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An IoT Based Water Health Monitoring System

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Abstract : Our country is the one of the largest populated country. To provide the basic needs of the people of India is the prime job of our government. One of these is the transmission of drinking water to every household. Due to large population and heavy networks of water supply pipeline, it has become difficult to keep a track of the water quality. The proposed research describes the wireless water quality monitoring system through which the quality of the water can be monitored and sends the alarm signal when the quality of water is not on the desired value. A user can check the status of pH on the mobile through Wi-Fi. The undesired pH value shows that the stored water is contaminated and not useful to consume, hence one should clean their water tank or change the water as early as possible.

Keywords : water quality management, IOT, microcontroller, PH Sensor

1. INTRODUCTION

For proper water supply, water management is required for the wise use of water resources. The main problemsare: poor water allocation, degraded water health or quality and lack of adequate water management system. These problems are the key motivation of this research and the main objective is to monitor the water health. Due to leakage of pipes where water distribution networks are implemented, the water can be contaminated and the quality of water degrades. Hence it is advisable to continuously monitor the water health. The earlier methods needed a person to take samples of water and then testing was done manually which consume a lot of time and was laborious. New Advancement of the technology has led to the development of automatic systems using sensors embedded in it [2, 4]. Emerging that came up with wireless sensor has eliminated the problem of power consumption and made the system more feasible and reliable. Several works has been done so far with using emerging technologies. Jin,Ning et.al proposed a wireless water environment monitoring systems in which the sensor node measures the PH, amount of dissolved oxygen , conductivity and temperature of the pond or lake situated in the ecosystem and communicate to server node via serial communication(based on RS-232 or 3G network). [1]O'Flyrm. B et.al. proposed a multi sensor system "smart cost" used to monitor water quality by measuring the temperature of water, its phosphate level, dissolved oxygen level, conductivity and PH value.[3]Based on the findings of previous work and ongoing research it has been found that the health of the water quality mainly depends upon its PH concentration, amount of phosphate and fluoride dissolved and amount of dissolved oxygen. The chief or prime factor to decide the water health from among these factors is its PH value. Apart from that the previous work done around the world also shows that the earlier water quality monitoring system were wired and

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done manually which was time consuming and laborious. Then the automated wired system was implemented in industries for water consumption and its quality. The wired systems werethen changed to wireless system. All these devices which are available in market now with wireless communication facilities generally work with ZigBee or RF communications. These devices are either costly or their monitoring is limited to range. A smart integrated system, *i.e*. an IOT wearable device which can monitor the water health anywhere and everywhere has not yet been implemented.

2. PROPOSED ALGORITHM

2.1. System Block Diagram

The system includes a microcontroller, a pH sensor and Wi-Fi module. The pH sensor data is sent to the microcontroller. The Data received by the microcontroller is processed and sent to the mobile via Wi-Fi module. If the pH value is not appropriate, then an alarm is generated using a buzzer.

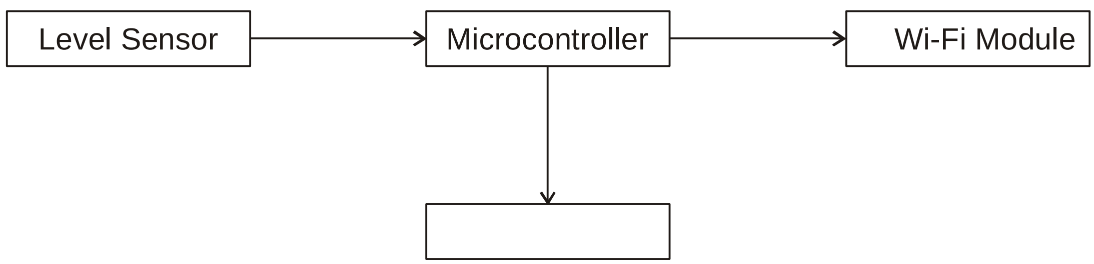

Fig. 1. System Block Diagram.

2.2. Internal Circuit

The internal circuit includes the circuit schematic of the system. The circuit consists of a microcontroller *i.e.* Arduino, a pH sensor and a Wi-Fi module *i.e*. ESP 8266. The pH sensor is connected to the analog pin of the microcontroller. The Wi-Fi module is connected to the RX-TX pin of the controller.

