VISVESVARAYA TECHNOLOGICAL UNIVERSITY
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K.L.E. COLLEGE OF ENGINEERING AND TECHNOLOGY, CHIKODI – 591201, KARNATAKA

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

A Seminar Report on,

"IOT BASED WATER QUALITY MONITORING SYSTEM"

submitted in partial fulfillment for the award of the Degree of

BACHELOR OF ENGINEERING
IN
COMPUTER SCIENCE & ENGINEERING

Submitted by,
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2019-20

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Certificate of Approval of Seminar

This is to certify that **Mr. Mamjunath Mushi** bearing **USN: 2KD16CS045,** has satisfactorily completed the Seminar entitled **"Iot Based Water Quality Monitoring System"** for the partial fulfillment of Bachelor of Engineering in Computer Science and Engineering prescribed by the **Visvesvaraya Technological University, Belagavi** for the academic year 2019-20. The seminar has been approved as it satisfies the academic requirements in Seminar prescribed for the VIII semester of Bachelor of Engineering Degree.

Guide	HoD	Principal
Prof. Mallappa Gurav	**Prof. Satish S Bhojannawar**	**Dr. Prasad Rampure**

ACKNOWLEDGEMENT

The success and final outcome of this seminar required a lot of guidance and assistance from many people and I am extremely fortunate to have got this all along the completion of the seminar. Whatever I have done is only due to such guidance and the assistance.

I owe my profound gratitude to my seminar guide **Prof. Mallappa Gurav** and Head of the Department **Prof. Satish S Bhojannawar**, who look keen interest in my seminar and guided me all along, till the completion of my seminar presentation by providing all the necessary information and valuable suggestion for a good presentation. I also thank for his continuous support and permitting to make use of the facilities available in the department.

I express my sincere gratitude to **Dr. Prasad B. Rampure**, Principal, KLE College of Engineering & Technology, Chikodi for his support and encouragement in this regard.

I am also thankful and fortunate enough to get constant encouragement, support and guidance from entire teaching and non-teaching staff of Department of Computer Science and Engineering who helped us in successful completion of my seminar.

Last but not the least, I am thankful to my Parents, family members and all my friends for their support and help, extended during this seminar.

Mr. Manjunath Mushi

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ABSTRACT

Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. In this paper we present a design and development of a low cost system for real time monitoring of the water quality in IOT(internet of things).The system consist of several sensors is used to measuring physical and chemical parameters of the water. The parameters such as temperature, PH, turbidity, flow sensor of the water can be measured. The measured values from the sensors can be processed by the core controller. The Arduino model can be used as a core controller. Finally, the sensor data can be viewed on internet using WI-FI system.

Keyword: pH sensor, Turbidity sensor, Temperature sensor, Flow sensor, Ardurino model, WI-FI module.

CONTENTS

CHAPTER 1

INTRODUCTION

As per increase in water pollution, there is need of controlling pollution in water is finished by monitoring Water quality. Our System consists of various sensors which will compute the standard values of water in real-time for effective action and is accurate and only less manpower required.The impact of water on any living beings is beyond description. With the rapid increase of world population, water management becomes an important issue specially in industrial, agricultural and other sectors. Most of the people around the world lack behind drinkable water. Every year many people are suffering from various fatal diseases caused by water pollution. Research has found that around 5 million death is caused only because of drinking unsafe water. Research by WHO (World Health Organization) shows that almost 1.4 million of child death can be prevented by providing drinkable water to them. The primary objective of this project is to introduce an intelligent water quality monitoring system in IoT (Internet of Things) platform which would help to monitoring different physical parameters of the drinkable water rather than relying on manual process. Moreover, IoT is a system of alliance among various devices and the competence of deportation data over the system. WHO also estimates that 21% of diseases are related to unsafe water in India. Also, more than 1600 deaths alone cause due to diarrhea in India daily. Therefore, various water quality parameters such as dissolved oxygen (DO), conductivity, pH, turbidity and temperature should be monitored in real time.

