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AUTOMATED WATER POTABILITY MONITORING SYSTEM

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ABSTRACT

In recent days, the most important problem that our society faces is low quality of drinking water. Water quality monitoring is important because contaminated drinking water can spread diseases faster than any other sources. With existing techniques, the general public is not aware of the potability of water. Lack of accurate and efficient low cost systems are a reason for poor awareness on the same. The traditional method of getting the water quality checked by the societies is to go to a laboratory and get the result. This method is time consuming and costlier too if the water quality need to be checked at regular intervals. In this paper we present a design and development of low cost real time water quality monitoring system based on IoT. The pH, turbidity and ORP parameters of tank water are sensed by sensors from the particular society and the data is sent to the society head as well as the pump station head officer for the further analysis.

Keywords*: *Atmega328P-PU, ESP8266, IoT, sensors.

I. INTRODUCTION

A healthy and clean living environment can be provided to the public by improving the supply of potable water, better sanitation facilities followed by efficient management of water resources which in turn has the ability to even boost the economy of a country by contributing to poverty reduction. Globally, over 1.8 billion people are estimated to be using water source polluted by faeces. This contaminated water becomes a source for transmitting contagious diseases like typhoid, cholera, dysentery and diarrhoea. Contaminated non-potable water is estimated to cause huge number of diarrheal deaths each year in developing and underdeveloped nations. This explains the relevance and social significance of the indispensable need for monitoring water quality for a safe and healthy living. In the world statistics, one out of five deaths under the age of five is said to be due to unsafe drinking water involving water borne diseases. In-efficiently managed waste water due to urbanization, industrialization depicts that the drinking water of millions of people are contaminated with anomalies or are chemically affected. Main challenges involved in setting up clean water supply systems varies from scarcity of water, reduction in ground water table, population growth, urbanization. Many people having access to better educational and financial backgrounds, while living in the crowded cities are not able to have affordable access to clean drinking water. Clean drinking water is no more a free natural resource for future. Quality of drinking water depends on biological, physical, chemical and radiological characteristics of water. Quality of water can be affected by human intervention or by natural influences. In order to create awareness

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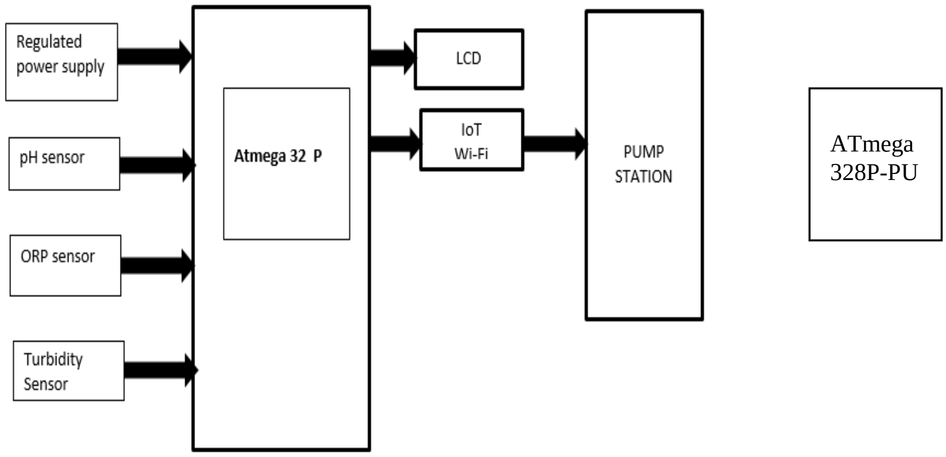
amongst the public regarding different water quality monitoring approaches, accurate and efficient systems or devices have to be designed. With advancing trends, internet technologies can also be utilized in acquiring the information of water quality parameters. The design should be at a lower cost, affordable by all so that continuous and real time testing of water can be carried out even at homes, hostels, hotels or public establishments to ensure that clean and safe drinking water is available to all irrespective of their economic status in the society. This paper focuses on modelling, developing a affordable water quality testing system.

