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Detection of Water Level, Quality and Leakage using Raspberry Pi with Internet of Things

Arjun K[1], Dr. Latha C A[2], Prithviraj[3]

[1]Assistant Professor, Department of Computer Science & Engineering
SDM Institute of Technology, Ujire, Karnataka, India
[2]Professor, Department of Information Science & Engineering
AMC Engineering College, Bengaluru, Karnataka, India
[3]Assistant Professor, Department of Computer Science & Engineering
SDM Institute of Technology, Ujire, Karnataka, India

Abstract - *Water is an essential resource. Quality of water is more important, it has to find whether the water is contaminated or pure. Pipe burst overflow of water from tank and a water leakage is another major reason for wastage of water. To monitor the quality of water with the help of information sensed by the sensors immersed in water, here pH sensor and Turbidity sensors are used to measure the quality of water, so as to keep the water resource within a standard described for domestic usage and to be able to take necessary actions to restore the health of the degraded water body. Pressure of water is detected by using Force Sensitive Resister (FSR) for water leakage. The technique of tank water level sensing system monitoring concentrated with some basic parts which are softly aggregated together in our proposed method. The ultrasonic sensor is a reliable circuit. It takes over the task of indicating the water level in the overhead water tanks. It is being used to detect liquid level, as the liquid to be measured either can be inside a water tank. LED sensors are used to indicate the water level. Relay is used for automatic switching of motor on or off. The system relies on raspberry pi and sensors.*

***Key Words*: Ultrasonic sensors, FSR sensors, Raspberry pi, pH sensor, Turbidity sensor, Relay.**

1. INTRODUCTION

Water is a limited resource and is essential for agriculture, industry and for creature's existence on earth including human beings. Lots of people don't realize the true importance of drinking enough water every day. More water is wasted by many uncontrolled way. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Therefore, efficient use and water monitoring are potential constraint for home or office water management system. Internet of Things (IoT) enables us to build a system without human interference. In other words IoT is an environment that has the ability to transfer data over a network without human to human or human to computer interaction. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for direct integration between the physical world and computer based system and it provides more efficiency, accuracy as well as economic benefits. If the projections and trends towards IoT become reality, it may force a shift in thinking about the implications and issues in a world where the most common interaction with the internet comes from passive engagement with connected object rather than active engagement with content. Five key IoT issue areas are examined to explore some of the most pressing challenges and questions related to the technology. These include security, privacy, interoperability and standard, legal, regulatory and rights, emerging economies and development. Water Level Monitoring is used to avoid overflowing and intimate level of water in the tank. Water controlling system implementation makes potential significance in home applications. The existing automated method of level detection is described and that can be used to make a device on/off. Moreover, the common method of level control for home appliance is simply to start the feed pump at a low level and allow it to run until a higher water level is reached in the water tank. This is not properly supported for adequate controlling system. Besides this, liquid level control systems are widely used for monitoring of liquid levels, reservoirs, silos, and dams etc. Water pollution monitoring can help with water pollution detection, discharge of toxic chemicals and contamination in water. And also check the quality by using Temperature, pH and turbidity are the typical parameters collected in river/lake water pollution/quality monitoring systems. The goal of this project is to design and manage a Wireless Sensor Network (WSN) that helps to monitor the quality of water with the help of information sensed by the sensors immersed in water, so as to keep the water resource within a standard described for domestic usage and to be able to take necessary actions to restore the health of the degraded water body. Pipeline systems are responsible for transporting vital materials such as water, oil and gas. Any leakage in the pipe can cause major financial losses and possible environmental damages. Currently, buried pipelines are only monitored at key points, which can be spaced several kilometres apart. A system with a higher spatial resolution would provide operators with a better understanding of their network. In buried pipeline monitoring, sensor nodes are deployed in soil. The

underground environment imposes major limitations on sensor nodes, such as poor Radio Frequency (RF) transmission and lack of maintainability. In this real time IoT system, a tank containing water is immersed with pH, temperature and turbidity sensors for water quality measurement, FSR sensor for water leakage detection and Light Emitting Diode (LED) sensors for determining the water level. These sensors measure the corresponding values in the water. Since the outputs of the pH sensors are analog in nature and this is converted to digital by Raspberry pi using Analog to Digital Converter (ADC). System uses Local Area Network (LAN) for communication with the control center. The values are stored in the repository. This process is displayed on LCD screen by Raspberry Pi 3 and also the data can be accessed through website. The IoT system provides the advantage of improved efficiency, accuracy and low price.

