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WATER QUALITY MONITORING SYSTEM

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ABSTRACT

Water is one of the needs with remarkable significance to man and other living things. Water quality management is a concept based on the continuous monitoring of water quality. The monitoring scheme aims to accumulate data to make decisions on water resource descriptions, identify real and emergent issues involving water pollution, formulate priorities, and plan for water quality management. The regularly considered parameters when conducting water quality monitoring are turbidity, pH, temperature, conductivity, dissolved oxygen, chemical oxygen demand, biochemical oxygen demand, ammonia, and metal ions. The usual method employed in capturing these water parameters is the manual collection and sending of samples to a laboratory for detection and analysis. However, this method is impractical in the long run because it is laborious and consumes a considerable amount of human resources. Sensors integrated into a mobile phone application interface can address this issue. This paper aims to design and implement an Internet of Things-based system comprising pH, temperature, and turbidity sensors, which are all integrated into a mobile phone application interface for a water monitoring system. This project utilizes the Bluetooth Standard (IEEE 802.15.1) for communication/transfer of data, while the water quality monitoring system relies on the pH, turbidity, and temperature of the test water.

Keywords: *Temperature sensor, pH sensor, Turbidity sensor, Bluetooth module.*

1. INTRODUCTION

The water quality parameters pH measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7pH value, less than 7pH has acidic, more than 7pH has alkaline. The range of pH is 0-14 pH. For drinking purpose it should be 6.5-8.5pH. Turbidity measures the large number of suspended particles in water that is invisible. Higher the turbidity higher the risk of diarrheoa, collera. Lower the turbidity then the water is clean. Temperature sensor measures how the water is, hot or cold. Flow sensor measures the flow of water through flow sensor. The traditional methods of water quality monitor involves the manual collection of water samples from different locations.

With the rapid development of the economy, more and more serious problems of environment arise. Water pollution is one of these problems. Routinely monitored parameters of water quality are temperature, pH, turbidity . The most common method to detect these parameters is to collect samples manually and then send them to laboratory for detecting and analyzing. This method wastes too much man power and material resource, and has the limitations of the samples collecting, long-time analyzing, the aging of experiment equipment and other issues. Sensor is an ideal detecting device to solve these problems. It can convert power information into electrical signals. It can easily transfer process, transform and control signals, and has many special advantages such as good selectivity, high sensitivity, fast response speed and so on. According to these characteristics and advantages of sensors, Monitoring of Turbidity, PH & Temperature of Water is designed and developed. The system implements automation, intelligence and network of water quality monitoring, and uses manpower, material and financial resources sparingly.

Freshwater is a world resource that is a gift of nature and important to farming, manufacturing, and the life of human beings on earth. Currently, drinking water facilities face new real-world problems (Shafi et al., 2018) (Siregar et al., 2017). Due to the limited drinking water resources, intensive money requirements, growing population, urban change in rural areas, and the excessive use of sea resources for salt extraction has significantly worsened the water quality available to people (Chen & Han, 2018) (Meng et al., 2017). The high use of chemicals in manufacturing, construction and other industries, fertilizers in farms and also directly leaving the polluted water from industries into nearby water bodies have made a huge contribution to the global water quality reduction, which has become an important problem (Cloete et al., 2014). Even due to containment water various water born are increasing day by day, due to which many human beings are losing their lives. Traditionally, detection of water quality was manually performed where water samples were obtained and sent for examination to the laboratories which is time taking process, cost and human resources (Das & Jain, 2017) (He & Zhang., 2012). Such techniques do not provide data in real-time. The proposed water quality monitoring system is consisting of a microcontroller and basic sensors, is compact and is very useful for pH, turbidity, water level detection, temperature and humidity of the atmosphere, continuous and real-time data sending via wireless technology to the monitoring station (Sugapriyaa et al., 2018) (Barabde & Danve., 2015).