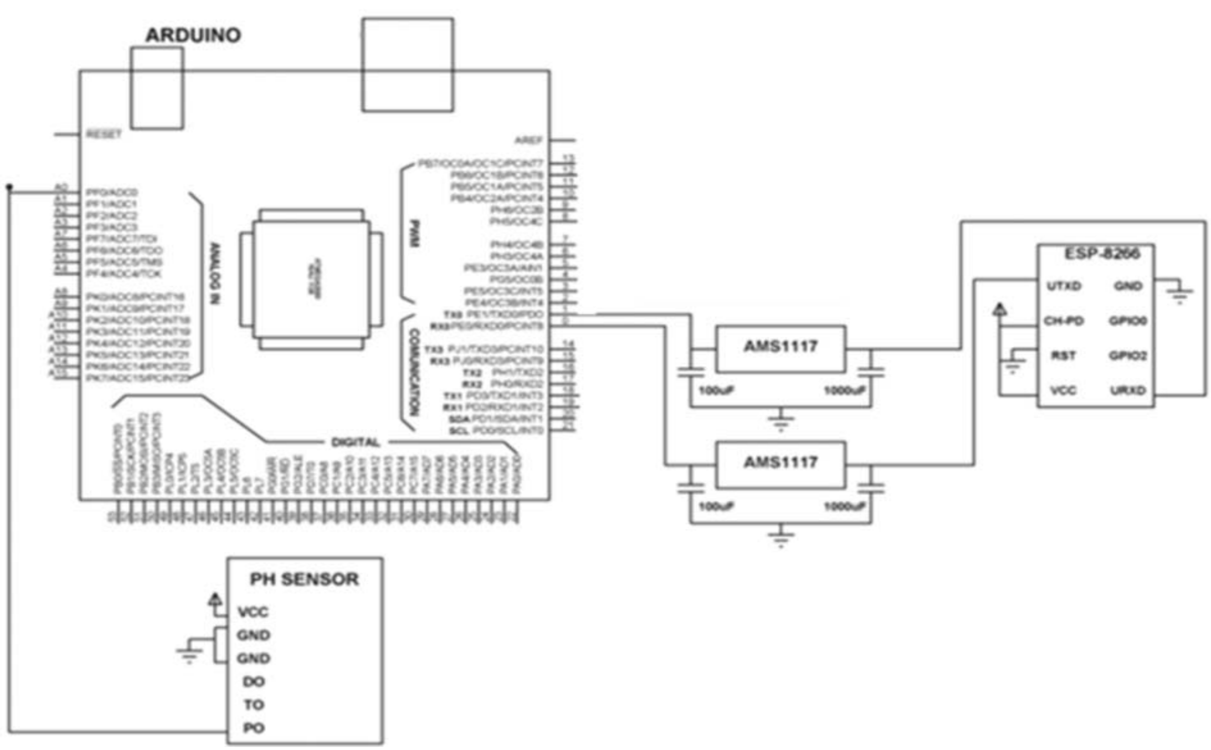

Fig. 2. Circuit Diagram of the System.

2.3. Flow Chart

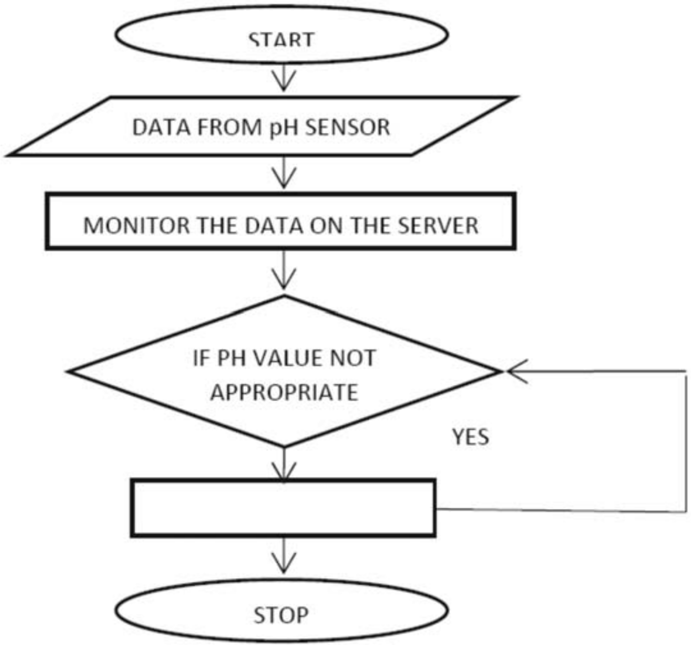

Fig. 3. Flow Chart

3. EXPERIMENT AND RESULT

3.1. Configuring the Wi-Fi module

ESP8266 Wi-Fi has to be configured it to send data on the server. The module is first flashed using Arduino and then the Arduino is programmed to send data to the server.