2. LITERATURE SURVEY

In this work [1], they introduced an intelligent water quality and control system based on wireless sensor networks. This system used mobile wireless sensors to monitor water quality in a remote fashion and can detect pollutant location. Wireless controlled UAVs are integrated for the marking, separation and removal of pollutant. The technical challenges such as sensor selection and wireless control are addressed with customized novel algorithms. But UAV control algorithm is not efficient method for control wireless systems.

In the paper [2], authors proposed new system for water quality measurement. This system is based upon wireless sensor network (WSN) which makes use of ZigBee. Another important fact of this system is the easy installation of the system that is the base station can be placed at the local residence close to the target area and the monitoring task can be done by any person with very less training at the beginning of the system installation. One important aspect is the system should work in different environment in more effective way, but in this system it is difficult to get reliable results in every situation

In this paper [3], the design of a prototype based on IEEE 802.15.2.4 and solar energy for water quality monitoring is described. The prototype used ECHERP routing protocol for energy conservation purposes and solar panels are used instead of batteries to ensure the system will last in a long period of time. But evidently solar energy technologies remain to be very costly alternative. The fabrication of solar modules and their installation entail large amount of resources.

In this paper [4], a water quality monitoring system based on wireless sensor network was presented. The system was constituted by a base station and several sensor nodes. In the node side, water quality data was collected by sensors such as pH and Temperature. Here they made use of ARDUINO UNO 3 as hardware component to interface between sensors and GSM module. The proposed system contained only two parameters to measure water quality namely pH and temperature.

In this work [5], they discussed about design and implementation of water level control system which is wireless, automatic, cost effective and reliable. It uses two Radio Frequency transceivers along with a controller each installed at the tank and sump. Radio Frequency transceivers are used for wireless communication. It is completely automated with the help of a micro controller. The system doesn't need any attention of the user unless the sump is empty. Installation cost is reduced since the system is wireless. It is reliable because it has no problems arising after installation such as breakage of wire.

This paper [6] shall report on method to localize the source of a pipe burst by estimating the arrival time of the pressure transientsat sensor nodes. Proposed method of this paper uses Short Time Fourier Transform that has shown to overcome the limitation of Fourier Transform temporal deficiency.

This paper [7], presents a method of mining the data obtained by a collection of pressure sensors monitoring a pipe network to obtain information about the location and size of leaks in the network. This inverse engineering problem is effected by Support Vector Machines (SVMs) which act as pattern recognizers. In this study the SVMs are trained and tested on data obtained from the EPANET Hydraulic modeling system. Performance assessment of the SVM showed that leak size and location are both predicted with a reasonable degree of accuracy. The information obtained from this SVM analysis would be invaluable to water authorities in overcoming the ongoing problem of leak detection.

3. PROPOSED SYSTEM

A tank containing water is immersed with pH and turbidity sensors for water quality measurement, FSR sensor for water pressure detection and LED lights and ultrasonic sensors for determining the water level. These sensors measure the corresponding values in the water. Outputs of the pH sensors are converted from analog to digital by Raspberry pi using ADC. System uses LAN for communication with the control center. It's a real time system and it doesn't need any man machine interaction for activity in the water quality measuring system. This requires a LAN or internet connection for communication. The systematic arrangements of the components are shown in the Fig 1.

