Scientific Journal of Impact Factor (SJIF): 4.72

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 6, June -2017

IoT based Water Monitoring System: A Review

Pragati Damor[1], Kirtikumar J Sharma[2]

[1]Computer engineering, Birla Vishvakarma Mahavidyalaya, Vallabh vidyanagar-388120
[2] Computer engineering, Birla Vishvakarma Mahavidyalaya, Vallabh vidyanagar-388120

Abstract: *This paper propose a more efficient water monitoring and control system for water utility to reduce the current water wastage problem. This approach will help utilities operators improve low cost water management systems, specially by using rising technologies and IoT is one of them. The Internet of Things (IoT) could prove to be one of the most important methods for developing more utility-proper systems and for making the consumption of water resources more efficient.*

Keywords: *Water Monitoring ,Water resources, Arduino Uno, sensors, Node MCU , Internet of Things*

I. INTRODUCTION

Currently drinking water is very prized for all the humans. In recent times all the humans and creatures on the earth all the human beings and creatures on the earth facing troubles because of growing population, aging infrastructure etc. So its too important to find the solution for water monitoring & control system .For that IoT is blessing as a solution. Microcontrollers and sensors are very useful for creating that system. Ultrasonic Sensor is used to measuring water level. The other parameters like pH, TDS, and Turbidity of the water should be calculated. 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 can also be done on sensed data to pick out for the solutions. In design various controller like Arduino Uno, Raspberry PI b+ are used as a core controller. The invented system is used some IoT modules for accessing sensor data from the core controller to the cloud. The data which is obtain from the sensors can be shown on the internet and provides facilities for screening the data on mobile phones or web application.

I. RELATED WORK

This study discusses the design and current development of system having low cost to monitor real time values and also to control the system using IoT. To measure the various parameters of the water, array of sensors are included in the system. The parameters which can be measured are like temperature, PH, turbidity of the water. Core controller can process the value measured from the sensors. The Arduino Uno model can be used to control the system. Lastly, to access the sensor data on internet, cloud computing can be used.

In 2016, Divya Kaur presented a paper on "IOT based Water Tank Control system "for prevent the water wastage. Making a control system to automatically control the water pump requires[1] careful observation of what people do as their daily activity to make sure that the tank is full. In almost all over india every state has a State Water Supply body which is responsible for development and[1] regulation of water supply in state. Due to scarcity of water the release of water is controlled and done at certain time(s) in a day. So this paper is aimed at presenting the project in embedding a control system into an automatic control system into an automatic water level controller using wi-fi module.

In 2015,N Vijayakumar and R Ramya[2] 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 consists different sensors like pH ,turbility,water level sensors etc.All the parameters are measured and that measured value which is stored from sensors can be processed by Raspberry PI B+.The sensor data can be shown on internet by using cloud computing and this devices are more efficient,low cost, and capable of processing,sending operation thorugh Wi-Fi module to mobile phones.This can implement for environment [2]monitoring and the data can be viewed anywhere in the world.

In 2013 Saima Maqbool , Nidhi Chandra presented a paper on "Real Time Wireless Monitoring and Control of Water Systems using Zigbee 802.15.4" in which the architecture which comprises a number of elements likes water quality sensor water level sensor, GSM modem , PC, XBee, and a database. Sensor nodes are performing the particular function or job , sense the data and those data are transmitted to the end tool or machine via inverter. Sensed data is coordinated by network equipments like Router. [3]Router will gather data from the end tool like XBees which in turn from sensors and sends the data to coordinator. In the computer all information are presented. In the Computer; river level, bore water

level and bore water level is shown by using C sharp program. From computer particular task can be executed like "SMS" is forwarded to user's system and at alarm are blows at the desired level. All these data can be kept and saved in database which will be utilized to implement a "water expert system" through a long term supervising and investigation.

In 2015 ,Thinagaran Perumal1, Md Nasir Sulaiman, Leong presented " Internet of Things (IoT) Enabled Water System" .They implemented " water monitoring system using IOT" for real time scenario. This resolution is of low cost which includes system of integrated sensory that permits inner observation for quality of water. Using Internet, relevant and warning data are transferred to a cloud server and these data can be received by user terminal which are owned by consumers. The water measurement's end result is shown on cloud. A Thingspeak[4] as a segment of alert system is integrated also. This type of organization can be utilized fairly effectively by residential users as by industrial users or more water utilities. By using Internet of Things, this type of organization can give early alert system for portable water quality.