Several research works have been conducted in recent times to develop intelligent system to identify and monitor water parameters. For real time monitoring of water quality and delivery, an in-pipe monitoring system based on sensor nodes is proposed. Their proposed architecture focused on the low cost, lightweight implementation, pipeline electrochemical system and the sensors that are used for this architecture are optical sensors. This system is appropriate for large amount categorizations enabling an approach to water purchaser, water distributers and water supremacies. Authors in has developed a broker-less architecture framework for both publisher and subscriber for monitoring water quality. They analyzed the measured data of temperature, pH and dissolved oxygen from water samples and results an inversely proportional relationship among them. An IoT based remote sensing system is introduced for collecting, monitoring and analyzing water quality

in remote area for Fizi. In article, a smart IoT based technology is explained for real time water quality monitoring system. An industrial water quality monitoring system using four different sensors e.g. turbidity, pH, temperature and level of water is developed in . The goal of this research is to develop a smart water quality monitoring (SWQM) system using the IoT platform. Four physical parameters: temperature, pH, conductivity and turbidity of different water samples are measured via four sperate sensors equipped with Arduino Uno. The extracted sensor data are analyzed using the fast forest binary classifier.

Water is one of the essential parts of life. Water pollution is one of the big problems to the world. In order to ensure the safe supply of the drinking and useful water for different purposes like agricultural, the water should be monitored. This paper presents a design of a low cost system for real time monitoring of the water quality and quantity of water in IOT (internet of things). The system having of several sensors is used to measuring physical of the water. The parameters flow sensor of the water can be measured. The measured values from the sensors can be processed by the controller. The Arduino model can be used as a controller. Finally, the sensor data can be shown on internet using WI-FI system. A cloud server was configured as data saving and analysis. This data can be used in future research and development..

Currently drinking water is very prized for all the humans. In recent times water levels are very low and water in the lakes are going down. So its too important to find the solution for water monitoring & control system. IoT is a solution. In recent days, development in computing and electronics technologies have triggered Internet of Things technology. Internet of Things can be describe as the network of electronics devices communicating among them by the help of a controller. The IoT is a collection of devices that work together in order to serve human tasks in a efficient manner. It combine computational power to send data about the environments. These devices can be in form of sensors, appliances, embedded systems, and data analysis microchips. This paper present a low cost water monitoring system, which is a solution for the water wastage and water quality. Microcontrollers and sensors are used for that system. Ultrasonic Sensor is used to measuring water level.

The other parameters like pH, TDS, and Turbidity of the water can be calculated using different corresponding sensors. This system use the flow sensor which can measure

the water flow and if the necessary quantity of water flow through the pipe then water flow can be stopped automatically. The calculated values from the sensors can be processed by the Microcontrollers and uploaded to the internet through the Wi-Fi module (ESP 8266). Analysis we can do by this process, how much water is used in certain time, in a day or in a month. Alerts messages and data generated by the sensors are transmitted over the Internet to a cloud server and can be received by user terminal owned by consumers. The data which is obtained from the sensors can be shown on the internet and provides facilities for screening the data on mobile phones or web application.

The water quality parameter pH show water is acidic or basic. Pure water has 7 pH value, less than 7 values indicate acidity and more than 7 indicate alkalinity. The normal range of pH is 6 to 8.5. In drinking water if the normal range of pH doesn't maintain it causes the irritation to the eyes, skin and mucous membranes. Also, it causes the skin disorders. The dissolved oxygen (DO) is indicated the oxygen that dissolved in water. It makes the drinking water taste better. The conductivity indicates the ability of water to pass an electrical current.

1.2 OBJECTIVE

- The objective of this water quality monitoring system using internet of things is to find the quality of the water by checking some parameters such as pH, conductivity, temperature, water level.
- To measure critical water quality parameters such as physical and chemical properties .
- System must be low cost , more efficient as well as processing , sending and viewing data on cloud through Wi-Fi to mobile.

- To collect data from various sensor nodes and send it to base station by wireless channel.

CHAPTER 2
LITERATURE SURVEY

[1] . Aaina Venkateswar an, Harsha Mends P, Prof Priti Bader, ” An IoT Based System for Water Quality Monitoring.”, DOI 10.1186/s40713-017-0005-y (2017).IEEE 4th Global Conference on Consumer Electronics (GCCE)

In the studies from [1] the author proposed that an IoT based water monitoring system that measures water level in real-time. The model is based on idea that the water level can be very important parameter when it comes to the flood occurrences especially in disaster prone areas. A water level sensor is used to detect the desired parameter, and if the water level reaches the parameter, the signal will be feed in real time to social network like Twitter.