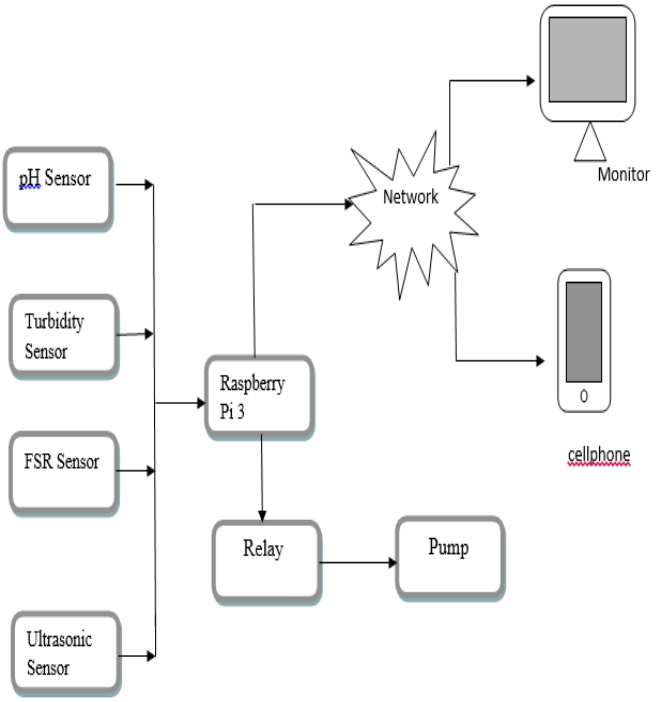

Fig -1: Architecture of working model

As per the Fig 1. The system uses pump which is kept inside water container. Water pump is controlled by relay to switch on or switch off the pump. When motor runs water flows into the tank. The tank is immersed with pH and turbidity sensor to check the quality of the water. Its reading is displayed in the monitor. Also the pipe is fixed with FSR sensor to detect the water pressure to identify the leakage. Its reading is shown in the monitor continuously. The ultrasonic sensor is fixed at the top of the tank to detect the water level. LED is used to indicate the water level in the tank. No analog is available in raspberry pi since it contains only digital pins, but the pH sensor is analog. Hence ADC is needed to convert analog to digital. It uses three LEDs to indicate the level of the water. LED 1 is fixed to indicate the lowest level. LED 2 is fixed to indicate the medium level. LED 1 is fixed to indicate the highest level. When water reaches lowest level the LED 1 blinks and pump will be automatically switched on and when it reaches the highest level the LED 3 blinks and pump will be switched off and message is sent to the mobile with details of the water quality, level and pressure using way2sms gateway.

4. EXPERIMENTAL SETUP

The Fig 2 shows the pH electrode BNC-E201 connections with the Raspberry Pi. It is an analog sensor, in the connection it has an analog to digital converter (ADC), MCP3008 which gives digital input to Raspberry Pi. The pH electrode uses BNC connector to connect to the Raspberry Pi through channel 1 of ADC.

