SMART WATER QUALITY MONITORING SYSTEM BASED ON IOT

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Abstract: *The economical and effective system of water quality observation is the most robust implementation of impure water. Drinking water could be precious for all people as water utilities face more challenges. These challenges arise due to the high population, fewer water resources, etc. So, different methods are used to monitor in the real-time water quality. To make sure that safe distribution of water is done, it must be observed in real time for a new method in the "Internet of Things (IoT)" based water quality has been projected. Real-time water quality observation is examined by data acquisition, method, and transmission with an increase in the wireless device network method in the IoT. Microcontroller and the processed values remotely to the core controller ARM with a WI-FI protocol are used to interface the measured values from the sensors. This projected the water quality observation interface sensors with quality observation with IOT setting. WQM selects parameters of water like temperature, pH level, water level and CO2 by multiple different device nodes. This methodology sends the information to the web server. The data updated at intervals within the server may be retrieved or accessed from anyplace within the world. If the sensors do not work or get into abnormal conditions, then a buzzer will be ON.*

Keywords: *Wireless Sensor Network (WSN), water parameters, Internet of things (IoT), WI-FI.*

I. Introduction

The pollution in water is increasing day by day, and many researchers and scientists are trying to solve the problem by checking and maintaining the quality of water. This paper focuses mainly on the quality checking of water. The aim of the paper is to test the water quality so that it will be n real time to keep human life safe from the

polluted water. Analyzing the condition and checking whether the water is favorable for the living beings and plants is the main target. There are different kinds of the available water quality measuring device on the market, ranging from cheap to expensive ones and house to industrial applications. Ex. Dr.Meter TDS-3C Water Quality, Sunny Water Tester ,Water quality Meter by generic, Play X-STORE Water Quality Meter ,APEC Water Systems Digital Meter and Started Filter Tester. Devices are very costly and hard to understand for the consumer and might be affordable but cannot fulfill the needs of quality checking ineffective and fast ways. And these water testers measure either turbidity or pH, but none of them measures the pH, turbidity, TDS as well as the temperature of the water. Some other waterquality testers only measure the pH of water. If all the parameters are available in the device, then that device is not affordable for common people. Since it is not available on the market, this project includes all three required parameters for checking the quality of water in affordable cost. This paper will check the value of pH, Turbidity, TDS and Temperature of the water and determines whether the water is suitable for the normal use.

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. We 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 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 to determining the quality of water in a convenient and user-friendly method for measuring the pH, Turbidity and Temperature.

II. Literature survey:

In [Geetha S and S Gotham, 2017], system is divided into three subsystems. Data management subsystem accesses the data storage cloud & displays the same to end user. Data transmission subsystem consists of a wireless communications device along with build in security feathers which transmit the data from the controller to data storage cloud. Data collection subsystem consists

of multi –parameter sensors & optional wireless communication device to transmit the sensor information to the controller, a controller gathers the data processes the same.

In [Mithila Barabde and Shruti Danve, 2015], their main aim here is to develop a system for continuous monitoring of water quality at remote places using wireless sensor networks with low power consumption, low cost and high detection accuracy.

The proposed water quality monitoring system based on WSN can be divided into three parts:

- Data monitoring nodes: The data sensed by the sensor will be passed through a signal conditioning circuit. Then the manipulated data will be given to the controller. With the help of the RF module the manipulated sensed data will be sending to the data base station
- Data base station: The data from all the nodes is collected at the data base station consisting of ARM processor. This obtained data is displayed on a LCD display.
- Remote monitoring centre: The remote monitoring station consists of a Zigbee module which will receive the data sent by the data base station. This data will be fed to a server PC consisting of Graphic User Interface (GUI) via serial communication. Also the obtained data is compared with the standard values of the water parameters. If the obtained water parameters do not match the preset values then SMS will be sending to an authorized person in order to take preventive measures.

In [Nikhil Kedia, 2015], highlights the entire water 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 water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.

In [Niel Andre Cloete et.al, 2015], In this paper the development of a a low-cost, wireless, multi-sensor network for measuring the physicochemical water parameters; enabling real-time monitoring, is presented. The system implements flow, temperature, conductivity and pH sensors from first principles. All the data from the sensors are processed and 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.

