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WATER TESTING AND TREATMENT USING IOT

SHWETHA V[1], PAVAN U[2], SREEKANTH V S[3], ARSHITHA G[4]

Asst professer, Sri Jagadguru Chandrashekaranatha, Swamiji Institute of Technology, Chikkaballapur,India[1]

Student, Sri Jagadguru Chandrashekaranatha, Swamiji Institute of Technology, Chikkaballapur,India[2-4]

Abstract: According to research, 8 lakh people die from waterborne diseases in most of developing and undeveloped countries. The flips in the sewage treatment cause the improper treatment of water, which in turn affects the lives dependent on that water. The automation of these treatment processes will help improve the treatment of water. Every year over a million people suffer from waterborne diseases and a number of them are mainly due to improper treatment of water. Water pollution has been an increasing problem over the last few years. Hence, it is a necessity to deal with this problem and to make sure most of the swage is treated before use. The treatment plant is automated with the help of IoT and IoT-based sensors. These sensors are used to monitor the quality of the water and control the flow of water. This data can also be used to process and store this information for future research and processing. This sewage treatment plant automation aims to achieve this by making use of IoT to reduce power consumption and gives better water quality. On a large scale, the implementation and sewage treatment plant automation will be way cheaper than the traditional methods.

Keywords: Water quality testing, Water treatment, Arduino, Arduino sensors.

I. INTRODUCTION

Water is the most essential sources of life on Earth. It is the vital requirement to meet the needs of everyday life by communities under every sector. Hence, the water must be well preserved and saved for the future generations. This can be achieved by reusing the water by testing and treating it accordingly and save it [3].

Water from any source may contain various suspended, dissolved and colloidal impurities which are harmful and must be taken care of. Therefore the process of removal of undesirable matter and pathogens from water is called water treatment process. Water testing is conducted to meet the regulatory requirements and adhere to the safety procedures that are needed for clean and safe water. This is a broad concept that involves several methods to analyse and evaluate the quality of water. Millions of water quality tests are carried out daily to fulfil regulatory requirements and to maintain safety. The testing and treatment can be done in various ways that includes physical, mechanical, biological and chemical processes. Some of the treatment processes include screening, aeration, coagulation, sedimentation, filtration, softening, disinfection, sludge drying, fluoridation, pH correction and so on [2].

The objective of the testing and treatment includes reduction of impurities, objectional colour, odour, turbidity and hardness, to eliminate corrosive nature of water and make it suitable for industrial purposes and to make water safe for drinking. Hence, water treatment ensures access to clean water and avoid contamination of water bodies. Water purification is energised to remove all the unnecessary bacteria and viruses from the water that is hazardous for our health. So, just like how oxygen is an essential component for survival, water is also a crucial component of life [3].

II. OBJECTIVES

- Extend the quality detection by finding other other parameters like salinity, turbidity and dissolved ions.
- With the help of continuous monitoring we can also includes messaging technology which used to send messages to the corresponding authorities.

III. METHODOLOGY

The proposed system is the real time solution for the automation of the treatment plant. With the help of Arduino and Arduino based sensors, the water is first tested for parameters such as pH, temperature, turbidity, and TDS. With this data, we can see that this treatment plan can be formed to treat this water in an effective way. This process can be modified to automate the treatment part also with the help of Solenoid valve which can be used to controls the flow of water and also affiliate itself with the treatment setups such as Acid/Base injection, Filtration, Carbon neutralization.

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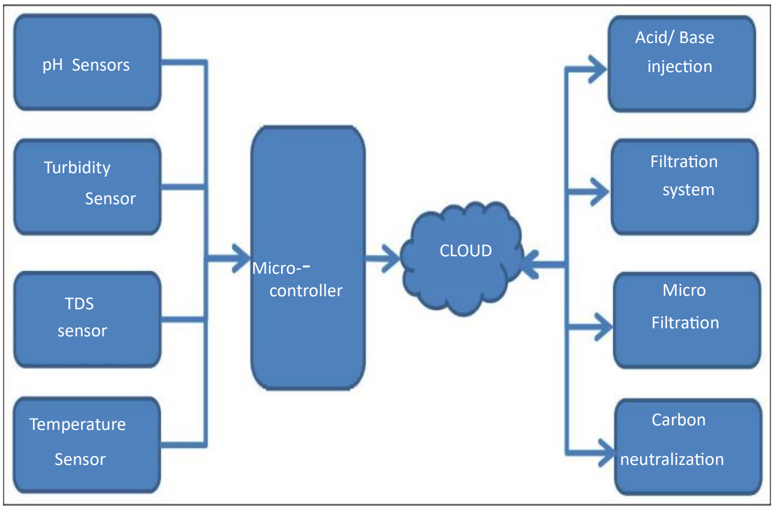

Figure 1: Block diagrams of the connections.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

The system is based on Arduino uno and Arduino based sensors the Arduino board has the memory capacity of 32K, with 34 functional pins. The board acts a brain to process the data and also controls the working of the sensors. Interfacing this board is made easy with the help of Arduino IDE software [2]. With the help of bluetooth module, the Arduino board can be connected to any nearby mobile devise wirelessly and can be controlled or transmit data [2]. The sensors that are in use are as explained