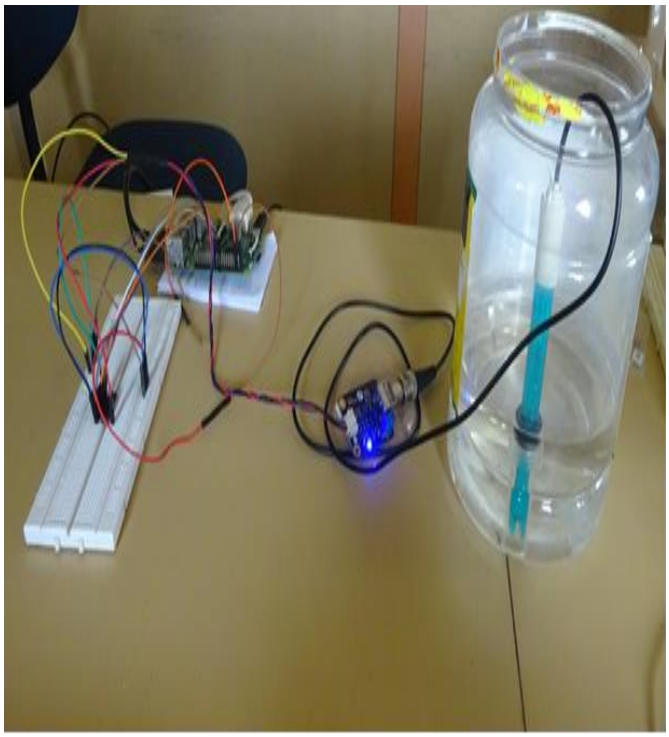

Fig -2: Connection of pH Sensor to Raspberry Pi

The connection of the turbidity sensor SEN-0189 is shown in the Fig 3. It is also an analog sensor which senses the clarity of the water. ADC, MCP3008 is used in the connection to get digital signal. It uses channel 2 of the ADC to convert the analog value to digital and then gives it as input to Raspberry Pi as it only support digital inputs.

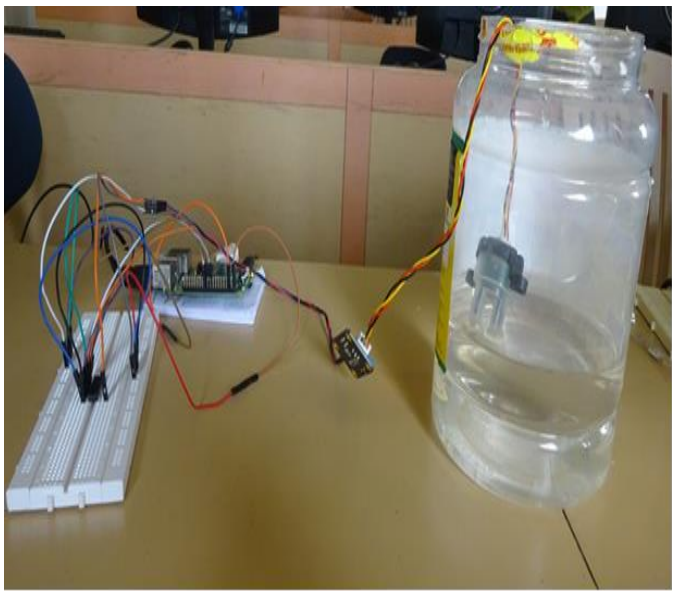

Fig -3: Connection of Turbidity Sensor to Raspberry Pi

The connection of ultrasonic sensor HC-SR04 is as shown in the Fig 4. It is a digital sensor. It has four pins Vcc, Trig, Echo and Ground. Here Echo pin is of 5v and Trig is of 3.3v so it

will create voltage imbalance. To overcome this drawback voltage dividing network is used.

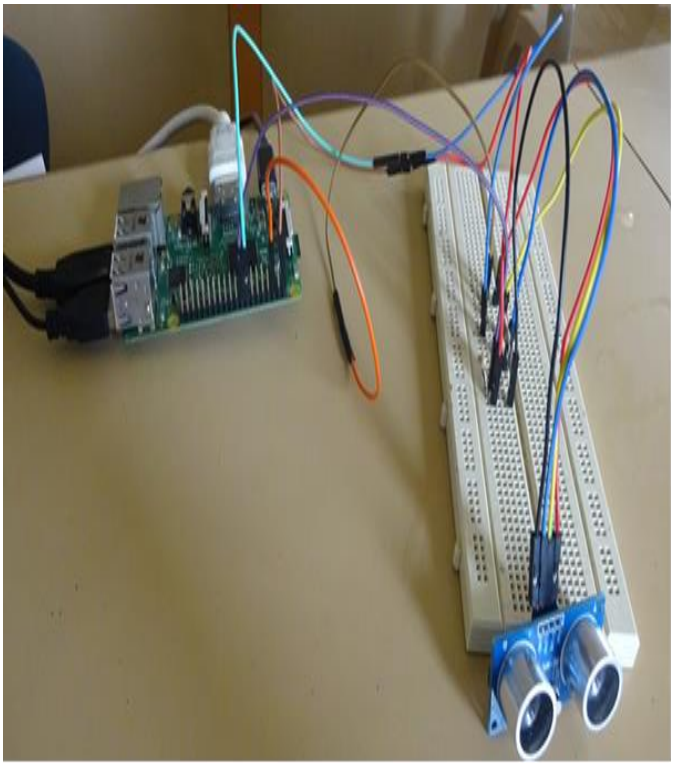

Fig -4: Connection of Ultrasonic Sensor to Raspberry Pi

The connection of FSR sensor is as shown in Fig 5. It has two pins. FSR's are basically a resistor that changes its resistive value (in ohms Ω) depending on how much it's pressed.