[2] . Vaishnavi V.Daigavane ,Dr. M.A Gaikwad ”Water quality monitoring system based on IoT” Advances in Wireless and Mobile Communication, ISSN 0973-6972 Volume 10,, Number 5 (2017).

To ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this paper, we present the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists 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 and this processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing.

[3] “Karthick. T, Gayatri Dutt, Tarunjot Singh Kohli, Snigdha Pandey ” Prediction of Water Quality and Smart Water Quality Monitoring System in IoT Environment. ” ,(2015), 2017 IEEE Conference on Systems, Process and Control (ICSPC 2017), 15–17 December 2017, Melaka, Malaysia

The paper suggests an Internet of Things (IoT) based system implementation by embedding the Radio Frequency Identification (RFID) system, Wireless Sensor Network (WSN) platform and Internet Protocol (IP) based communication into a single platform for water quality monitoring (WQM) purpose. The measured water parameter in this proposed system is pH level by using an analog pH sensorThis novel proposed system prototype was evaluated in a real environment to ensure that the main functionality on pH measuring process is following the design requirements. Several experimental analysis were conducted including the energy analysis and communication read range analysis to study the overall performance of the proposed system.

[4] . Anuradha T, Bhakti, Chaitra R, Pooja D,"IoT Based Low Cost System for Monitoring of Water Quality in Real Time Environment."SciPollut Res 22(7):4894906 (2015). 2015 update and MDG assessment. World Health Organization, 2015.

The primary objective of this project is to introduce an intelligent water quality monitoring system in IoT (Internet of Things) platform which would help to monitoring different physical parameters of the drinkable water rather than relying on manual process. Moreover, IoT is a system of alliance among various devices and the competence of deportation data over the system.

[5] S. M. G. Nikkam and V. R. Pawar, "Analyzing water quality for industrial application under IOT environment," International Research Journal of Engineering and Technology, vol. 3, 2016, pp. 882-885.

The goal of this research is to develop a smart water quality monitoring (SWQM) system using the IoT platform. Four physical parameters: temperature, pH, conductivity and turbidity of different water samples are measured via four sperate sensors equipped with Arduino Uno. The extracted sensor data are analyzed using the fast forest binary classifier. A desktop application is developed in .NET platform to identify whether the tested water samples are safe or unsafe for human consumption. The overview of the proposedWQMSsystem is introduced in Section II. Section III presents the design methodology including the hardware setup and desktop application development. The measured data of different sensors and their analysis are described in Section IV. Lastly, Section V is concluded the paper.

CHAPTER 3

SYSTEM REQUIREMENT SPECIFICATION

A System Requirements Specification (SRS) (also known as a Software Requirements Specification) is a document or set of documentation that describes the features and behaviour of a system or software application. It includes a variety of elements (see below) that attempts to define the intended functionality required by the customer to satisfy their different users.

3.1 Software Requirements:

Arduino IDE 1.6.7:

The Arduino IDE is a cross-platform application for Windows, Linux that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2.

Programming language:

Embedded C is set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded system. Embedded C is one of the most popular and most commonly used programming languages in the development of embedded system. Embedded C is perhaps the most popular languages among embedded programmers for programming embedded systems. There are many popular programming languages like assembly, BASIC, C++ etc. That is often used for developing embedded system but embedded C remains popular due to its efficiency, less development time and portability.

3.2 Hardware Requirements

Arduino UNO: Arduino UNO is an open source electronics platforms based on easy – to-use hardware and software. Arduino boards are able to read inputs-light on sensors, finger on a button and turn it into an output. Arduino is a physical computing devicebased on simple I/O operations and used to implement the program written in Arduino IDE.

Fig 3.1.5: 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.

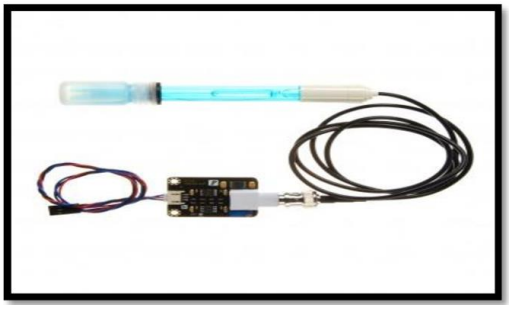

Fig 3.1.1: pH Sensor

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 and it is easy to interface with arduino.The normal range of pH is 6 to 8.5.