2. LITERATURE REVIEW

The protocols and standards required for implementing the wireless sensor network in various industries differ. Hence, new/existing standards and protocols must expand the wireless sensor network application to the industrial circle [15]. The majority of the standards used in wireless

communication are supported by the IEEE standards, which include IEEE802.11, IEEE802.15.1, IEEE802.15.4, and IEEE 802.16 [16]. This standard applies to the physical (PHY) and media access control layers of the wireless personal area network. The IEEE802.11 is a networking infrastructure used by wireless fidelity (Wi-Fi) local area wireless networking. The Bluetooth network (IEEE802.15.1) is configured as a wireless personal area network with one main function, that is, to link devices to a personal computer or cell phone. The IEEE802.15.4 is designed for low-cost, minimal power, low to moderate/average information rate and optimization applications [16]. IEEE802.16 is the foundation for wireless metropolitan area network design. Another protocol that supports IoT technology is the ZigBee, which was developed in 2004 by ZigBee Alliance. The protocol currently has three models: ZigBee 2006, ZigBee 2007 otherwise known as ZigBee, and ZigBee PRO. All the models of the ZigBee standard generally have some features. For instance, the models are capable of handling mesh networks utilizing multiple types of network equipment. Wireless networking is one of the most desired innovations because it delivers the same benefits as a wired connection, including minimum deployment and operating costs. However, specific problems must be considered when merging several wireless technologies into the same vital network. The issues principally include the interaction between wireless structures (Bluetooth), radio frequency identification, wireless sensor networks utilizing IEEE 802.15.4, WiMAX (that is, IEEE 802.16), and Wi-Fi/IEEE 802.11, compatibility with current hardware–software elements, privacy, and connectivity efficiency. Each of these specifications was recently proposed by HART to describe a particular framework as a component of the HART Field Communication Protocol Revision 7. The latest standard, which is known as Wireless HART, aims to provide commercial solutions via wireless mesh networks comprising node classes [17]. ISA100.11 version one is an open platform accepted by the ISA100 protocol board in 2009. This model emphasizes the delivery of a range of automation and process control facilities. The fundamental purpose is to maintain information sharing with other contact networks, compliance with current hardware and software networks, energy efficiency, durability, and stability. The specification provides a collection of rules and procedures for controlling a non-sensitive and essential process, including manufacturing and management structures, such as the supervisory control and data acquisition system. LoRa, which means long range, is classified as a low-power wide-area network system. Spread spectrum modulation, which is derived from the chirp spread spectrum system, is the foundation of the LoRa [18].

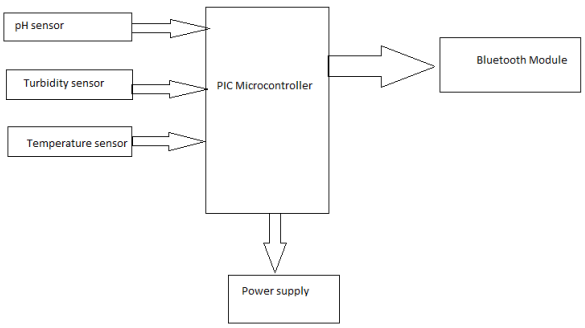
3. MEASUREMENT PARAMETERS OF WQM SYSTEM

Basically, there are many parameters that are needed to be measured for water quality analysis. However, the WQM system proposed measures the key water parameters:

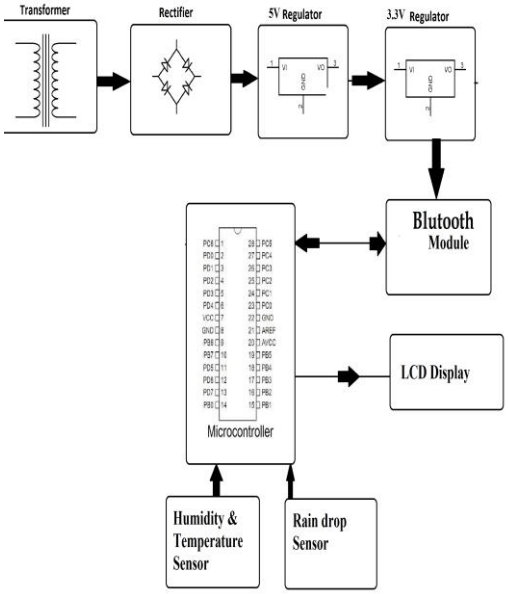
- Water's pH value
- Turbidity of the water
- Temperature