In [Poonam j et.al.,2016], the water analysis is done manually by taking the samples from the water source and send to the lab for study. To mechanize this process water quality monitoring sensors. The ARM7, ZIGBEE module and data concentrates module are physically placed in each and every water sources. The water quality monitoring sensors gather data from water.ARM7 forward that data to concentrates module through ZIGBEE module for remote transfer of data to the lab. The data concentrates which is located in each & every lake sends that data to the cloud configured server which is situated TWAD testing laboratory. The TWAD department workers monitoring this data remotely & securely provide this data to the requested users which are stored in the cloud.

In [Kulkarni Amruta and Turkane Satish, 2016], created Solar Powered Water Quality Monitoring framework utilizing remote Sensor Network. In this framework the WSN innovation controlled utilizing sun oriented board. The framework comprises hub and base station in which the hub gathers that get from the distinctive remote sensor. The hub is associated with the base station through the Zigbee innovation that fueled by the sunlight based board. This framework is ease yet in the event that the sun oriented board can't be charged due to the some environment impact then the framework will quit working. From, all above specify procedure we come to realize that each unique framework comprise some impediment however it can't meet the point of ongoing, minimal effort consistent checking of water quality parameters. Along these lines, to conquer this confinement, that lead us to be created and plan the new technique that will minimal effort, ongoing and easy to use.

In [Pradeepkumar M et.al, 2016], system consists of Turbidity, pH &Temperature sensors of water quality testing Arduino microcontroller data acquisition module, information transmitted an module, monitoring center and other accessories. Turbidity, pH & Temperature &ware are automatically detected under the control of single microcontroller all day. The single chip gets the data & then processes and analyses them, if the water quality is abnormal, the data will be sent to monitoring center & alert the public at the same time.It is convenient for management to take corresponding measures timely & be able to detect real time situations of water quality remotely.

In [Jayti Bhatt and Jignesh Patoliya ,2016], In this system we present the design of IoT Based Water Quality Monitoring System that monitor the quality of water in real time.This system consist some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature. The measured values from the sensors are processed by microcontroller to make compatible for Zigbee module. These processed values are transmitted remotely to the call controller using Zigbee protocol. Finally sensors data can view on internet browser application using cloud computing.

In [Aaina Venkateswaran et.al, 2017], Autonomous water quality monitoring system using GSM:This was developed jointly as an element of the Autonomous Live Animal Response Monitor (ALARM) Toxicity biosensor designed to be displayed in stream for continuous observation. The objective of this system is to develop a low cost wireless water quality monitoring system that aids in continuous maturation of water conditions. Their contribution during this is that the system level integration of biosensors sensing element signal processing and sensing element information management. Their system was designed to measure a suite of biologically relevant physiochemical parameters in fresh water.They measure temperature, intensity level,pH element electrical conduction.Total dissolved solid,salinity,dissolved oxygen there parameters provide insights into the current status of changing water conditions and assist in identifying pollution sources.

III. Existing System

Now a day's water is polluted due to many reasons. In this current system, the equipment cost is high, and it takes a lot of time to process. Traditional methods have the drawbacks such as long waiting time for results high cost, low measurement precision and complicated methodology.
So with the implementation in the technology, we use different methods and techniques to check the quality of water. There is a disadvantage in the existing system that the system has high complexity and low performance.

IV. Proposed System

In this proposed system the complexity reduces and the performance increases by collecting the data of the water parameters like temperature, water level, co2 and pH. The information collected is updated on the web server that can be retrieved from anywhere in the world.

