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CONDITION AND MONITORING OF DRINKING WATER IN WATER PURIFIER USING IOT

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Abstract - *Water contamination has been a long-standing problem in the country. That rapidly increases population and again infrastructure of water distribution system in the country increase the water contamination. The older method was unable to monitor the water quality in real time and notify the users about the contamination. So, it is necessary to develop a real time water quality monitoring and a notification system which gives effective result and save the precious health of human being by alerting them in real time. Water quality depends on PH, turbidity, temperature along with some other factors are significant. A traditional method consists of collecting water sample manually and then send to laboratory for testing. It takes so much time without providing result in real-time. The existing system has a mechanism which are semi-automated or manually controlled devices which are to be handled by a person responsible for monitoring the water quality. The instruction or tools are used either putting or inserting a water sensing part into water and seeing the result on small display device or by directly inserting a portable device in water and observing the output on the display. The objective of this system is to develop a real time system for assessment of fully automated portable water quality. It reduces human effort, covers a large area efficiently. This system consists of different type of sensors, notification module consists of LCD display, Wi-Fi device and Arduino. The portable and automatic water quality monitoring and notification system saves time and human resources. The notification will be sent to the authorized person when sensor will detect bad water quality and if any user wants to know the current status of the water.*

Key Words: **Temperature sensor, TDS Sensor, Electrical conductivity, Water flow sensor, Turbidity, Arduino, Wi-Fi Module, IoT.**

1. INTRODUCTION

With rapidly rising population in India, Fresh Water Management is very much essential which demands an increase in agricultural, industrial and other requirements. The Quality of Fresh Water is characterized by "chemical, physical and biological" content. Monitoring the water quality helps in detecting the pollution in water, toxic chemical and contamination. The traditional method still in vogue entails collection of water samples, analyzing it in lab and advice for any water treatment and so forth. This paper is considered beneficial for the development of water quality measuring devices for the measurement and analysis of water used for living things, for example, human beings, animals as well as marine fishes and plants. All of us consume water every day, so it is indispensable for us. Therefore, water should be checked in real time. Since water has a direct effect on life on earth; it has become crucial to check whether the water is in good condition to use. Checking the quality of water requires much hard work. Most of the things that exist in the earth dissolve in water, and it is very hard to determine the amount of the material mixed in it. For determining the number of materials in water requires much hard work and is time-consuming. It has become necessary with the evolving technology a quick and efficient method to determine the quality of water.

This paper focuses on checking the TDS, pH value, Turbidity and Temperature, which can be verified on a daily basis. It includes the description of the needed sensors and its specifications. It is possible to make the device either from the starting phase, or you can select the parts and combine it. Therefore, it has two ways to make the device. It is quite a new step in developing water quality measuring 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. This paper focuses on the present requirement for the development of sanitation in water. There are many other factors which could be found in water, but these three factors like pH, TDS, Turbidity and Temperature are crucial to determine the quality. It helps to determine either water is basic or acidic as well as to determine the number of solid particles dissolved in water. As a whole, this paper contributes for determining the quality of water in a convenient and user-friendly method for measuring the pH, Turbidity and Temperature.

2. RELATED WORKS

There have been a number of researches works in the literature that adopt Wireless Sensor Networks in Aquaculture and Water Quality Monitoring. In [2], the researchers adopted wireless sensor, embedded computing, MEMS technology, distributing information processing and wireless communication technology to build the wireless network sensor network system. It provides primarily the hardware architecture design and technology used for the transmission and real-time data acquisition. But it still needs to describe more about the embedded structure and programming structure. Besides, the data from the sensor

network accepted by the gateway node will be processed by the application server must betransmitted via an external I/O communication unit (e.g., Ethernet, and RS232).