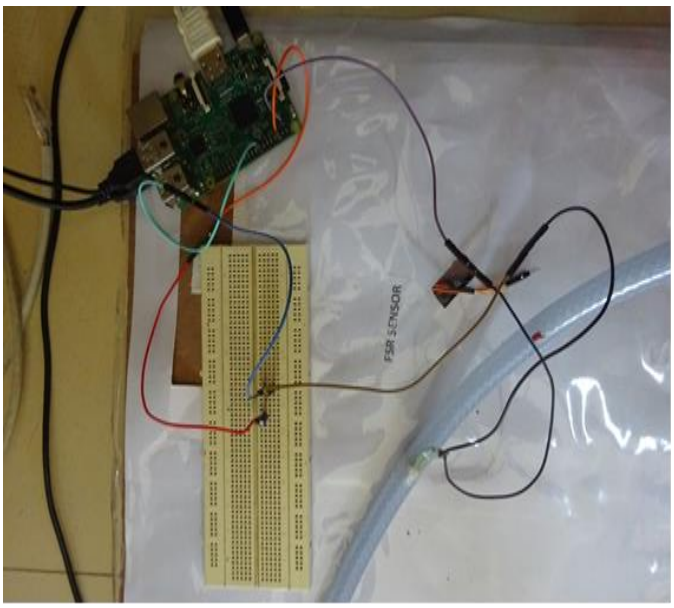

Fig -5: Connection of FSR Sensor to Raspberry Pi

The connection of all the sensors (Turbidity, pH, Ultrasonic, FSR) are shown in the below Fig 6. All the three sensors in this scenario measuring the quality, level and pressure of normal tap water. ADC, MCP3008 is used to convert the outputs of pH and turbidity sensors from analog values into digital while connecting to Raspberry Pi. The breadboard is used for the connections.

Fig -6: Final System

5. RESULTS

The Fig 7 which shows the readings of all the sensors measuring the level, quality and pressure of normal tap water. The Level, pH, Turbidity and Pressure values of the water is displayed along with its measuring units in the Terminal (Command Prompt) of the Raspberry Pi. It also shows the SMS notification sent to the registered user when there is a variation in water.

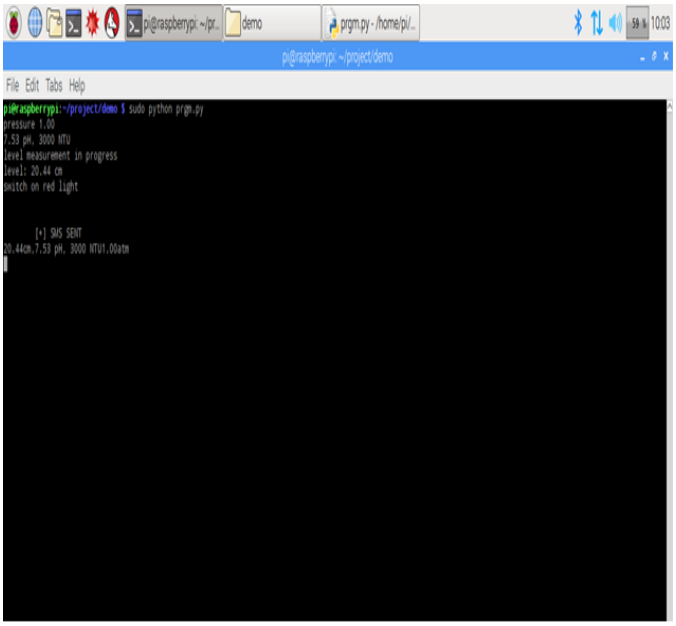

Fig -7: Output of all sensors

The Fig 8 shows the SMS notifications sent to the registered device to know the water quality, level and pressure.