In 2012,Made Saraswati, Endrowednes Kauntama , Pono Mardjoko presented a paper on "Design and Construction of Water Level Management system Accessible Through SMS". This system utilizes ultrasonic sensor which calculates the level of water without any contact to water. For the data processor, the microcontroller is used and controller to other electronic components. In this system, SMS (Short Message Service) is used to report the measurement. The major aim of this exploration is to implement or develop a such type of organization that[5] can calculate the water level using microcontroller automatically. As a SMS, all these results of measurement can be forwarded to the cell phone of user at every request. This type of organization can reorganize with many measurements site, as long as the initial setting by SMS according to the installation to each measurement site was done.

In 2016 ,B.Dhivyapriya, C. Gulabsha, S. P. Maniprabha , G.Kandasamy, Dr.V. Chandrasekaran ,GSM based water tank level monitoring and pump control system .In which a new technique is proposed to continuously keeps track of the level of water in water systems like overhead water tanks. The user can send the message to the system to know the water level details of the tank and also be used to regulate the pump spontaneously by turning OFF the pump when the critical level of water in tank is reached and send the message to the user that the water in the tank is full[6]. This is aimed to control the level of water with support of ultrasonic sensor and GSM technology.

In 2015 ,Prachet Varma, Akshay Kumar, Nihesh Rathod, Pratik Jain,Mallikarjun S,Renu Subramaniyam, Bhardhwaj Amrutur, M.S.Mohan kumar, Rajesh Sundresan presented a paper on " IoT based water management System for a Campus "proposed real time water monitoring system for campus. That work used an off-the –shelf ultrasonic sensor HC-SR04 [7]which is mounted at the top of the tank. It sends so much ultrasound pulses at 40 KHz towards the water surface and measures the time to receive the reflected waves by sensing when the reflected edge crosses a threshold. this approach works well when the received signals are large in amptitude and hence its range was limited to about 4km,which is insufficient for large distribution tanks that can be deep as 8m.

In 2014, Sanam Pudasaini, Anuj Pathak, Sukirti Dhakal, Milan Paud presented a paper on "Automatic Water Level Controller with Short Messaging Service (SMS) Notification ". The automatic water level controller is Smart system as all processes occur automatically with continuous updates by controller, to the user, via GSM technique i.e. SMS Notification. This system is deprived of any sort of noise and has effective switching action. To widen the application to this project work, security home alarm system can be matching application. The automatic water level controller system can be used in home, office sectors, swimming pool and even in industrial areas[8]. As mentioned earlier there is no link between reservoir tank and tank of interest; henceforth, communication between the two can take this project to another level. Furthermore, extra care needs to be given as water is used as conducting media. Moreover, GSM module can be replacement to cell phone. The system also can be modified to two tank system with wireless communication between tank of interest and reservoir tank. All in all , despite being the smart system there are many rooms for improvement, which when considered, this system can be more smart ultimately user being smarter

In 2016, Jayti Bhatt, jignesh Patoliya presented a paper on " IoT Based Water Quality Monitoring System". This system is useful to observe the water quality which is one by microcontroller and Zigbee module which is used to make WSN(Wireless Sensor Network) which is low cost and more efficient. Furthermore, to monitor data from all over the word IOT environment is provided using raspberry pi for creating gateway and also, cloud computing technology is used to monitor data on the internet.[9] Moreover, to make system user-friendly web browser application is there. Thus, they can fulfill aim and objective of the proposed system.

In 2013, Raghavendra. R, M. Uttara Kumari , S.A. Hariprasad presented a paper on 'Implementation of Simulated Water Level Controller. Water is one in all the foremost vital basic desires for all living beings. however sadly an enormous quantity of water is being wasted by uncontrolled use[10]. Another machine-driven water level observance system is additionally offered thus far, however, most of the strategy has some shortness in observe. We have a tendency to tried to beat these issues associated enforced an economic machine-driven water level observance and dominant system. The main connotation of this analysis work is to determine a versatile, economical and simple configurable system which may

solve water losing issues. The internet primarily based water level observance and dominant system are often designed, through that the system is often controlled from anywhere via the web even with the totally different variety of devices [12]. this might have a considerable take pleasure in this analysis work for economical management of water.

II. RELATION WITH IOT

In past, the living of individuals has been changed due to the Internet. The IoT has been became an emerging research area because of need of an establishment for connecting things, sensors and other smart technologies [13]. IoT is known as internet's advanced version. Information related to physical objects can be immediately accessed by IoT and results into novel system having high efficiency and outputs. In IoT, a number of main technologies are there like ubiquitous computing, RFIP, wireless sensor network, cloud computing[13].Cloud computing, a large-scale, low cost processing unit and also an IP based connection mostly used for calculation and storage purpose. The water quality monitoring application contains many distributed monitoring sensors' array and a wide distribution network. Separate monitoring system is also required in it as told in paper [13].This paper introduces cloud computing techniques for screening values on the internet.