In some other works, sensor nodes are data acquisition unit, environmental statistics are collected by various sensors (pH, temperature, and dissolved oxygen sensor) and transmitted via ZigBee/IEEE 802.15.4 RF transceiver [10], [8]. In these systems, a gateway (coordinator) is the core of the network that receives, pre-processes and analyzes the data from sensor nodes then sends to a computer via a RS232 cable. In [10], the advantage of this project in comparison to the other one is the software design and data aggregation. The status of the system is monitored in real-time with LabVIEW. Besides, the testing result of this project is promised. Overall, this project is a good solution for water quality monitoring. Meanwhile, the second project has a better graphic user interface that able to interact with the hardware (coordinator) at the base station. The GUI provides a lot of features like view values of each sensor node by clicking on the node or views a table of values from all nodes with Link Quality Indicator (LQI) for each node. LQI is a number representing the best possible link quality by a built- in module to measure Energy Detection of received signal.

In [3], [11], ZigBee is used to build WSN systems that consist of sensor units, and a micro-controller for signal digitizing, data transmission. A base monitoring station collects data from sensor nodes and transfers the data to a PC via RS232 protocol. All calculation will run on PC. [11] does not configure an automatic polling function for nodes; user can get values by clicking the GUI; on the other hand, [3] can automatically poll data, but the period cannot be changed.

In [9] Arduino is used, an open electronic prototype, and open source, to build Node and Base Station. ZigBee protocol is used to connect the Node and Base Station. They configure threshold value of temperature and pH and salinity as constant values and cannot be changed without re-program the board. Data is saved in a database, and they also did not build a user interface for reviewing data. The report can be created by connecting to the database and extract pure data.

Central Water Commission (CWC) monitors water quality [12] [13], by collecting samples from representative locations within the processing & distribution system. These samples are analyzed at the well-equipped laboratories. At these laboratories' samples from raw water, filter water and treated water are taken for analysis, these analyses can be performed by human intervention which for specific period only. The disadvantage of this system is, water is not monitoring seamlessly, and it always needs a human intervention.

[4] In Real Time Water Quality Monitoring System is a Sensor-Based Water Quality Monitoring System. The system wireless communication link. The data from nodes is send to the base station consisting of ARM controller designed for special compact space application. Data collected by the base station such as pH, turbidity, conductivity, etc. is sent to the remote monitoring station. Data collected at the remote site can be displayed in visual format on a server PC with the help of MATLAB and is also compared with standard values. If the obtained value is above the threshold value automated warning SMS alert will be sent to the agent. Disadvantage of this system is, it is MATLAB based system, which is not portable. To overcome this disadvantage, our system will use Raspberry Pi which is comfortable with Linux operating system and allows to program in many languages which are open source and there is no need to maintain data on computer system.

[5] In this paper, Li Zhenan, Wang Kai, Liu Bo has worked on Sensor-Network based Intelligent Water Quality Monitoring and Control, they focused on the monitoring and control of water quality in natural water bodies such as rivers and lakes. Disadvantage of this system is that it uses to monitor the water from rivers and lakes, which is not monitoring the water from storage system. In some small cities it has been observed that the water coming from Municipal Corporation may get impure at some intermediate source like pipeline leakage or damage in the storage facilities. Sometime the ignorance of the authority in maintenance work is also the reason that the citizens do not get pure water. So, this system is not adequate. Our proposed system will overcome these problems.

3. PROPOSED SYSTEM

The objective of proposed system is to provide methods for Portable and Automatic Water Quality Monitoring and Notification System which saves time and to mainly reduce the human intervention. This notification will be updated to the authorized person when sensor will detect the quality of water is changes. The data is stored in the cloud and it is seen by using BYLNK app. For these features, this System has a mobile device and field setup device to monitor water quality remotely. Here ARDUINO UNO is used as core controller and various sensors to monitor the water Quality. The block diagram of the proposed system is shown in Figure 1. Arduino OS run on the Arduino to manage various types of equipment including sensors and so on. Different sensors are connected to Arduino to monitor the conditions of water. The Arduino will access the data from different sensors and then processes the data. The sensor data can be viewed on the LCD and cloud.

