Water Quality Monitoring System using IoT

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***Abstract*— The contamination of water has become a common problem globally. The conventional method of monitoring involves manual collecting water sample from different locations and tested in the laboratory using the rigorous skills. Such approaches are time consuming and are no longer to be considered to be efficient. Moreover, the current methodologies include analyzing various kinds of physical and chemical parameters. The old method of quality detection and communication is time consuming, low precision and costly. Therefore, there is a need for continuous monitoring of water quality system in real time. By focusing on the above issues, low cost monitoring system to monitor water in real time using IoT is proposed. In this system quality parameters are measured using different sensors such as pH, turbidity, temperature and communicating data onto a platform of microcontroller system and GPRS are used.**

Keywords: IoT (Internet of Things), GPRS (General Packet Radio Service).

I. INTRODUCTION

With growing world population and industry advancement, environmental pollution became big concern. Systems for water quality monitoring are required for activity analysis and their impact on nature of the power plants, mining sector, oil industry, etc. Basically, determination of water quality relies on estimation of values of some important and indicative parameters. For example, the water quality depends of the water temperature, activity level, water flow and presence of volatile organic compounds. Although there are well known and widely used methods for measurement of these parameters with appropriate Sensors, design of electronic systems for environmental monitoring is not often straightforward. The engineering challenges are various: (a) sensor nodes are usually deployed in remote places, (b) long-term deployments require sensor nodes to be robust and systems to be easily reconfigurable, (c) sensor nodes have to be able to operate autonomously in the required environment, etc. Moreover, such applications require highly reliable and accurate sensors with the reduced level of maintenance, long lifetime, fast response times, high sensitivity and high selectivity. With the introduction of IoT in the modern world, many problems have been solved. With the use of IoT in monitoring water quality various issues such as data collection, communication, data analysis and early warnings are worked on. But in order to get this into picture, technologies and protocols are combined to get the desired output.

The IoT can be used in practically all scenarios for public services by governments. Sensor-enabled devices can help monitor the environmental impact of cities, collect details about sewers, water quality, and garbage. Such devices can also help monitor woods, rivers, lakes, and oceans. Many environmental trends are so complex, that they are difficult to conceptualize. The Internet of Things (IoT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet. An urban IoT can provide means to monitor the quality of the water in crowded areas, parks, or fitness trails. The realization of such a service requires that water quality and pollution sensors be deployed across the city and that the sensor data be made publicly available to citizens.

II. LITERATURE REVIEW

Raja Vara Prasad Y, Mirza Sami Baig, Rahul K. Mishra et.al., The system proposed integrates different technologies like frequency hopping communication technology and virtual instrument technology to fulfill wireless data transmission for monitoring of water quality. The carrier frequency is adjusted according to the result and full radio spectrum is used with the use of a spectrum hole detection sample. The wireless transmission of data is performed without interference with this specimen and real time information can be received by a system effectively. Moreover, this system is useful for non-professional staff also as the data is easy to read and shown clearly. [1]

Devarakonda, S., Sevusu, P., Liu, H., Liu, R., Iftode et. al., Pollution can be effectively monitored with the use of WSN is capable of providing a real time pollution data. The calibration of gas sensors like CO2 gas sensors, NO2 gas sensor is done by using various suitable calibration technologies and then WSN is formed using a multi hop data aggregation algorithm. The pollution data is shown in the form of numbers and charts with the help of web interface and is available on internet as well. Temperature and humidity parameters are measured along with the gases and data is analyzed data fusion. [2]

Shruti Sridharan, et al., addressed about developing an efficient wireless sensor network (WSN) based water quality monitoring system, that examines water quality, an important factor as far as, irrigation, domestic purposes, industries, etc. are concerned. The parameters involved in the water quality monitoring such as the pH level, turbidity and temperature are measured in real time by the sensors that send the data to the base station or control/monitoring room. As the monitoring is intended to be carried out in a remote area with limited access, signal or data from the sensor unit will then be transmitted wirelessly to the base monitoring station. The application of wireless sensor network (WSN) for a water quality monitoring is composed of a number of sensor nodes with networking capability. Such monitoring system can be setup emphasizing on the aspects of low cost, easy ad hoc installation, easy handling and maintenance. The use of wireless system for monitoring purpose will not only reduce the overall monitoring system cost in terms of facilities setup and labor cost but will also provide flexibility in terms of distance or location. In this paper, the fundamental design and implementation of WSN featuring a high-power transmission Zigbee based technology together with the compatible transceiver is proposed. It is chosen due to its features that fulfill the requirement for a low cost, easy to use, minimal power consumption and reliable data communication between sensor nodes. The development of graphical user interface (GUI) for the monitoring purposes at the base monitoring station is another main component. The GUI should be able to display the parameters being monitored continuously in real time. The developed GUI platform using MATLAB is cost effective and allows easy customization [3].