II. BLOCK DIAGRAM



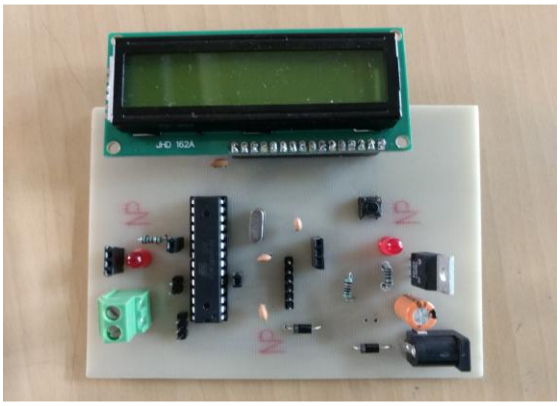
System block diagram

III. COMPONENTS

Components used-

1. Main PCB
2. ESP 8266 WiFi module
3. LCD display
4. ORP sensor
5. pH sensor
6. Turbidity sensor

1. Main PCB



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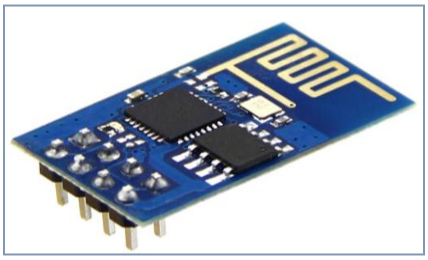
The above shown image is of the main PCB. This PCB consists of the core controller i.e. ATmega328P-PU. There is also a separate section of power supply on the board itself. The following sensors can be interfaced with the board directly using the ports pins provided on the board. The outputs of sensors are very small in value. Hence, a signal conditioning circuitry is required. Therefore a separate board designed for signal conditioning.

2. **ESP8266 WiFi module**



ESP8266 is an impressive, low cost WiFi module suitable for adding WiFi functionality to an existing microcontroller project via a UART serial connection. The module can even be reprogrammed to act as a standalone WiFi connected device–just add power!

Specification:

- The ESP8266 requires 3.3V power–do not power it with 5 volts!
- The ESP8266 needs to communicate via serial at 3.3V and does not have 5V tolerant inputs.

Characteristics:

1. 802.11 b / g / n
2. Wi-Fi Direct (P2P), soft-AP
3. Built-in TCP / IP protocol stack
4. Built-in TR switch, balun, LNA, power amplifier and matching network
5. Built-in PLL, voltage regulator and power management components
6. 802.11b mode + 19.5dBm output power
7. Built-in temperature sensor
8. Support antenna diversity
9. off leakage current is less than 10uA
10. Built-in low-power 32-bit CPU: can double as an application processor
11. SDIO 2.0, SPI, UART
12. STBC, 1x1 MIMO, 2x1 MIMO
13. A-MPDU, A-MSDU aggregation and the 0.4 Within wake
14. 2ms, connect and transfer data packets
15. standby power consumption of less than 1.0mW (DTIM3)

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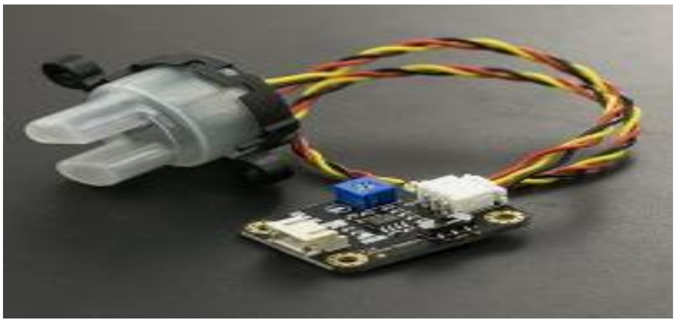
3. ORP sensor

Oxidation refers to any chemical action in which electrons are transferred between atoms. Oxidation and reduction always occur together. ORP is a reliable and cost effective method to measure the effectiveness of water disinfection sanitizers (chlorine, sodium hypochlorite, bromine and ozone) in real time. As the measured value of ORP increases, the solution has more potential to oxidize and thus to destroy any unwanted organisms. WHO adopted an ORP standard for drinking water disinfection of 650 mV. Research has shown that at 650-700 mV of ORP, bacteria such as E.coli and Salmonella are killed on contact. ORP level can also be viewed as the level of bacterial activity of the water because a direct link occurs between ORP level and Coliform count in water.

4. pH sensor

The pH value can be used to determine weather the water is soft or hard. The pH of pure water is 7, for surface water systems it is 6.5 to 8.5 and for ground water systems it is between 6 and 8.5 .The pH electrode used is combination of a glass electrode and are reference electrode. pH value is determined by measuring the voltage difference between these two electrodes. The output of the pH electrode produces DC voltage (mV), 1 pH indicates ±59.4mV for full scale range. An ideal electrode at 25°C will produce 0 mV when placed in a solution with a pH of seven.