4. METHODOLOGY OF THE PROPOSED SYSTEM

The proposed system uses sensors which are pH, turbidity, temperature, microcontroller unit as the main processing module and one data transmission module Bluetooth module. The microcontroller unit is a significant part of the system developed for water quality measurement. Among the all sensors, two of the sensors collect the data in the form of analog signals; the MCU has an on-chip ADC that translates the sensor analog signals into the digital format for further study. So, to get this analog output from the sensor, the sensor's analog output of will be connected to the MCU's analog pins. Whereas the other two sensors output directly connected to the digital pins of the MCU units. All the sensors data processed by the MCU and updated to the server using the data communication module to the central server . The block diagram of the system proposed for water quality measurement is shown in Figure 1. The whole system is designed in Embedded-C and simulating the written code using PIC Microcontroller. In order to collect data on pH, turbidity ,temperature the water quality monitoring system employs sensors.



5. FLOWCHART



6. LIMITATIONS

The system was only implemented for a day, and certain areas of concern were not tested. If any fault occurs in hardware devices then we are not able to monitor the quality of water. When quality of increases then each and every time we have change the system range. Limited sensor parameters for testing. The system was calibrated manually, which effectively reduced system accuracy.

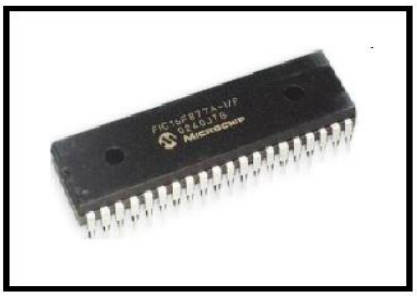
7. ACTUAL WORK

This section describes an IoT-based water quality monitoring system comprising hardware components and software platforms. Some of the tasks performed include design specification, design concept and materials, and method.

The whole design of the system is based mainly on IOT which is newly introduced concept in the world of development. There is basically two parts included, the first one is hardware & second one is software. The hardware part has sensors which help to measure the real time values, another one is PIC microcontroller converts the analog values to digital one, & LCD shows the displays output from sensors Bluetooth module gives the connection between hardware and software. In software we developed a program based on embedded c language. The PCB is design at first level of construction and component and sensors mounted on it. HC-05 app is installed in the android version to see the output. When the system get started dc current given to the kit and PIC microcontroller and Bluetooth gets on. The parameters of water is tested one but one and their result is given to the LCD display. The app went provided with Bluetooth connection gives the exact value as on LCD display shows on kit.

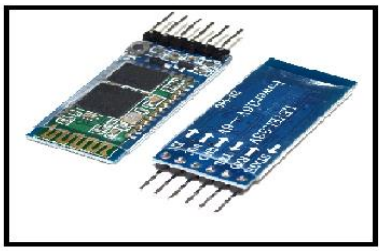
8. COMPONENTS

PIC Microcontroller: PIC is a Peripheral Interface Microcontroller which was developed in the year 1993 by the General Instruments Microcontrollers. It is controlled by software and programmed in such a way that it performs different tasks and controls a generation line.