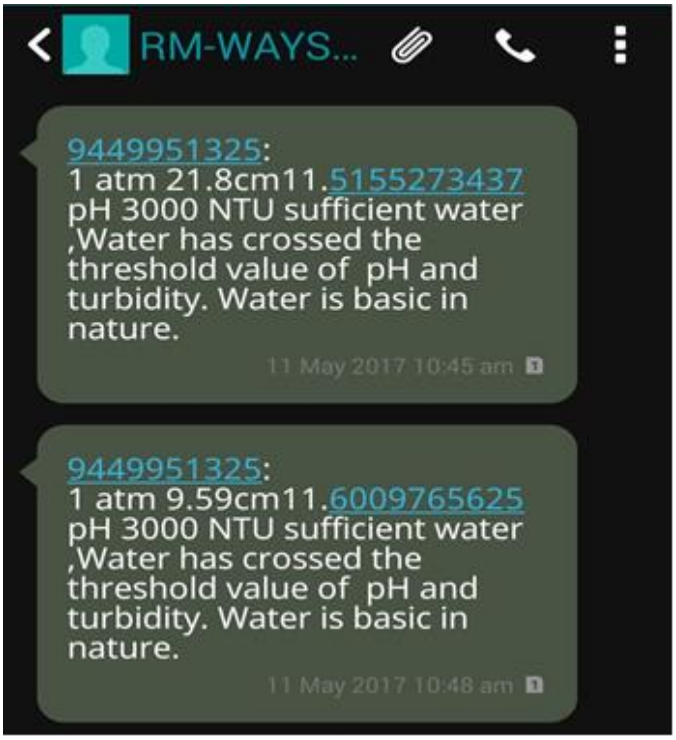

Fig -8: SMS Notification

The website provides a brief description about the work. We created a website called autowater.tk, it has information regarding the sensors and devices used in the project as well as an option to get the readings of the sensors which is stored in the database. The Fig 9 shows data retrieved from database in website.

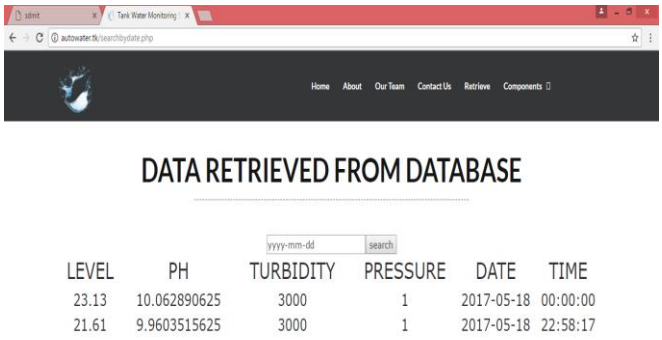

Fig -9: Website data

6. CONCLUSION

In the current days industrial waste water has a major effect on human, animal and plant life. The contaminated water from industries effects the environment in several ways. This waste water has to be continuously analyzed and purified in order to make it as clean water. This project focusses on analyzing the water level, water quality and pressure of flowing water. Water quality is to be determined by considering several parameters like pH, turbidity. Water level is determined by considering the distance of water using ultra sonic senor. With the help of Raspberry Pi some Parameters of the water is determined. The proposed system measures the level, turbidity, pressure and pH and these measured values are stored into database, and based on the threshold values set, Raspberry Pi notifies the registered user by sending text SMS with the values and these values can also be retrieved through website.

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time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

BIOGRAPHIES

Description "Working as an Assistant Professor in the dept. of Computer science and engineering at SDMIT Ujire. He is having four years of teaching experience.

Description "Professor and HoD of Dept. of ISE at AMC Engineering College at Bengaluru. "

Description "Working as an Assistant Professor in the dept. of Computer science and engineering at SDMIT ujire. He is having two years of teaching experience. "