Fig 3.1.2: Turbidity sensor

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 3.1.3: Temperature sensor

Temperature sensor : Water Temperature indicates how water is hot or cold. The range of DS18B20 temperature sensor is -55 to +125 °C. This temperature sensor is digital type which gives accurate reading. A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.

Fig3.1.4: WiFi module

WiFi module : The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost effective board with a huge, andever growing, community.

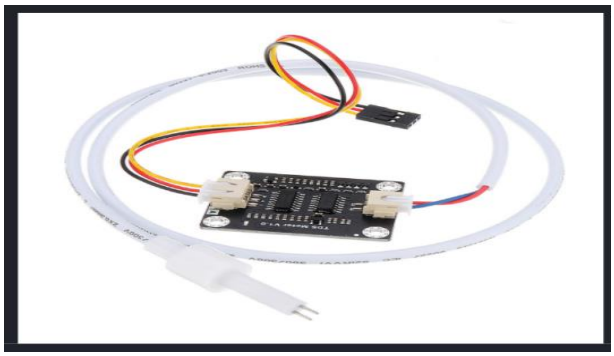

Fig 3.1.4 : conductivity sensor

conductivity sensor : Measures the ability of a solution to conduct an electrical current. It is the presence of ions in a solution that allow the solution to be conductive: the greater the concentration of ions, the greater the conductivity. Water conductivity sensors are used in water-quality applications to measure how well a solution conducts an electrical current.

Cloud: Our proposed system uses a lightweight Message Queuing Telemetry Transport (MQTT) protocol for exchanging messages between small embedded devices, mobile devices, and sensors. The MQTT is a publish/subscribe messaging protocol that runs on top of TCP/IP.

CHAPTER 4

SYSTEM DESIGN

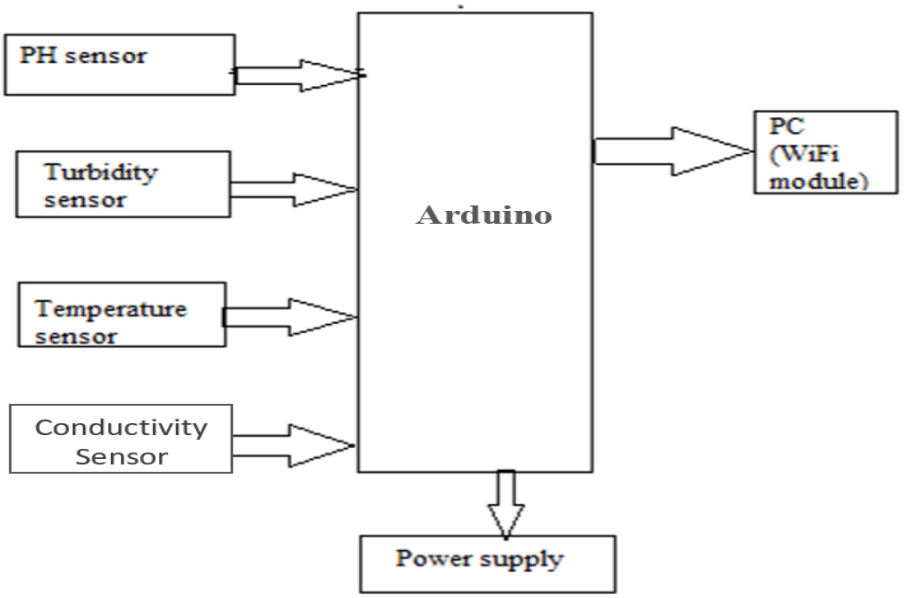

Fig4.1: Block diagram of the proposed WQMS system.