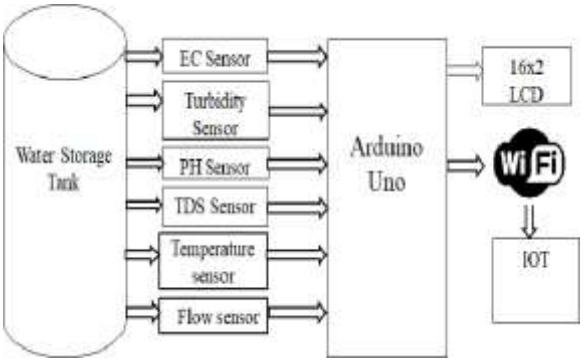

Fig -1: Block diagram of the proposed system

3.1 pH Sensor (SKU: SEN0161)

A pH meter is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity expressed as pH [2]. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in electrical potential relates to the acidity or pH of the solution. pH is the hydrogen-ion concentration in water-based solutions, which indicates the acidity and alkalinity in the solution. The pH scale is a logarithmic scale whose range is from 0-14 with a neutral point being 7. Values above 7 indicate a basic or alkaline solution and values below 7 would indicate an acidic solution. The normal range of pH is 6 to 8.5.

Fig -2: pH Sensor (SKU: SEN0161)

3.2 Turbidity Sensor

Turbidity is the measure of a number of particles in the water. In this system Turbidity Sensor (SEN0189) is used for measuring the Turbidity which is shown in Figure 3. Turbidity is measured in Nephelometric Turbidity Units (NTU). It is taken as the optical property of water and is an expression of the amount of the light that is scattered by the suspended particles in the water when a light is shined through the water sample. As the intensity of scattered light is increased, the turbidity increases. During the period of low flow, many rivers are a clear green color, and turbidity is low, usually less than 10 NTU. During rainstorm, floods, water flows fast and mixes with the different particles, which makes the turbidity of water high.

Fig -3: Turbidity Sensor (SEN0189)

High Turbidity has effect in the lakes, rivers and ponds. Because of the turbidity lakes and ponds are filled faster with the solid particles and causes aquatic life in danger for habitat. These kinds of particles provide the place which could be suitable for the pollutants, mostly metals and bacteria. This is the reason why turbidity measurements can be used as one of the indicator of possible pollution in a water body.

3.3 Temperature Sensor

The LM35 temperature sensor is used to detect precise centigrade temperature. The output of this sensor changes describes the linearity. The o/p voltage of this IC sensor is linearly comparative to the Celsius temperature. The operating voltage range of this LM35 ranges from -55 to +150degree Celsius and it has low-self heating. This is operated under 4 to 30 volts. The most extensively used electronic devices are operational amplifier, which are certain kind of differential amplifier. Temperature sensor circuit has terminals such as two inputs like non-inverting (+) and inverting (-) and only one output pin. Operational amplifier IC741 is used as a non-inverting amplifier. The variation between the I/P terminals amplifies the circuit.

The amount produced by IC2 amplifier in an amount to the temperature by 10 mV per degree. This unstable voltage is supply to a comparator IC 741. OP Amplifier is the most generally used electronic devices today. The IC 741 op-amp is one sort of differential amplifier. We have used IC741 as a non-inverting amplifier which means pin-3 is the input and output is not inverted. This LM35 temperature sensor circuit amplifies the difference between its input terminals. The advantages of temperature sensor include it has no effect on the medium, more accurate, it has an easily conditioned output and it responds instantly. Temperature sensor is shown in Figure 4.