R Karthik Kumar et al., investigated Underwater wireless sensor network to monitor the quality of water using wireless sensor network (WSN) technology powered by solar panel. Underwater wireless sensor network is the simple and basic way to monitor the quality of water using wireless sensor network (WSN) technology powered by solar panel. To monitor the quality of water over different sites as a real time application, a base station and distributed sensor nodes are suggested. A WSN technology like ZigBee is used to connect the nodes and base station. To design and implement this model powered by solar cell and WSN technology is a challenging work. Through WSN various data collected by various sensors at the node side such as pH, Turbidity and oxygen level are sent to base station. At the base station collected data is displayed as visual and is analyzed using different simulation tools. The advantage in this system is low power consumption, no carbon emission, more flexible to deploy at remote site and so on. [4]

Marco Zennaro, Athanasios FloroSs, Gokhan Doga et al., proposed the design of a water quality monitoring system and, building upon the Sunspot technology, a prototype implementation of a water quality wireless sensor network(WQWSN) as a solution to the water quality monitoring problem. More than one billion people lack access to safe drinking water in the world. Providing a way to measure auto- metrically water quality will help tackle this problem. The design of a water quality measuring system and proposes a prototype implementation of a water quality wireless sensor network (WQWSN) as a solution to this challenging problem. When applied to developing countries, the design and implementation of such a system must take into consideration the difficult environment in which it will operate. An application to water quality measurement in Malawi reveals the relevance of using our novel solution to mitigate two challenging issues: energy consumption of the system and the inter-networking problem. [5]

Kiran kumar G.Sutar, Prof.Ramesh T.Patil presented the fish farm monitoring system based on wireless sensor network. The system is constituted by a base station and sensor nodes. The sensed parameters with their exact precision values are transmitted to the observing station through wireless communication and details are monitored by the administrator. When any of the parameter is found to be above a threshold value an indicator will indicate it. The system has advantages such as low power consumption, more flexible to deploy. In recent years, the interest in Wireless Sensor Network (WSN) has been growing dramatically. To meet this trend, we have designed Wireless Sensor Network system to monitor the fish farm. The application requires two different kinds of modules; the sensor itself and the wireless module. The sensor collects and transmits the information to a wireless module using wired connection. Once the information reaches the wireless node, it is forwarded to the central unit through a wireless protocol. The sensor module includes a temperature sensor and pH sensor. The wireless node collects the sensed data by means of a synchronic wired serial polling communication. The use of this kind of protocol allows connecting single master with multiple slaves. [6]

III. SYSTEM DESIGN

Sensors for measuring water quality such as pH, Temperature, Turbidity are connected to Microcontroller Unit for processing. Serial Communication unit acts as a phase between MCU and GPRS module, GPRS module transmits the data to workstation and later the data is stored in cloud for further use.