❖ Hardware Availability:

a. Arduino UNO Board

The hardware of the proposed system consists of Arduino microcontroller development board, Ultrasonic Sensors, Turbidity sensor, pH sensor ,Wi-Fi module to collect & transfer data to cloud. Data is collected from different types of sensors mentioned below by using Arduino Uno microcontroller. Arduino is a open source hardware platform which is able to work with various sensors and communication technology. There are different types of Arduino microcontroller that are used for different purpose. It not only control devices but also can read data from all types of sensor. It is simple, low cost and easy to use. It takes 5V voltage as input speed 16 MHz .Arduino Uno contains the 14 digital i/o pins and 6 analog input pins to connect various sensors that gives analog inputs.

Fig: 1 Arduino Uno Board [15]

b. Raspberry Pi

The Raspberry Pi is a Quad-Core 64bit CPU, WiFi and Bluetooth. Raspberry Pi 3 Is the 3rd generation of Raspberry Pi[13]. It is a credit card sized board computer which is used for multiple applications. Although maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processor, 10x faster than the first generation Raspberry Pi[13]. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected.

Fig:2 Raspberry Pi 3[14]

c. Node MCU

Node MCU is an Open-source,Interactive,Programmable,Low cost,Simple,Smart, WI-FI enabled. It Contains firmware which runs on the ESP 8266 Wi-Fi SoC from Espressif Sysyems .

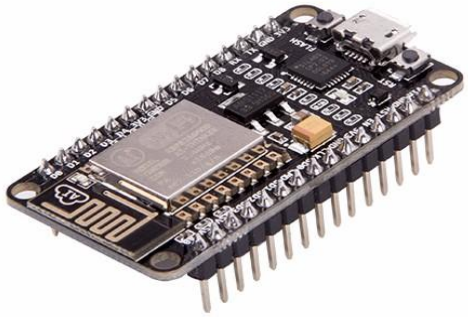

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Fig:3 Node MCU[15]

III. PRESENT WATER MONITORING SYSTEM

This system will be built using Arduino Uno and Node MCU. Arduino Uno is connected with Water level sensor(HCSRO4), Turbidity Sensor, pH sensor, Wi-Fi module (ESP8266) that process and transfer sensed data to cloud. . And other side ultrasonic sensor connected with Node MCU. This stored data is accessed by users. This enables the user to check the level of water and if it goes full then automatic stop. Other parameters related to water like water quality can also monitored for prevent wastage of water

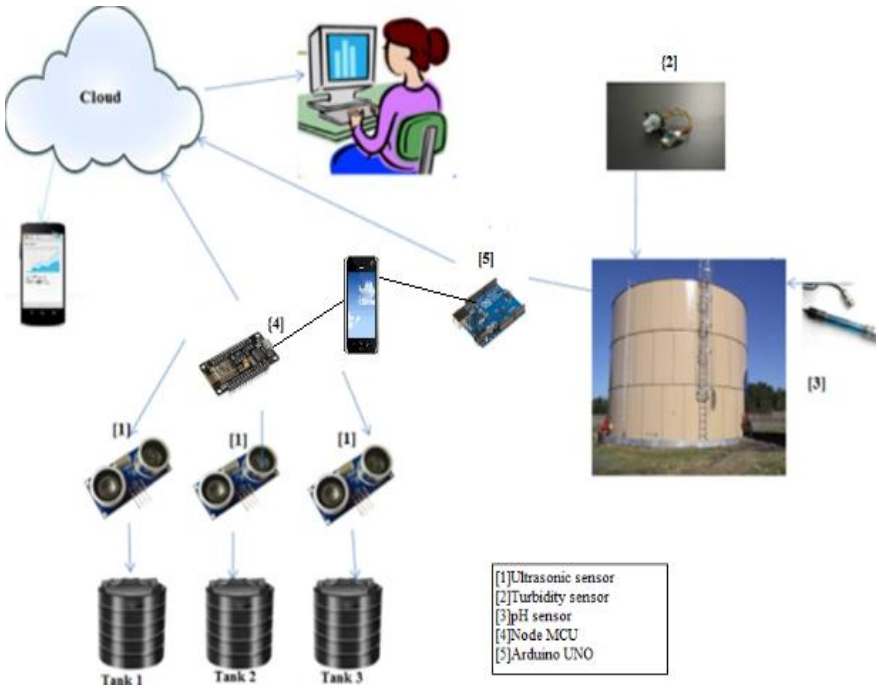

Fig: 4 Model Diagram

- **WHY THIS PROJECT IS COST EFFECTIVE?**

This project will be definitely cost effective but after a long time. Because at same time ph, turbidity and water level are measured in this system. Only one system is so costly nowadays like RO water plant, which its cost is around 8 to 10 thousand and for water level, the water sensor also is costly around 2 to 4 thousand. So total cost

is around 12 to 15 thousand so this system is better than all things. Water is also saved. Water wastage problem also prevented. Electricity bill also being low.