Table 1. Connection of ESP 8266 to Arduino for flashing

ESP8266	*ARDUINO UNO*
RX	RX
TX	TX
GND	GND
RESET	GND
CH_PD	3.3V (external supply)
VCC	3.3V (external supply)
GPIO0	GND

After flashing the module the RX and TX pins are reversed and the Arduino is programmed to send data on the server.Figure. 3 shows the setup for configuring the Wi-Fi module.

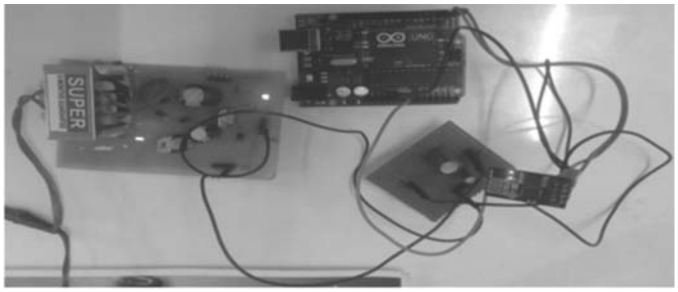

Fig. 4. Setup for configuring the ESP 8266

3.2. Calibration of pH sensor

The steps to calibrate a pH sensor are :

- Take two buffer solutions with pH 4.00 and pH 9.20.
- First dip the probe in the 4.00 pH buffer solution and set the sensor to get pH as 4.00.
- Wash the probe with distilled water.
- Dip the probe in the 9.20 pH buffer solution and check the sensor reading. The reading could be less or more than 9.20. The difference in the reading is the error.
- Then take the solution for which the pH is to be obtained
- Dip the probe into the solution and get the reading.
- Actual pH = pH reading +/- error.

Calculation

First the average value of 6 sample values is taken by storing in a buffer. Then the analog average value is converted to millivolt (mV) using the formula: Value = average value * 5.0 / 1024 / 6. Then, the pH value is calculated using the formula: pH Value = 3.5* Value + Offset; // convert the millivolt into pH value. Here, Offset is a parameter to change for the calibration.

3.3. Validation of pH Sensor

The pH sensor used is validated using a standard digital pH meter 802 by Systronics. The validation was done by first calibrating the digital pH meter. To calibrate it, first the sensor was set using pH 4.00 buffer solution and then the pH of 9.20 pH buffer solutions was measured.

pH of buffer solution 9.20 obtained =8.90 ; Error = 9.20-8.90 = .30 ; pH of sample water obtained by the meter = 8.07; Actual pH = pH obtained pH + error = 8.07+.30 = 8.37 .