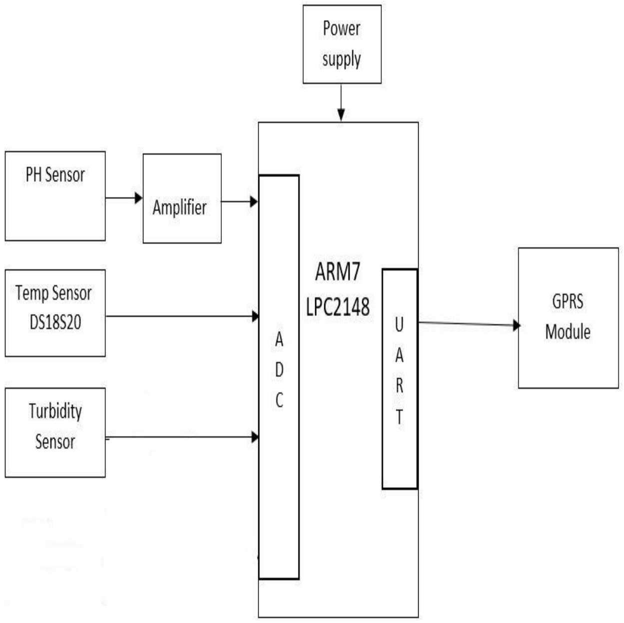

Figure 1: Block diagram of water quality monitoring system

The proposed block diagram shown in fig. 1 consists of three modules:

- Data sensing module
- Server Module
- User Module

a. Data sensing module

Data sensing module includes microcontroller, pH sensor, Turbidity sensor, Temperature sensor. The data sensed by the sensor will be passed through amplifier circuit (signal Conditioning circuit) in order to manipulate the analog signal in such a way that it meets the requirements of the next stage for further processing. Then the manipulated data will be given to the microcontroller unit. The inbuilt ADC module present in the controller will convert the analog signal to digital signal for further processing. Converted data is transmitted to the server using the GPRS module.

The pH sensor uses CA3140 operational amplifier is used in this paper it is integrated circuit operational amplifier that combine the advantages of high voltage PMOS transistors with high voltage bipolar transistors on a single monolithic chip. The CA3140 BiMOS operational amplifiers feature gate protected MOSFET (PMOS) transistors in the input circuit to provide very high input impedance, very low input current, and high-speed performance.

The gravity arduino turbidity sensor detects water quality by measuring the levels of turbidity. It uses light to detect suspended particles in water by measuring the light transmittance and scattering rate, which changes with the amount of total suspended solids (TSS) in water. As the TTS increases, the liquid turbidity level increases. Turbidity sensors are used to measure water quality in rivers and streams, wastewater and effluent measurements, control instrumentation for settling ponds, sediment transport research and laboratory measurements. This liquid sensor provides analog and digital signal output modes. The threshold is adjustable when in digital signal mode.

DS18S20 temperature sensor is used in this paper The DS18S20 digital thermometer provides 9-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18S20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18S20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. Each DS18S20 has a unique 64-bit serial code, which allows multiple DS18S20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18S20s distributed over a large area. The temperature readings obtained are in degree Celsius it is converted to binary format and later to hexadecimal format. Example readings are as follows

b. Server Module

Server module consists of PC with internet, where an application has been developed such that the received data will be stored in cloud.

TEMPERATURE(ºC)	DIGITAL OUTPUT(BINARY)	DIGITAL OUTPUT(HEX)
10	0101000000	140H
12.625	0011000001	0C1H
23.25	0110100100	1A4H
0	0000000000	000H
-10	1011000000	2C0H
-12.625	1100111111	33FH

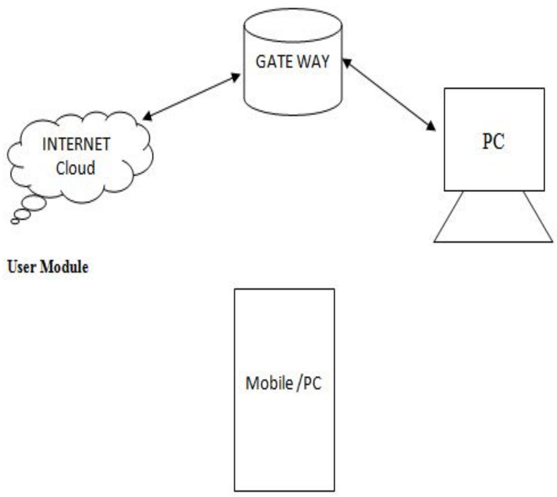

Fig 2: Block diagram of server module

c. User Module

The user module consists of a GPRS for communication which will receive the data sent by the base station. User can use PC, Mobile or Tablet to access the data from server module. Server module, provides the service where data is remotely maintained, managed, and backed up. The service is available to users over a network, which is usually the internet. It allows the user to store the data online so that the user can access them from any location via the internet.