Fig. 4.1 consists of four different sensors connected with controller to measure four important physical parameters (pH, temperature, conductivity and turbidity) of water samples. The pH sensor SEN0161 is used to measure the presence of acidity or alkalinity of any solution in logarithmic scale. The digital temperature sensor DFR0198 provides accurate reading between –55 to 125ºC. To measure the electrical conductivity of water sample, the analog sensor DFR0300 is utilized. The recommended detection range of this sensor is 1 to 15 ms/cm within a temperature between 040ºC. Turbidity sensor SEN0189 is used in the design to detect the presence of suspended particles by using light. The extracted data from these sensors are accessed by the controller arduino-uno and transfer them to the developed desktop application. Machine learning algorithm is implemented at the backend to predict the water quality based on the measured data. Since the system will predict either the test water sample is “Drinkable” or “Not Drinkable”, the fast forest binary classifier algorithm is employed. 60 different water samples have been collected from nearby tap, filter, soft drinks and other sources. The prediction accuracy of the designed system is compared for the experimented data.

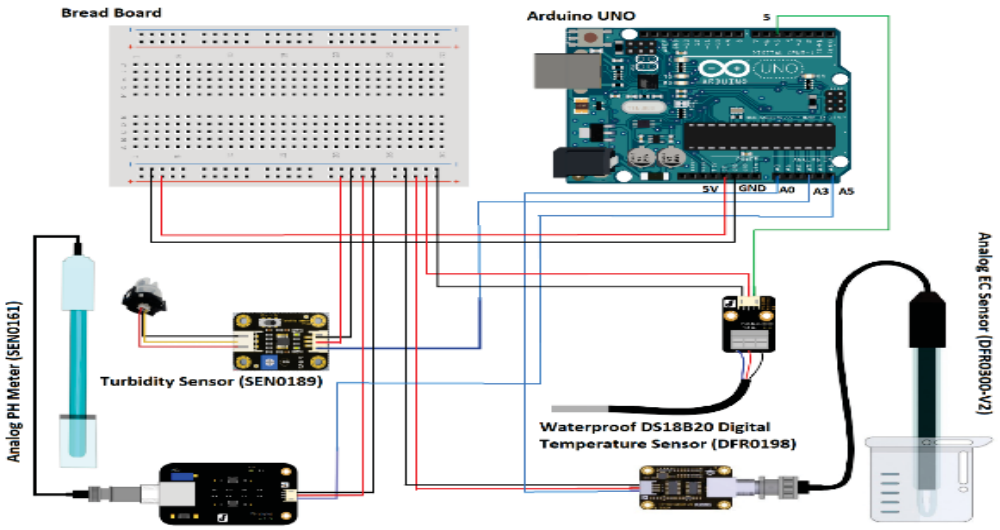

Figure 2. Circuit diagram of the hardware of WQMS system.

Fig. 2 shows the schematic circuit diagram of the hardware set-up of the proposed WQMS system. Except the temperature sensor, other three sensors are of analog type. Each sensor has three different color wires such as red, black and others. Here, red wires are for +5V power supply, black wires are for ground and others are used for data estimation. A breadboard is used for creating common points for ground and power supply separately. Then common node of ground is connected to the ground of arduino and same process is repeated for power supply. The analog sensors are connected to the analog pins and digital sensor is connected to digital pin of the controller.

The performance of the adopted fast forest binary classifier is compared with three other binary classifiers: support vector machine (SVM), logistic regression and average perceptron techniques. Among four algorithms, fast forest binary classifier provides better accuracy for the same set of data and used to develop the desktop application “Sprinkle: Water Quality Checker” (Fig. 4) for monitoring the water quality, demonstrates the working scheme of the desktop application built in .NET platform. Firstly, ports connected with the arduino are selected. Then, data are read with the assistance of the sensors. These data are used to check whether the water sample is drinkable or not drinkable, and the result is saved into the database. During the processing of data, only three parameters (pH, Conductivity and Turbidity) are considered, because temperature is used in the experiment as a factor of conductivity.

CHAPTER 5

IMPLEMENTATION

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 arduino atmega328 converts the analog values to digital one, & LCD shows the displays output from sensors.

Wi-Fi 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. BLYNK app is installed in the android version to see the output. When the system get started dc current given to the kit and arduino and WIFI 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 hotspot gives the exact value as on LCD display shows on kit. Thus like this when the kit is located on any specific water body and WIFI is provided we can observe its real time value on our android phone anywhere at any time.

- The whole design of the system is based mainly on IOT which is newly introduced concept in the world of development.
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is provided we can observe its real time value on our android phone anywhere at any time .

ADVANTAGES

1.It will reduce the time to measure the parameters.