HC-05 Bluetooth Module:

The HC-05 Bluetooth module runs on the serial port profile concept. This module is built exclusively for serial wireless communication. Moreover, the Bluetooth module is designed for the 3 Mbps modulation with a complete 2.4 GHz wireless transceiver and baseband Bluetooth V2.0 + enhanced data rate. The Bluetooth device with CMOS and adaptive frequency hopping feature is based on CSR Bluecore 04-External single chip. The Bluetooth module has low prices, reduced power usage, and a high degree of connectivity from a wide distance. The sensitivity of the Bluetooth module is −80 dBm. This module also uses the UART protocol, which has a baud rate that can be configured. The baud speed used is typically 36,800, and the data packet normally comprises 8 bits, 1 stop, and no parity bits. These Bluetooth modules have two modes: master and slave device. The consumer can customize modes as a master or slave with AT commands for a device with an odd number, such as HC-05 [36].



pH sensor: The pH of a solution is the measure of the acidity or alkalinity of that 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. It operates on 5V power supply .The normal range of pH is 6 to 8.5.

pH measurement is based on the use of a pH sensitive electrode (usually glass), a reference electrode, and a temperature element to provide a temperature signal to the pH analyzer. The pH electrode uses a specially formulated, pH sensitive glass in contact with the solution, which develops a potential (voltage) proportional to the pH of the solution. The reference electrode is designed to maintain a constant potential at any given temperature, and serves to complete the pH measuring circuit within the solution. It provides a known reference potential for the pH electrode. The difference in the potentials of the pH and reference electrodes provides a millivolt signal proportional to pH. Most pH sensors are designed to produce a 0 mV signal at 7.0 pH, with a (theoretically ideal) slope (sensitivity) of -59.16 mV / pH at 25°C.

Turbidity sensor: Turbidity is a measure of the cloudiness of water. Turbidity has indicated the degree at which the water loses its transparency. It is considered as a good measure of the quality of water. Turbidity blocks out the light needed by submerged aquatic vegetation. It also can raise surface water temperatures above normal because suspended particles near the surface facilitate the absorption of heat from sunlight.

Turbidity is the calculation of the water clearness, i.e. the number of particles suspended in the water. It uses light to detect suspended particles to evaluate light transmit and dispersion rate. The calculation measures the numbers of water particles floating in the water, for example, plant waste, sand, silt and clay, impacting the sunlight in water (Daigavane & Gaikwad, 2017). The rate changes with the total number of particles suspended in water. Total Suspended Solids (TSS) increases in water with increasing turbidity. The sensor produces both digital and analog mode output (Shafi et al., 2018). The input voltage of the sensor is 5V with an analog output voltage ranging from 0 to 4.5V. It can withstand a maximum temperature of 100 C–900 C. The NTU (Nephelometric Turbidity Units) is its units. In essence, the sensor is positioned to the side of the beam. When light reaches the sensor, if many small particles are dispersed in the water, this small particle will be detected by the source beam.

Temperature sensor: Water Temperature indicates how water is hot or cold. The range of DS18B20 temperature sensor is -55 to +125 ℃. This temperature sensor is digital type which gives accurate reading. The temperature sensor is an electronic device that converts temperature into an electrical signal. A temperature sensor is a device which can be a Thermocouple or RTD (Resistive Temperature Detector) that provides temperature measurement in a readable form through an electrical signal.

9. CONCLUSION

In this paper, Water is one of the needs with considerable significance to man and other living things. However, this project reveals that a large amount of water remains unmonitored and polluted. This project attempts to address the question of utilizing WSN as a water quality monitoring system. Based on the aforementioned literature in this project, IoT has been proven to be a reliable method of monitoring and measuring water quality via the utilization of various water property sensors. This form of monitoring is flexible and economical because sensors could easily be replaced along with the required changes in the software to draw data of other parameters in water. The sensors can measure the various required parameters and send the data to the receiving/monitoring device or center through the implementation of real-time monitoring systems. Concerns related to the daily impact on human health and the environment are increasing due to the rise in mortality rate caused by the emission of gaseous and particulate pollutants from machines and industries. Therefore, monitoring air quality and creating public awareness is crucial for a safe future. Therefore, the future work aims to design a real-time IoT low-cost air quality monitoring system.

10. APPLICATIONS

- This system is used in commercial and domestic use.
- Water supply agencies.
- For health department to identify the reason of water dieses

11. FUTURE SCOPE

- Detecting the more parameters for most secure purpose
- Increase the parameters by addition of multiple sensors.

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