The server sends data to the web page when a proper connection is established. The web page will allow us to monitor and control the system. By entering IP address of server which is placed for monitoring we will get the corresponding web page. The web page gives the information about the pH level, turbidity level temperature variations in that particular region, where the embedded monitoring system is placed.

IV. SYSTEM IMPLEMENTATION

Through this paper an IoT based Water quality monitoring system is developed. In which it monitors water quality over a web server using internet. When the water quality goes down beyond a certain level, means when there is a water like variation in pH, Temperature and turbidity. It will show the water quality on the web page so that we can monitor it very easily. Connection is as shown in the fig. 3.

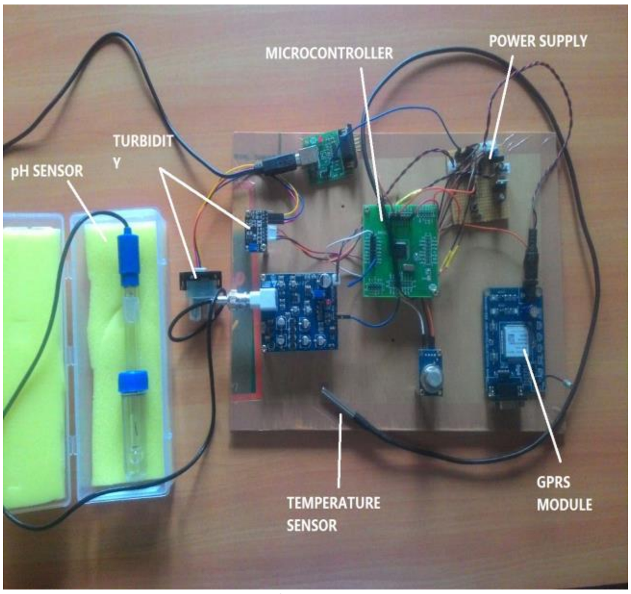

Fig 3: Implementation of water quality monitoring system

The implementation of Water quality monitoring using IoT is as follows.

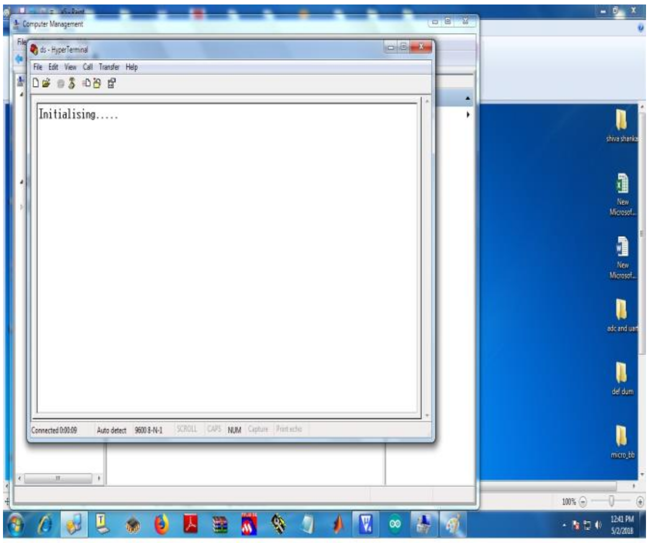

Fig 4: Initializing the Hyperterminal

Open the hyper terminal which is a tool to initialize communication with the modem. after opening we enter login credentials and port is selected and hyperterminal is initialized.

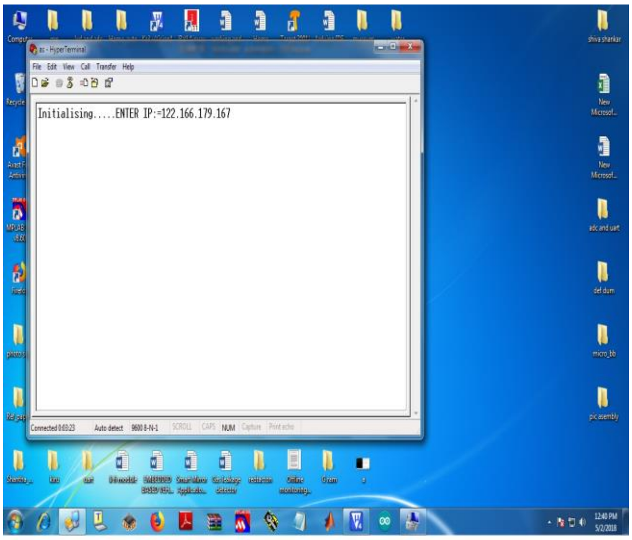

Fig 5: Entering the IP address

After entering the IP address communication is set up with the website domain.