5. Turbidity sensor



Turbidity sensors measure the amount of light that is scattered by the suspended solids in water. As the amount of total suspended solids (TSS) in water increases, the amount of turbidity level (and cloudiness or haziness)

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also increases. Turbidity sensors are used in river and stream gaging, wastewater and effluent measurements, control instrumentation for settling ponds, sediment transport research, and laboratory measurements.

Specifications:-

1. Operating Voltage: 5V DC
2. Operating Current: 40mA (MAX)
3. Response Time : <500ms
4. Insulation Resistance: 100M (Min)
5. Output Method:
   - Analog output: 0-4.5V
   - Digital Output: High/Low level signal (you can adjust the threshold value by adjusting the potentiometer)
6. Operating Temperature: 5℃~90℃
7. Storage Temperature: -10℃~90℃
8. Weight: 30g

IV. STANDARD VALUES

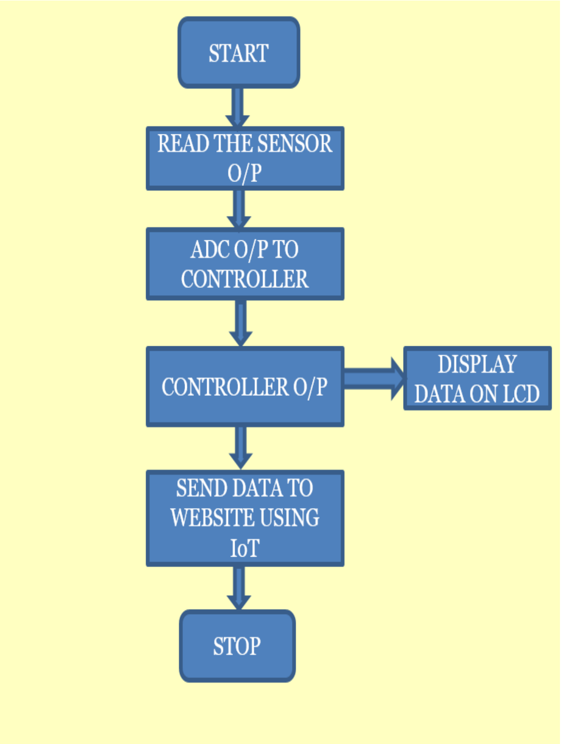
	Parameter	Units	Quality Range	Meas. Cost
1	Turbidity	NTU	0 – 5	Medium
2	Free Residual Chlorine	mg/L	0.2 – 2	High
3	ORP	mV	650 – 800	Low
4	Nitrates	mg/L	<10	High
5	Temperature	^{o}C	-	Low
6	pH	pH	6.5 – 8.5	Low
7	Electrical Conductivity	$\mu S/cm$	500 – 1000	Low
8	Dissolved Oxygen	mg/L	-	Medium

Suggested parameters to be monitored. Quality range is suggested by WHO guidelines and EU standards.

V. WORKING

The three sensors are implanted in the water tank of the society. Sensors will sense the values of pH, turbidity and send it to core controller. The output of the sensors is very small i.e. mV and hence before sending it to core controller pre-amplification of the output is required. The amplified signal is analog in nature, so analog to digital conversion is also needed. The digital output signal is then processed by the core microcontroller. The microcontroller based on the software code gives output of the respective values of quality parameters i.e. pH, turbidity and ORP. Then these values can be viewed by the people of the society on LCD and at the same time these values are send to the IoT platform thinkspeak. All the data will be stored on thinkspeak as well as its graph is also created. The change in the values can be viewed easily in the graphical form. All this data can be viewed by the head of the pump station using a URL. The head can thus verify the quality of the potable water on the daily basis. If any of fault occur, there will be change in the values too. Hence, any fault in the transportation or in the pipeline can be detected.

VI. FLOWCHART



VII. ADVANTAGES

1. Due to automation it will reduce the time to check the parameters.
2. This is economically affordable for common people.
3. Low maintenance.
4. Prevention of water diseases.
5. This model can be generalised for commercial as well as for industrial purposes.

VIII. APPLICATIONS

1. This system is used in commercial and domestic use.
2. Water supply agencies.
3. For health department to identify the reason of water diseases.

IX. CONCLUSION

The three important parameters of water i.e pH, turbidity and ORP can be analyzed using this low cost model designed. The data can be viewed by the society members as well as this data is transferred to the head of pump station for the further analysis to take necessary action. This model is economical and hence can be afforded by societies.

X. FUTURE SCOPE

1. To give information to whole users those are depends on that plant.
2. Detecting the more parameters for most secure purpose
3. Increase the parameters by addition of multiple sensors

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