2.This is economically affordable for common people.

3.less expensive for large scale implantation.

LIMITATIONS

1.If any fault occurs in hardware devices then we are not able to monitor the quality of water .

2.When quantity of water increases then each and every time we have change the system range.

TESTING

We will test the project in two stages:

- software
- hardware
- The software part is to be tested via the Arduino IDE, whereas the hardware part has to be tested physically.
- Before inserting the IC's the power supply is made on the voltage rating at the output of each regulator is taken that is 5V.
- The VCC and ground pin are checked at the appropriate pin of the IC socket of controller.
- All the required components are collected &checked for good condition before mounting.
- Initially the components with small height are mounted.

- Before mounting each component the leads are cleaned properly to achieve good soldering.
- The extra leads of the components remaining after soldering are cut out properly.
- The electronic components are mounted and soldered, before all the components are checked for the respective voltages and current.
- After the components are soldered the connectivity is checked using multi meter. If the problem is found the connection is done again.
- It is necessary to check whether the system is working properly or not.
- To check whether the readings are accurate, we will check the distance pointed out by the sensor by a meter tape.
- After building the whole circuit we test it,This project should satisfy some features. Features to be tested as follows:
- All the sensors like temperature, Turbidity, pH, conductivity sensors are working properly or not To check whether the output is accurate or not.
- The arduino board should show the distance in the serial monitor.
- The GSM module should send messages after the specified delay. If the text messages are reaching the phone, that means the GSM module is working.

CHAPTER 6

Modules

Arduino module: The Aurdino Uno board is equipped with sets of digital and analog input/output(I/O) pins that may be interfaced to various expansions boards and other circuits. The board has 14 digital pins,6 analog pins and programmable with the Arduino IDE(Integrated Development Environment) via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. This module loads the sensors and it is main part of the system. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers can be programmed using the C and C++ programming languages.

Arduino IDE: The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++[2]. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.[3]

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring.[5] The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.[6] The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

WiFi Module: The ESP8266WiFi Module is a self contained SoC with integrated TCP/IP protocol stack that can give access to your WiFi network (or the device can act as an access

point). One useful feature of Uno WiFi is support for OTA (over-the-air) programming, either for transfer of Arduino sketches or WiFi firmware. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost effective board with a huge, andever growing, community.

Sensor module: In the broadest definition, a sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics. A sensor is the part who provides data to a system via its input. Say you set your air conditioning system to bring the room temperature to 15 degrees, considering it was previously off (and the current temperature of the room is different than 15 degrees), now the system starts pumping air to bring the room to the desired temperature, We need a sensor to feed data to the system and tells the controller when to take action If you are building an Arduino powered car that will avoid obstacles while cruising, you could, for example, make use of a collision crash sensor to tell the controller when an obstacle is ahead of the car, then the controller can tell the wheel to stop and move to a different direction.

CONCLUSION

This presents a detailed survey on the tools and techniques employed in existing smart water quality monitoring systems. Also a low cost, less complex water quality monitoring system is proposed. The implementation enables sensor to provide online data to consumers. This can be improved by incorporating algorithms for anomaly detections in water quality. 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.

REFERENCES

1. Aaina Venkateswar an, Harsha Mends P, Prof Priti Bader, ” An IoT Based System for Water Quality Monitoring.”, DOI 10.1186/s40713-017-0005-y (2017).
2. Vaishnavi V.Daigavane ,Dr. M.A Gaikwad ”Water quality monitoring system based on IoT” Advances in Wireless and Mobile Communication, ISSN 0973-6972 Volume 10,, Number 5 (2017).
3. Karthick. T, Gayatri Dutt, Tarunjot Singh Kohli, Snigdha Pandey ” Prediction of Water Quality and Smart Water Quality Monitoring System in IoT Environment. ” ,(2015).
4. Anuradha T, Bhakti, Chaitra R, Pooja D,”IoT Based Low Cost System for Monitoring of Water Quality in Real Time Environment.”SciPollut Res 22(7):4894906 (2015).
5. Pulkit Sharma and Vinayak Abrol: Deep-Sparse-Representation-Based Features for Speech Recognition, IEEE/ACM Transactions on Audio, Speech, and Language Processing, Volume 25, Issue: 11, Nov. (2017)