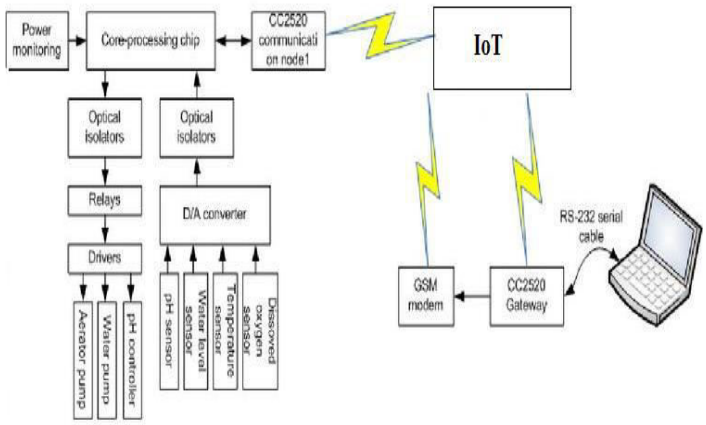

Figure 1: System block diagram

V. Implementation

1. pH Sensor

A pH is an electronic device which is used for measuring the pH level in the water. It consists of three types of probes
(i) Glass electrode
(ii) Reference electrode
(iii) Combination of gel electrode.
pH is described as the "negative logarithm" of hydrogen ion concentration in water.

pH=-log[H+]

A pH meter consists of special probes which are connected to an electronic meter that would display the reading. If the pH level is greater than 7 then it is alkaline in nature, if the pH level is less than 7 then it is acidic in nature, and generally the range of pH is 0-14pH.

Figure 2:pH Sensor

Features

a) Operating range: 0-14
b) Operating temperature: 0-45°*c*
c) Operating voltage: -5 to 5 v
d) Output voltage: analog

2. 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.

Fig 3: Turbidity sensor

3. CO2 Sensor

The co2 sensor is a device which is used to measure the carbon dioxide in the water. This system uses SKU:SEN0219 to measure the concentration which is an analog infrared co2 sensor. Parts per million (ppm) is the unit which is used for measuring the concentration of co2. One “ppm (parts per million)” is equal to 1 milligram of something per liter of water. The characteristics of this type of co2 sensors are low power consumption, high sensitivity, waterproof, and anti-corrosion, temperature compensation and stability.

Figure 4: CO2 Sensor

Features

a) Operating voltage: 4.5 to 5.5v DC
b) Output signal: Analog output(4-20mA)
c) Digital output: -150mA
d) Measuring range: 0-5000ppm

4. Water Level Sensor

“Water level sensor” is designed for detecting the water level in the reservoir and overhead tanks. This is generally utilized in sensing the water leakage, water level, and the rainfall. It consists of mainly three parts: 1MΩ resistor, an electronic brick connector and numerous lines of bare conducting wires. It works by having a series of “exposed traces” that are associated to ground. This is also interlaced between “grounded traces and the sunstrokes”. A weak pull-up resistor of 1MΩ is present. 1MΩ resistor pulls up the sensor value till a drop of water shorts the sensor trace to the grounded trace. This can measure the water droplet/water size by using a series of “exposed parallel wires”. The characteristics are it has high sensitivity and low power consumption.

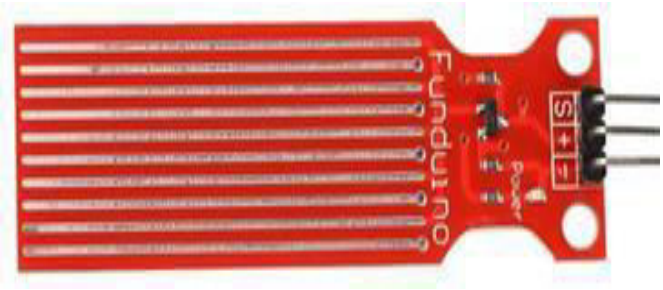

Figure 5:Water level sensor

Features

a) Operating voltage: -3 to 5 V DC
b) Operating temperature: -10°c to 30°c
c) Measuring range: 0 to 15 feet's

5. Temperature Sensor

This sensor is an "integrated circuit sensor". The yield voltage is linearly proportional to the Celsius temperature. The "LM35 sensor" is used in this project because the user cannot convert Kelvin to centigrade temperature. It is not suitable for remote applications and directly measures in Celsius. The applications of the temperature sensor are in the microwave, fridges, household devices, and air conditioners. It measures not only the heat but also measures cold temperature. They are two categories of sensors; they are "contact temperature sensor" and "non-contact temperature sensor". Contact temperature sensor is again divided into three types; they are electromechanical, resistive resistance temperature detectors, and semiconductor-based LM35, DS1820, etc.

