions, we have demonstrated an affordable and point-of use platform capable of detecting trace amounts of arsenic in ground water samples.

System Architecture:

The proposed system measures certain pollution causing agents which are present in the water bodies. The gaseous pollutants measured by the sensors, include CO2, sulphide and ammonia, while as far as the water quality is being considered the turbidity is taken into consideration. The sensor nodes are connected to corresponding Node MCU for the data transmission. The data received from the sensors is transmitted to the online repository. The remote data access is ensured. The couple of Node MCUs will be used in this system, each with one corresponding sensor being attached. This whole setup, of two sensors and two Node MCUs, constitutes the water pollution sensing component.

Further more, to provide mobility to our system, we are using a Quadcopter. The water pollution sensing component will be installed on this quadcopter. It will be controlled by Arduino UNO Micro controller and thus will provide the necessary mobility and range to our system so that distance and terrains are not any concern. It is extremely important to develop mobile devices with the new commercial low-cost sensors to detect and measure pollution content from water

bodies, that can severely affect the health of people and animal.

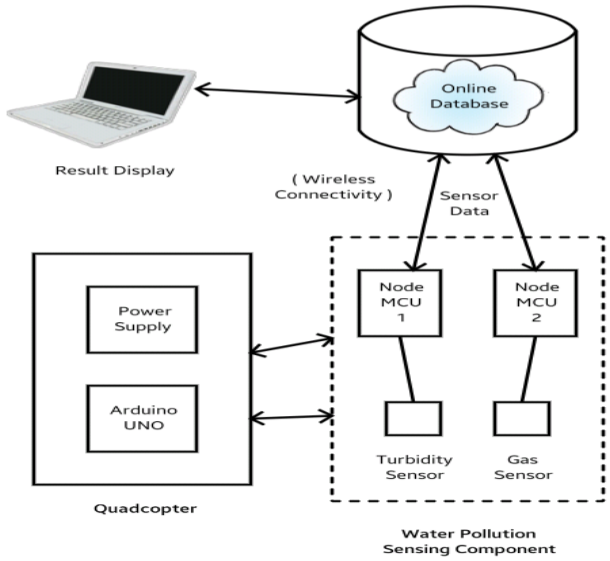

Fig : System Architecture Diagram

CONCLUSION :

Our project "Smart Water Pollution Detection System" focused on analyzing the water quality with high performance, real time and accurate. In our proposed system we have measured the Turbidity and gas content values of water with the help of various Sensors. In future, the parameters like hardness, conductivity, ammonia, lead, fluoride etc will also be considered for the purpose of water quality measurement, as these values will help us to check the extent of purity of the water for many purposes such as drinking water and daily requirements. The major point is we have been able to record all the data obtained in our online cloud repository. The results can be viewed and fetched whenever required. The monitoring of water can be done online easily using this mobile system. Hence, we have tried to achieve all our objectives. The system can monitor water quality automatically, and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility and reach as the type of terrain is no concern. We have been able to implant the detection system on the drone and can control it accordingly shall be a very hassle-less work and thus could help us to enhance the functionality of our system. Merely by replacing the corresponding sensors and changing the corresponding software programs and code, this system can be used to monitor other different water quality parameters as well.

As far as the future scope is concerned, we are planning to implement on our system few more different sensors so that variety of different water quality parameters and pollution causing components can be detected and recorded. Being able to implant the camera system on the drone and controlling it accordingly shall be a very handy as it would help us navigate through the route remotely and thus could help us to enhance the reach and range of our system.

References

[1] IEEE International Conference Design of Smart Gas Detection System in areas of Natural gas, University of Ferrara Italy(2015)

[2] The Low-Cost Turbidity Sensor for Low-Power Wireless Monitoring of Fresh-WaterCourses[2015]

[3] A Wireless Sensor Network Environment Monitoring System Based on TinyOS," Electronics, no. Iceoe, pp. 497-501, 2011.

[4] Detection of Salt and Sugar Contents in Water on the Basis of Dielectric Properties Using Microstrip Antenna-Based Sensor

[5] Reconfigurable Smart Water Quality Monitoring System in IoT Environment[2014]

[6] A Biological Sensor System Using Computer Vision for Water Quality Monitoring[2014]

[7] J. A. Stankovic, "Research directions for the Internet of Things," IEEE Internet Things J. , vol. 1, no. 1, pp. 3–9, Feb. 2014

[8] Peris-Ortiz, M.; Bennett, D.; Y´abar, D. P., "Sustainable Smart Cities: Creating Spaces for Technological, Social and Business Development", Springer, 5 October 2016, p.103

[9] IEC International Electrotechnical Commission, "Wireless Sensor Networks", White Paper, July 31 2014, p.13

[10] Chen et al ., "A Vision of IoT: Applications, Challenges, and Opportunities With China

Perspective", IEEE Internet of Things Journal, vol.1, No.4, Aug 2014.

[11] Jing,M., "The Design of Wireless Remote Monitoring System of Water Supply Based on GPRS", Computer Science and Society (ISCCS), 2011 International Symposium on , Kota Kinabalu, 2011, pp. 29-31.

[12] Purohit,A and Gokhale,U., "Real Time Water Quality Measurement System based on GSM", IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) , vol. 9, no. 3, pp. 63-67, May - Jun. 2014.

[13] Beri,N,N., "Wireless Sensor Network Based System Design for Chemical Parameter Monitoring in Water", International Journal of Electronics, Communication Soft Computing Science and Engineering , vol. 3, no. 6

[14] Hsia,S,C.; Hsu,S,W.; Chang,Y,J., "Remote monitoring and smart sensing for water meter system and leakage detection", IET Wireless Sensor Syst ., vol. 2, no. 4, pp. 402-408, Dec. 2012.

[15] Chi,Q.; Yan,H.; Zhang,C.; Pang,Z.; Xu,L,D., "A Reconfigurable Smart Sensor Interface for Industrial WSN in IoT Environment", in IEEE Transactions on Industrial Informatics , vol. 10, no. 2, pp. 1417-1425, May 2014.