➢ HOW TO USE CLOUD?

- This system is using WI-Fi module (Esp8266) to send the sensor data to the cloud.
- All the sensors are connected with Wi-Fi module. Wi-Fi module needs the internet.
- So here Mobile data or Wi-Fi is the access point for the internet. And after all this data sends to the cloud (Thingspeak).

➢ RESULTS (DATA STORED ON THE CLOUD)

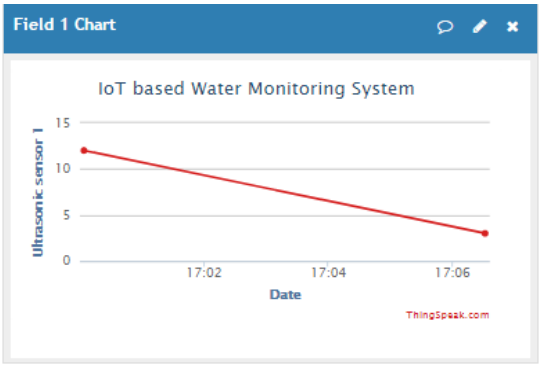

Fig:5 Result of Ultrasonic Sensor on Thingspeak Cloud (Wi-Fi Module)

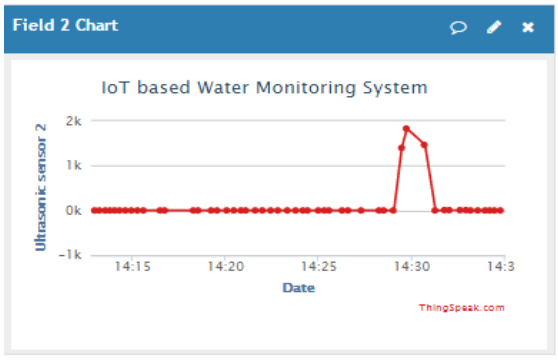

Fig:6 Result of Ultrasonic Sensor on Thingspeak (Node MCU)Cloud

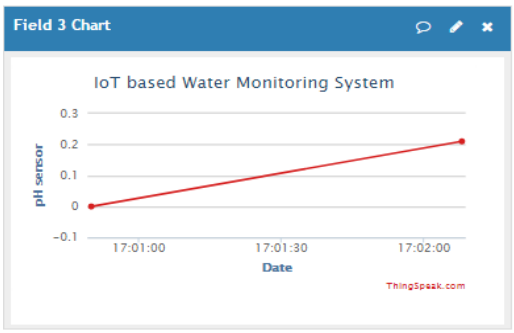

Fig:7 Result of pH Sensor on Thingspeak Cloud

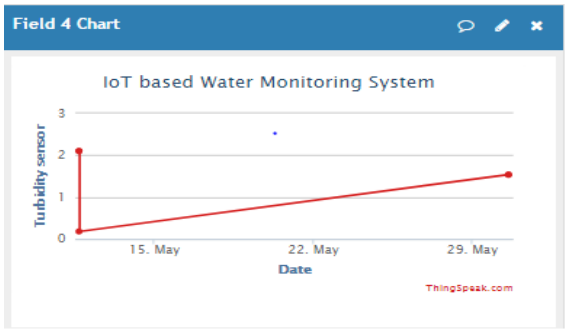

Fig:8 Result of Turbidity Sensor on Thingspeak Cloud

Here, All the sensors like pH, Turbidity & Ultrasonic sensor are connected with different microcontrollers like Arduino Uno & Node MCU. And three sensors pH, turbidity, Ultrasonic sensor are connected with Arduino Uno & ESP 8266 to sending data to the cloud. One ultrasonic sensor is connected with the Node MCU. In 2nd figure Node MCU is connected with an ultrasonic sensor. The water level is shown in inches (in)and centimeters(cm).The graph is plotted by using sensor data. This sensor data are sent to the cloud(Thingspeak) using Node MCU& Wi-Fi module.

IV. CONCLUSION

This paper is presented the design and development of IoT based water monitoring & control system .For this some sensors are used. The collected data from the all the sensors are used for analysis purpose for better solution of water problems. The data is sends to the cloud server via Wi-Fi module ESP8266. So this application will be the best challenger in real time monitoring & control system and use to solve all the water related problems.

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