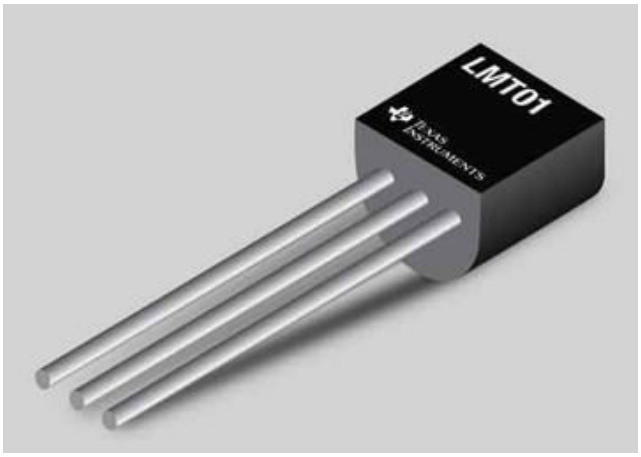

Figure 6: Temperature sensor

6. WI-FI

The WI-FI module used in this project is ESP8266. It follows TCP/IP stack and is a microchip which is less in cost. This microchip allows the microcontroller to connect to a WI-FI network, by using Hayes style command connections are done or made through TCP/IP connection. ESP8266 has 1MB of built-in flash, single chip devices able to connect WI-FI. Espressif systems are the manufacturers of this module, and it is a 32-bit microcontroller. There are 16 GPIO pins in this module. This module follows the RISC processor. It has 10 bit DAC. Later Espress if systems released a software development kit(SDK) which is used to programme on the chip so that another microcontroller is not used. Some of the SDK's are Node MCU, Arduino, Micro Python, Zerynth and Mongoose OS. SPI, I2C, I2S, UART are used for communicating between two sensors or modules. IOT gateway is discussed briefly in [7]