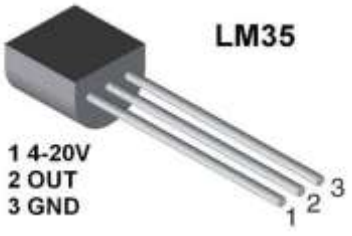

Fig -4: Temperature Sensor

3.4 TDS Sensor

Dissolved solids refer to any minerals, salts, metals dissolved in water. Total dissolved solids (TDS) comprise in organic salts (principally calcium, magnesium, potassium, sodium, bicarbonate, chlorides, and sulphate) and some small amounts of organic matter that are dissolved in water. TDS (Total Dissolved Solid) sensor kit which is compatible with IoT Device, plug and play, easy to use. This is shown in Figure 5. TDS detector is easy to build to measure the TDS value of liquid. This sensor supports with 3.3 ~ 5.5V wide voltage input, and 0 ~ 2.3V output voltage which makes it compatible with 5V or 3.3V control system or board. The excitation source is AC signal, which can effectively prevent the probe from polarization and prolong the life of the probe, meanwhile, increase the stability of the output signal and this TDS sensor Measurement Range is 0 ~ 1000ppm.

The TDS probe is waterproof; it can be immersed in water for long time measurement. This sensor can be used in water quality application, such as domestic water, hydroponics. With this sensor, you can easily DIY a TDS detector to reflect the cleanliness of water to protect your health.

Fig -5: TDS Sensor

3.5 Conductivity Sensor

Measuring electrical conductivity in liquid substance is a highly powerful diagnostic and analytical tool in a range of application in spite of its simplicity. The latest thin-film conductivity sensor element is a suitable alternative to the bulky, classical conductivity sensor of the past. Conductivity sensor in shown in Figure 6. An electrolyte is a liquid that contains ions. The ions behave as charge carriers and a current flow when a voltage is applied. Hence the liquid quality can be assessed by determining the conductivity. The liquid conductivity is based on two temperature dependent parameters that include ion concentration and their mobility. A temperature sensor is placed directly at the measurement point for improved accuracy.

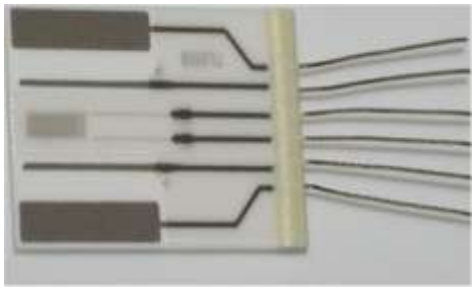

Fig -6: Conductivity Sensor

3.6 Flow Sensor

It is used to the know the water flow in the water purifier. A mass (air) flow sensor (MAF) is a sensor used to determine the mass flow rate of air entering a fuel-injected internal combustion engine. The air mass information is necessary for the engine control unit (ECU) to balance and deliver the correct fuel mass to the engine. Air changes its density with temperature and pressure Working voltage of this sensor ranges from 5v to 24v.Flow rate is ranges from 1~30L/min. Maximum current range is 15mA (DC 5v). The operating pressure of this sensor is under 1. 2Mpa.Operating temperature is from 0degree Celsius to 80degree Celsius. The flow sensor is shown in figure 7.

Fig -7: Flow Sensor

3.7 ARDUINO UNO

Arduino is a microcontroller board based on the ATmega328P. It has 14 digital input and output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything need to support the microcontroller. Arduino Software (IDE) were the reference versions of Arduino, now evolved to new releases. The Uno board is the first in a series of USB Arduino board, and the reference model for the Arduino platform. Arduino is a single-board microprocessor to make using electronics in multidisciplinary projects more accessible. Arduino is shown in Figure 7. The hardware consists of an open-source hardware board designed around an 8-bit Atmel AVR microprocessor, or a 32-bit Atmel ARM. The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller.

Fig -8: ARDUINO UNO

3.8 Wi-Fi Module

The ESP8266 Wi-Fi Module is a self SOC with integrated TCP/IP protocol s that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module come pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost effective.