Fig. 5. Calibrating the meter to get pH of buffer solution with pH 4.00

Fig. 6. pH obtained by buffer solution of pH 9.20

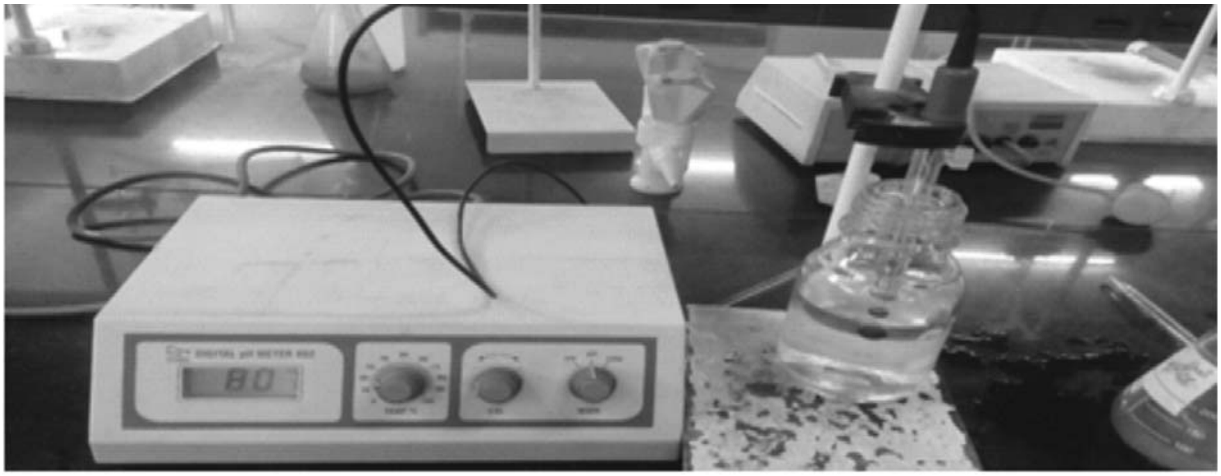

Fig. 7. pH of the water sample from pH meter

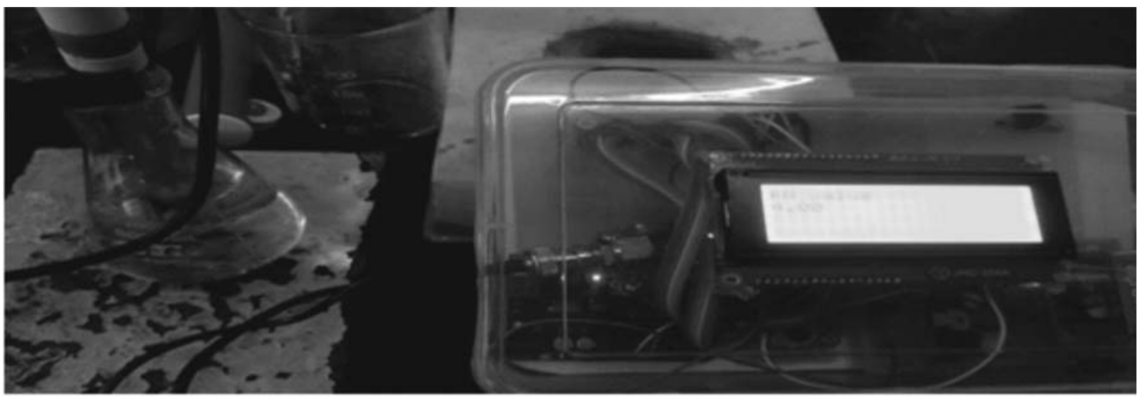

Fig. 8. Sensor calibration by 4.00 pH buffer solution

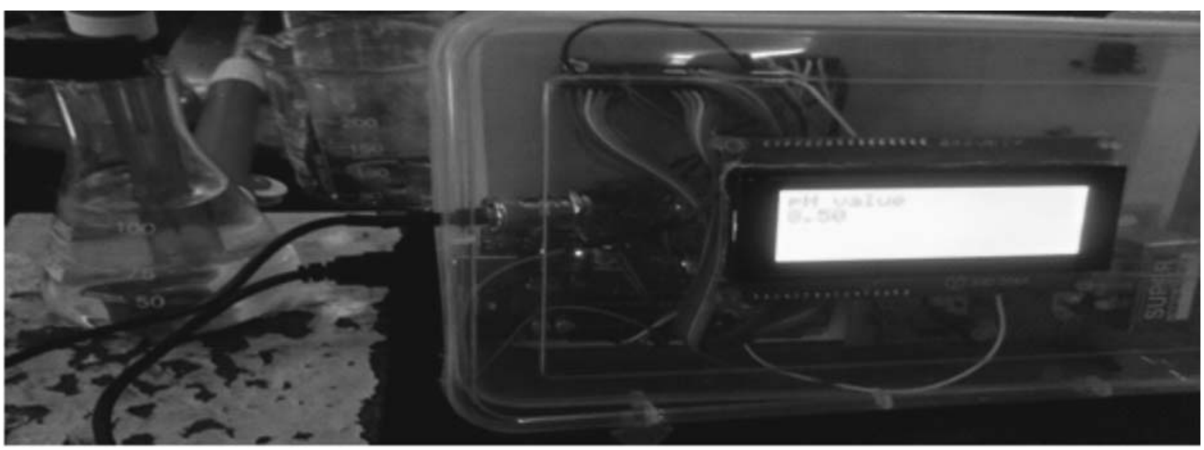

Fig. 9. pH value by sensor for 9.20 pH buffer solution

Figure.5 shows the process of calibrating the digital pH meter to get the 4.00 pH for the with 4.00 pH buffer solution.Figure.6 shows the obtained pH of buffer solution with pH 9.20 to get the error in the pH meter.Figure. 7 show the obtained pH of sample water solution. The actual pH will be the sum of the pH obtained and the error. Now, the pH sensor used is calibrated using a 4.00 pH buffer solution by setting the offset in the programming.Figure. 8 show the sensor calibration using a 4.00 pH buffer solution to get a pH of 4.00 by setting the offset value. Now, the pH value for 9.20 pH buffer solution is obtained as 8.50. So, the error is 9.20-8.50= 0.70.Figure. 9 show the pH value obtained for 9.20 pH buffer solution to calculate the error. The error obtained will be added to pH of the solutions measured. Now, the pH of the sample water is measured using the sensor.pH value obtained = 7.33 ; Error = 0.70 ; Actual pH = pH obtained + Error = 7.33+0.70=8.03