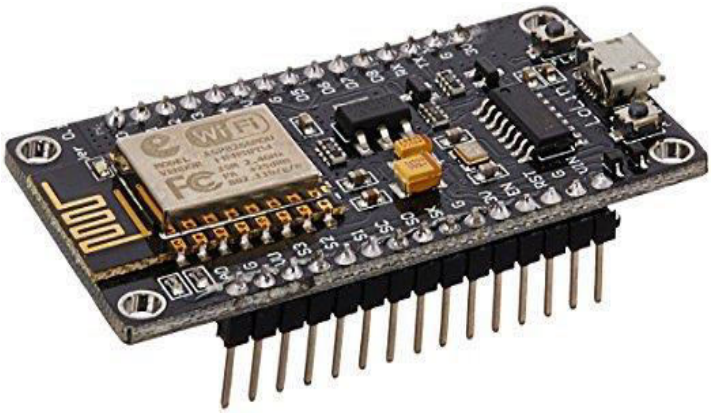

Figure 7:Wi-Fi Module

7. Arduino Uno

Arduino is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

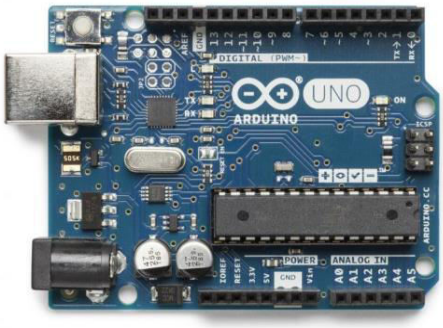

Fig 8:Arduino Uno

VI. Flow chart

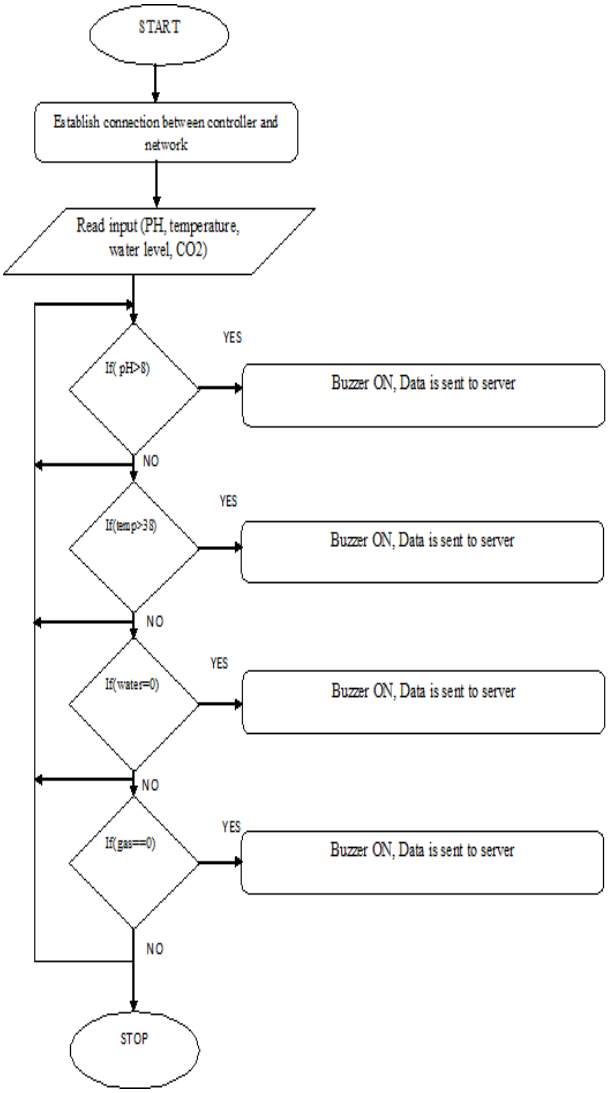

Figure 9: System Design Flow Chart

VII. RESULT & DISCUSSION

We have identified a suitable implementation model that consists of different sensor devices and other modules, their functionalities are shown in figure. In this implementation model we used ATMEGA 328 with Wi-Fi module. Inbuilt ADC and Wi-Fi module connects the embedded device to internet. Sensors are connected to Arduino UNO board for monitoring, ADC will convert the corresponding sensor reading to its digital value

and from that value the corresponding environmental parameter will be evaluated.

After sensing the data from different sensor devices, which are placed in particular area of interest. The sensed data will be automatically sent to the web server, when a proper connection is established with sever device.

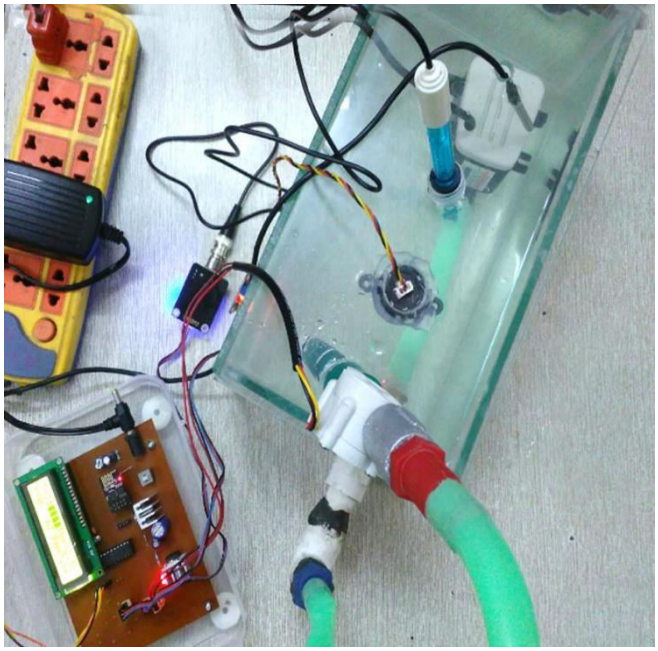

Fig 10:System design model of water quality monitoring system using IOT

VIII. CONCLUSION AND FUTURE SCOPE

Conclusion: Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost 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. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.

By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the Wi-Fi.

Future Scope:

- ✓ In future we use IOT concept in this project
- ✓ Detecting the more parameters for most secure purpose
- ✓ Increase the parameters by addition of multiple sensors
- ✓ By interfacing relay we controls the supply of water

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