Fig -9: Wi-Fi Module

3.9 Lab View

Laboratory Virtual Instrument Engineering Workbench is a system-design platform and development environment for a visual programming language from National Instruments. The graphical language is named "G"; not to be confused with G-code. LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of operating systems, including Microsoft Windows, various versions of Unix, Linux, and mac OS. Dataflow programming. The programming language used in LabVIEW, also referred to as G, is a dataflow programming language. Execution is determined by the structure of a graphical block diagram (the LV-source code) on hitch the programmer connects different function-nodes.

4. SOFTWARE IMPLEMENTATION

4.1 Internet of Things (IoT)

Global network of “smart device” that can sense and interrelate with their environment using the internet for their communication and interaction with users and other systems. The main conceptions behind every IoT technology and implementation are “Device is integrated with virtual world of Internet and interacts with it by following, sensing and monitoring object and their environment”.

4.2 ARDUINO IDE

Arduino is an Open-source-electronic-prototyping base for simple hardware and software in the field of micro controlling. The software that is used to program the microcontroller, is open-source-software and can be downloaded for free on www.arduino.cc. With this “Arduino software” can write little programs by which the microcontroller should perform. This program is called “Sketch”. In the end the sketches are transferred to the microcontroller by USB cable.

4.3 Blynk app

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After downloading the Blynk app, one can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen. Using the widgets, pins can turn on and off or display data.

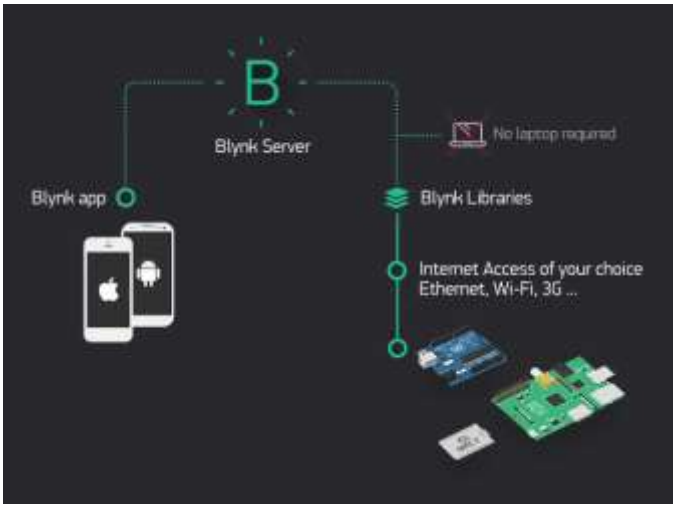

Fig -10: Architecture of Blynk IoT platform

5. HARDWARE SET UP

Fig -11: Prototype of the automatic water purifier system

All the data from the sensors are processed analyzed, and transmitted wirelessly to a notification node. Algorithms are developed to detect possible contaminations. The notification node informs the user as to whether the water quality parameters are normal or abnormal.

Fig -12: Display of water parameters

6. RESULTS AND DISUCSSION

This paper focused on analysing the water quality with high performance, real time and accurate. In our proposed system we have measured TDS, Temperature, Turbidity and pH values of water with the help of Arduino and various Sensors. In future, the parameters like conductivity, hardness, chloride, ammonia, iron, fluoride etc. also considering water quality measurement and these values are used to check the purity of the water for many purposes such as drinking water and daily requirements.