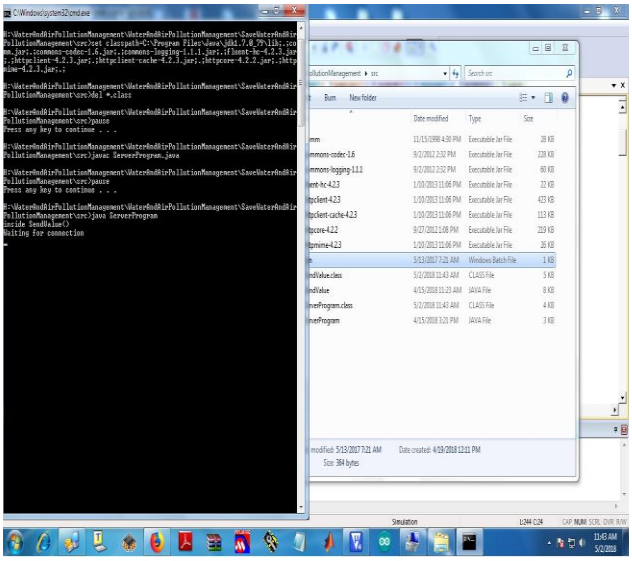

Fig 6: Waiting for connection with server

Install the teamviewer to establish the connection between computer to computer for real time support or access to files. Once the partner credentials are entered in teamviewer it will connect with the server.

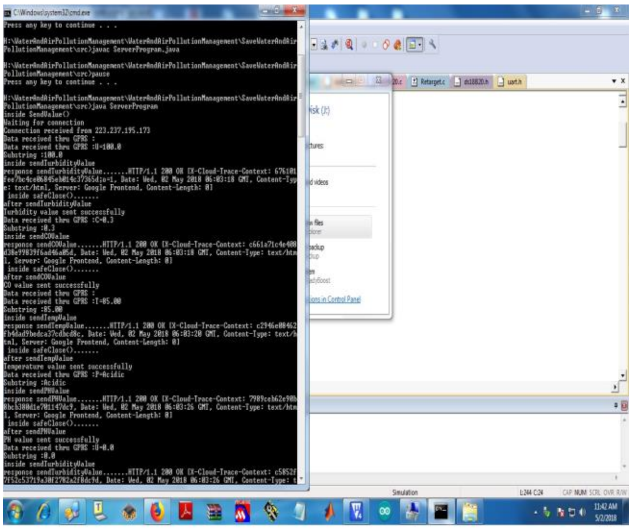

Fig 7: Result is stored in server

Once the connection is established results of pH, Turbidity, Temperature are stored in the server. This acts as cloud for storing the data and this data can be fetched using the IP address.

V. RESULTS

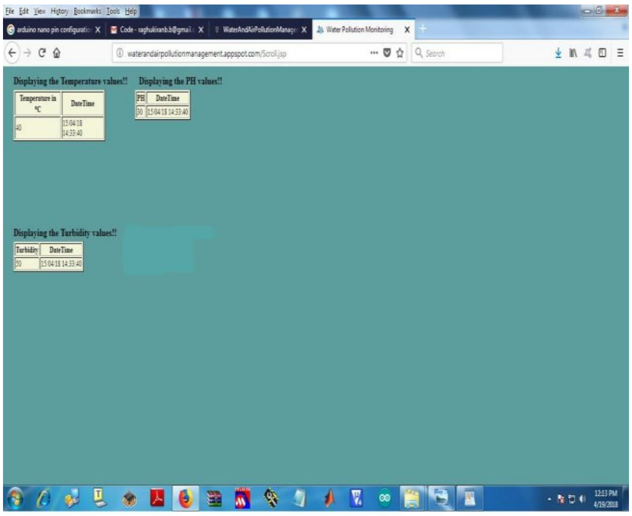

Fig 8: The stored data are displayed on the web page

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. The web server page which will allow us to monitor and control the system. By entering IP address of server which is placed for monitoring we will get the corresponding web page. The web page gives the information about the pH and turbidity level and temperature variations in that particular region, where the embedded monitoring system is placed.