3.3. Results of pH sensor data on server

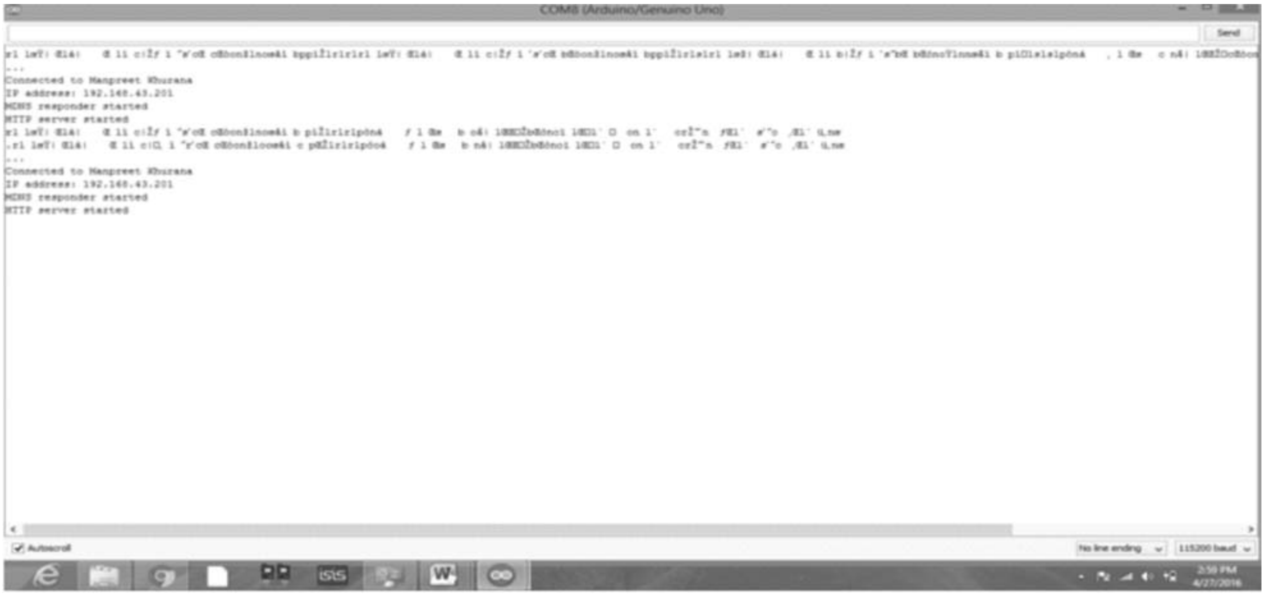

Fig.10. flashing the ESP 8266 to get the IP address on the serial monitor

Figure. 12 screenshot of the data on server on mobile

Results of the data on the server include the module being flashed and data being received on mobile. Figure. 9 shows the snapshot of the ESP 8266 module being flashed using Arduino UNO. After the module is flashed and the uploading is complete. The serial monitor of the Arduino IDE 1.6.7 displays the IP address of the module being used. This IP address is used to access the data on mobile on server. Figure.10 shows the IP address of the module on the serial monitor of Arduino IDE 1.6.7.Figure. 11 shows the output of the data on mobile when the ESP 8266 module is connected to the mobile hotspot. After the module connects to the hotspot, the IP obtained is opened on the browser and the data is received.

4. CONCLUSION

The proposed work, awater health monitoring system has been designed, in which the real time quality monitoring data can be transmitted to the smart phone, embedded with Wi-Fi connectivity. The proposed system is not only easy to install but also cheap in cost and gives real time data on the users' smart phone. The present prototype system uses PH sensor to monitor the water quality but more sensors can also be interfaced to know the quality of water like: amount of dissolved oxygen and minerals in the drinking water.The future scope of the current work is huge. In future, it can be executed to monitor the quality of water not only in household but for the whole city or a town, from where the water supply takes place. Through this system the appropriate time can be estimated for the cleaning of the city water tank. With combination of others sensors, a hybrid quality monitoring system can be designed in the near future for the whole city or town.

5. REFERENCES

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