The collected data from the all the sensors are used for analysis purpose for better solution of water problems. The data is sends to the cloud server via Wi-Fi module ESP8266 and graph seen in lab VIEW. So, this application will be the best challenger in real time monitoring & control system and use to solve all the water related problems. An efficient, real-time water quality monitoring system based on IoT is presented. Central base station and nodes are connected through IoT networks and base station is interfaced to internet so that users can login and get the real time water quality data. Future works include the using of more efficient routing algorithms to extend the network to wide area. A future work also lies on Integration of turbidity sensor, dissolved oxygen sensor and colour sensor to the sensors used in this work. Monitoring of Turbidity, pH of Water uses corresponding sensors. The system can monitor water quality automatically, and it updates the parameter details automatically to the cloud server. The proposed water quality testing has to be more cost-effective, suitable and rapid. The system has good flexibility by replacing the corresponding sensors and changing the appropriate python programs. This system can be used to monitor other water quality parameters. The operation is simple. The system can be prolonged to examine hydrologic, air pollution, industrial and agricultural fabrication and so on. By using water quality method shows the monitoring of water which is suitable for drinking. Due to the monitoring of water parameters like pH, TDS, electrical conductivity etc., helps to decrease the severe human disease.

REFERENCES

[1] T. T. Binh, T. N. Thinh, and B. V. Hieu. Applying CoAP for sleepy devices in wireless water quality monitoring systems. In Proceedings of International Conference ADVCIT - APPEIC - REEGETECH, pages 76–82, Bandung, Indonesia, 2014.

[2] W. Ding and Y. Ma. The application of wireless sensor in aquaculture water quality monitoring. In D. Li and Y. Chen, editors, Computer and Computing Technologies in Agriculture V: 5th IFIP TC 5/SIG 5.1 Conference, CCTA 2011, Beijing, China, October 29-31, 2011, Proceedings, Part III, pages 502–507, Berlin, Heidelberg, 2012. Springer Berlin Heidelberg.

[3] K. G.Sutar. Development of wireless sensor node for water quality monitoring in intensive fish culture. International Journal of Science and Engineering, 1(2), 12 2013.

[4] Li Zhenan, Wang Kai, Liu Bo, "Sensor-Network based Intelligent Water Quality Monitoring and Control", International Journal of Advanced Research in Computer Engineering &Technology (IJARCET) Volume 2, Issue 4, April 2013.

[5] K. G.Sutar and P. T.Patil. Wireless sensor network system to monitor the fish farm. International Journal of Engineering Research and Applications, 3(5):194–197, 9-10 2013.

[6] J. Huan, X. Liu, H. Li, H. Wang, and X. Zhu. A monitoring and control system for aquaculture via wireless network and android platform. Sensors and Transducers, pages 250–256, 4 2014.

[7] M. Lin, Y. Wu, and I. Wassell. Wireless sensor network: Water distribution monitoring system. Radio and Wireless Symposium, 2008 IEEE, 1 2008.

[8] L. Qi, J. Zhang, M. Xu, Z. Fu, W. Chen, and X. Zhang. Developing wsn- based traceability system for recirculation aquaculture. Mathematical and Computer Modelling, 8 2009.

[9] Z. Rasin and M. R. Abdullah. Water quality monitoring system using zigbee based wireless sensor network. International Journal of Engineering and Technology IJET-IJENS, 9(10), 12 2010.

[10] Santoshkumar and V. Hiremath. Design and development of wireless sensor network system to monitor parameters influencing freshwater fishes. International Journal on Computer Science and Engineering, (6):1096–1103, 6 2012.

[11] D. S. Simbeye and S.-F. Yang. Water quality monitoring and control for aquaculture based on wireless sensor networks. Journal of Networks, 9(4):840–849, 2014.

[12] S. Sridharan. Water quality monitoring system using wireless sensor network. International Journal of Advanced Research in Electronics and Communication Engineering, 399–402, 4 2014.

[13] Texas Instrument. A True System-on-Chip Solution for 2.4- GHz IEEE802.15.4 and ZigBee Applications, 2 2011. Report on Water Quality Monitoring "Hot Spots" in Rivers of India (Central Water Commission, New Delhi), Aug, 2011.

[14] Guidelines for Water Quality Monitoring Central", Central Pollution Control Board, 2007-2008.

[15] Sneha Angal , "Raspberry pi and Arduino Based Automated Irrigation System", International Journal of Science and Research, Volume 5 Issue 7, July 2016.