VI. CONCLUSION

Water quality analysis and its monitoring for large scale industries is a challenging task. Hence a system is being designed to tackle industrial polluted water and major effects on atmosphere. It has advanced features when compared to traditional monitoring system such as low-cost implementation, reusability, flexibility, power consumption, real time data acquisition. This system efficiently acquires water parameters (Temperature, pH and Turbidity) in real time operation at base station without data loss. Then obtained parameters are updated simultaneously at remote station and these values are compared to threshold value and the information is sent through GPRS and saved in servers. Hence monitoring water quality at each stage can avoid severe issues related to industrial water pollution.

VII. REFERENCES

[1] Raja Vara Prasad Y, Mirza Sami Baig, Rahul K. Mishra, P. Rajalakshmi, U. B. Desai And S.N. Merchant,, "Real Time Wireless Water Pollution Monitoring System" Ictact Journal On Communication Technology: On Next Generation Wireless Networks And Applications, Vol. 2, Issue 2, June 2011.

[2] Devarakonda, S., Sevusu, P., Liu, H., Liu, R., Iftode, L., &Nath, B., "Real-time Water Quality Monitoring Through Mobile Sensing in Metropolitan Areas", in Proceedings of the 2nd ACM SIGKDD International Workshop on Urban Computing, pp. 15, Aug 2013.

[3] Shruti Sridharan, " Water Quality Monitoring System Using Wireless Sensor Network" -International Journal of Advanced

Research in Electronics and Communication Engineering (IJARECE) Volume 3, Issue 4, April 2014.

[4] R.Karthik Kumar, M.Chandra Mohan, S.Vengateshapandiyan, M.Mathan Kumar, R.Eswaran, " Solar based advanced water quality monitoring system using wireless sensor network " - International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue3, March 2014 ISSN: 2278 – 7798.

[5] Marco Zennaro, Athanasios FloroSs, Gokhan Doga et al, proposed the design of a water “quality monitoring system and, building upon the Sunspot technology”.-JOURNAL OF ENGINEERING RESEARCH , VOL 5 NO.6, MAY 2015.

[6] Kirankumar G.Sutar , Prof.Ramesh T.Patil ," Wireless Sensor Network System to Monitor The Fish Farm" - Int. Journal of Engineering Research and Applications Vol. 3, Issue 5, Sep-Oct 2013, pp.194-197.

[7] Himadri Nath Saha, Supratim Auddy, Avimita et al., “Pollution Control using Internet of Things (IoT)”. Dept. Of Computer Science & Engineering Dept. Of Information Technology Institute of Engineering & Management Maulana Abul Kalam Azad University of Technology, Kolkata.

[8] Cesar Encinasn, Erica Ruizy et al.,“IoT system for the monitoring of water quality in aquaculture”. Cesar Encinas_, Erica Ruizy, Joaquin Cortezz and Adolfo Espinozax Dept. Electrical and Electronic Engineering, Instituto Tecnologico de Sonora Cd. Obregon, Sonora, Mexico

[9] Jozsef Konyha proposed “Grid-based wide area water quality measurement system for surface water”. Department of Research Instrumentation and Informatics Research Institute of Applied Earth Sciences, University of Miskolc Miskolc, HUNGARY

[10] Pradeep Kumar, Somasundaram and Dharon Joseph proposed “Monitoring Water Quality using RF Module”. Electronics and Communication St. Joseph’s College of Engineering Chennai, India

[11] Cho Zin Myint, Lenin Gopal, and Yan Lin Aung “Reconfigurable Smart Water Quality Monitoring System in IoT Environment”.Department of Electrical and Computer Engineering Curtin University Sarawak Campus, CDT 250

[12] Shailaja M Gunda Nikkam ,Dr.V R Pawar “Water Parameter Analysis for Industrial Application using IoT”.VLSI and Embedded System,Bharati Vidyapeeth’s College of Engineering for Women, Bharati Vidyapeeth’s College of Engineering for Women, Pune, Maharashtra