- pH Sensor

Figure 3: pH Sensor.

pH is a measure of how acidic or alkaline a liquid is, and it can be measured using a specific sensor. The pH scale goes from 0 to 14, with 0 being very acidic and 14 being very alkaline. The sensor measures the amount of hydrogen ions in the liquid using two electrodes, a reference electrode and a glass electrode. pH measurement has many uses, including in agriculture, wastewater treatment, industrial processes, environmental monitoring, and research and development. The pH sensor is a useful scientific instrument that can help determine if a liquid is acidic or alkaline, which is important in many different fields [3].

- Turbidity Sensor

Figure 4: Turbidity Sensor.

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A turbidity sensor is a device used to measure the clearance of water caused by particles suspended in it. The sensor measures the amount of light scattered or absorbed by the particles, which can affect the accuracy of the measurement. The US Environmental Protection Agency (EPA) uses a visible light source to measure turbidity. The device used to measure turbidity is called a turbidity meter, which consists of a light source, a chamber to hold the liquid sample, and one or more photodetectors [3].

Ideally, turbidity levels should be kept below 1 nephelometric turbidity unit (NTU) to minimize the negative impacts of sediment on aquatic life. The measurement of turbidity is based on the color matching technique and is measured with an electronic instrument called a nephelometer. It is important to maintain low turbidity levels in water sources to ensure that disinfection, as high turbidity levels can interfere with disinfection [4].

- TDS Sensor

Figure 5: TDS Sensor

A TDS meter is a device that measures the amount of dissolved solids in water. It works by using two electrodes that are placed in the water sample. When there are no dissolved solids in the water, the meter will show zero ppm. However, if there are dissolved solids present, they will conduct electrical charge and cause the meter to display a ppm value that is proportional to the amount of dissolved solids [4].

The TDS Meter is a useful tool for testing the quality of water. It can be used in various fields such as home water testing and hydroponics. The meter measures the conductivity of the water and uses that reading to estimate the TDS level. A high TDS level in water can affect its taste, making it salty, bitter, or metallic. Additionally, high TDS levels can indicate the presence of toxic minerals that can be harmful to human health [5].

- Temperature Sensor

Figure 6: Temperature sensor.

The DS18B20 is the temperature sensor in use which has 64-bit serial code both address that lets in more than one DS18B20s to run at the same 1wire bus. Temperature sensors are devices that detect and measure the heat or the coldness and then convert this information in an electric pulse that can be used to record its reading. The voltage across the diode tells us the working of the temperature meter. Variation in Temperature is proportional to diode's resistance [4].

The cooler the water temperature, the lesser the resistance and vice-versa. The measurement of this resistance is done across the diode will help to determine the temperature reading [4].

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- Solenoid Valve

Figure 4: Solenoid valve [7]

A solenoid valve with a 1.27 centimeters size is used to control the flow of liquid. This valve is normally closed and will only open when a positive pulse is applied to it. The valve will then close again when a negative pulse is applied. The valve's thread size is G1/2 in and it is commonly used in water purification equipment, water control systems. The electric pulse solenoid valve is durable and has a stable, long life with minimal risk of breaking down [7]. The 5V Solenoid Valve uses a magnet to stay in either an open or closed state without consuming any power. To shift the valve from one state to another, a short DC voltage pulse of 25 milliseconds is applied to the coil. To switch the valve back, a reverse polarity pulse is used. This valve has very low power usage, which results in a negligible increase in valve coil temperature and a very long battery life [7].

- Mobile filtration

Figure 7: filtration system

The technology used in this filtration process is based on physical filtration and chemical adsorption. It contains multiple layers of filtration to remove impurities and bacteria from water. The first layer is of mesh cloth that filters larger particles and sediment. The next layer is activated carbon, which is highly porous and has the ability to absorb chemicals and other impurities. Then next layer is cotton which acts as a barrier to prevent the sand or gravel, which helps to remove any remaining impurities and bacteria from the water [9].

V. RESULTS

The result that system is expected to measure the parameters accurately, also provide a good study on the water body, with the help of this data water can be treated accurately and get the water quality to match with that of WHO's recommended range.

Table 1: Results

S.no	Liquids to be tested	pH	Turbidity	TDS
1.	Normal tap water	7.5	4.4V	230ppm
2.	Drinking water	7.2	3.79V	198ppm
3.	Salt water	8.4	5V	1298ppm
4.	Sugar water	7.4	4.5V	899ppm
5.	Soap water	9.5	39.3V	560ppm
6.	Detergent water	8.9	50.9V	799ppm
7.	milk	6.8	0.5V	1726ppm
8.	Soft drink	2.9	3.51V	521ppm
9.	Fruit juice	4.0	5.0V	618ppm
10.	coffee	5.7	16.0V	150ppm

The table is the results that system obtained by testing different liquids and water quality.

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