Detection of Cartridge Quality in Sediment Filter for Water Purification System

(Dr.P.Tamilvani, Associate Professor in department of Electricl and Electronics
Engineering,M.P.Nachimuthu M.Jaganathan Engineering Collage.)

Gokulakannan S
Department of **Electricl and Electronics
Engineering,M.P.Nachimuthu M.Jaganathan
Engineering Collage.**Tamilnadu 638 112,India
Email id-kannaneeeg@gmail.com

Gokilan k
Department of **Electricl and Electronics
Engineering,M.P.Nachimuthu M.Jaganathan Engineering
Collage.**Tamilnadu 638 112,India
Email id-gokilankumar979@gmail.com

Karthikeyan R
Department of **Electricl and Electronic**s
**Engineering,M.P.Nachimuthu M.Jaganathan
Engineering Collage.**Tamilnadu 638 112,India
Email id-karthisuriya461@gmail.com

Veerasamy A
Department of **Electricl and Electronics
Engineering,M.P.Nachimuthu M.Jaganathan Engineering
Collage.**Tamilnadu 638 112,India
Email id-samyveera354@gmail.com

Abstract- **Efficient water purification is vital for ensuring access to clean and safe drinking water. One essential component of water purification systems is the sediment filter, responsible for removing particulate matter and debris from the water. Monitoring and maintaining the performance of sediment filters are critical to guarantee the overall effectiveness of the water purification process. This study focuses on the development of a detection method to assess the water quality within sediment filters. The proposed detection method combines advanced sensing technologies and data analysis techniques to continuously evaluate the sediment filter's efficiency and identify potential issues. The system can promptly detect deviations from optimal performance by integrating real-time monitoring of key water quality parameters, such as turbidity, sediment concentration, and pressure differentials. Additionally, machine learning algorithms are employed to analyze the collected data, enabling the system to predict sediment filter clogging and degradation trends.**

Key words - temperature sensor, turbidity sensor, ph sensor, colour sensor

INTRODUCTION

The continuous monitoring of detection of water quality in sediment filter for water purification process is achieved through the IOT.The system with help of a sensors to detect sentiment filter cartridge purity and colour status.The systems are used to provide safe drinking water world wide.Detecting the level of contamination of sediment filter cartridges.

Water is essential for life and comes in different forms such as saltwater in oceans and freshwater in rivers, lakes, and underground. Only a small portion of water about 2.5% is freshwater that we can use. Sadly, over 2 billion people face water scarcity which means they don't have enough clean water for daily needs. Many people lack access to clean drinking water leading to health issues from waterborne diseases. Water is used in various ways like around 70% goes to farming that helps in grow our food, industries use water for making things and households need it for drinking, cooking, and cleaning. Unfortunately, a large amount of waste water about 80% is released into the environment without proper treatment polluting water sources. .

TEMPERATURE SENSOR

The RTD Pt100 is used as temperature sensor. The system consists of Pt100 RTD temperature sensor, a microcontroller, and a display. The Pt100 RTD temperature sensor would be mounted on the outside of the sediment filter housing. The microcontroller would be connected to the Pt100 RTD temperature sensor and the display. The microcontroller would periodically read the output of the Pt100 RTD temperature sensor and compare it to a reference value (40ºC). If the output of the Pt100 RTD temperature sensor is above the reference

value (40ºC) the microcontroller would send a signal to the relay to turn off the pump and the value is displayed in the LCD. The equation 4.1 represent the calibration unit of temperature sensor. This system helps to ensure that the water temperature is within the recommended range (10ºC to 25ºC) for the filter media, to detect problems with the water purification system like clogged filter or a malfunctioning of pump, it helps to improve the efficiency of the water purification process.

pH SENSOR

A pH sensor is used in a sediment filter to monitor the pH of the water. The pH sensor is typically mounted on the outside of the sediment filter housing. The sensor is inserted into the water flow in the sediment filter. The pH sensor is connected to a microcontroller using a shielded cable. The microcontroller periodically reads the voltage output of the pH sensor. The voltage output is then converted into a pH reading The pH sensor needs to be calibrated regularly. The equation 4.2 gives the calibration formula for pH sensor. The pH of the water determines the quality of water either it can be used or not. The pH of water 1-6 pH represents acidic in nature, 7 pH is neutral and 8-14 pH is alkaline in nature. The pH range 6.5 to 8.5 is recommended for drinking purpose. Therefore, the microcontroller reads the pH values and compares with the reference value (10 pH) then the relay turns off the motor and This help to improve the overall performance of the water purification system.

COLOUR SENSOR

An IR colour sensor is used in a sediment filter to detect changes in the colour of the filter media. As the filter media becomes clogged with sediment it will turn from white to brown or black colour. An IR colour sensor is a device that uses infrared light to detect and identify colours. It consists of an IR LED emitter and an IR photodiode detector. The IR LED emits infrared light which is reflected by the sediment filter being sensed. The IR LED emits the light with particular intensity and it gets reflected and if it receives same intensity then the water is pure. If the intensity received from the filter is less than the sent intensity then the sediment filter is colour or dirt. The IR photodiode detects the reflected light and converts it into an electrical signal. The electrical signal is then processed by a micro- controller to determine the colour of the sediment filter. This system consists of an IR colour sensor, a micro-controller, and a display. The IR colour sensor is mounted on the outside of the sediment filter housing. The micro-controller would be connected to the IR colour sensor and the LCD display. The micro-controller periodically read the output of the IR colour sensor and compare it to a reference value. If the output of the IR colour sensor is below the reference value, the micro-controller sends a signal to relay to turn off the motor and this indicates the need for replacement of sediment filter. The

following table 4.1 represent the colour range and colour of water in sediment filter

TURBIDITY SENSOR

A turbidity sensor in a sediment filter is used to monitor the amount of suspended particles in the water. A turbidity sensor in a sediment filter works by detecting the amount of light that is scattered by the suspended particles in the water. The more suspended particles in the water, more light will be scattered. Turbidity sensors consist of a light source and a photo detector. The light source emits a beam of light into the water. The photo detector measures the amount of light that is scattered by the suspended particles in the water and reflected back to the photo detector. The amount of scattered light is proportional to the turbidity of the water. The output of sensor will be in voltage. The turbidity sensor needs to be calibrated regularly and equation 4.3 gives the calibration formula of turbidity sensor. The microcontroller converts the amount of scattered light into a turbidity reading and compares with the reference value (70 NTU). When the turbidity is above 70 NTU then relay gets turn off the pump. This helps the monitoring the turbidity and maintains the quality of water.

PROPOSED SYSTEM

The proposed system is user-friendly, cost-effective, and can monitor water samples in real-time with an accurate.If the sensor detects the increase or decrease in the set range it sends the signal to the ESP 32micro-controller.Using a relay the motor is turned on or turned off respectively. The values of temperature, pH, and turbidity are displayed in the LCD display.
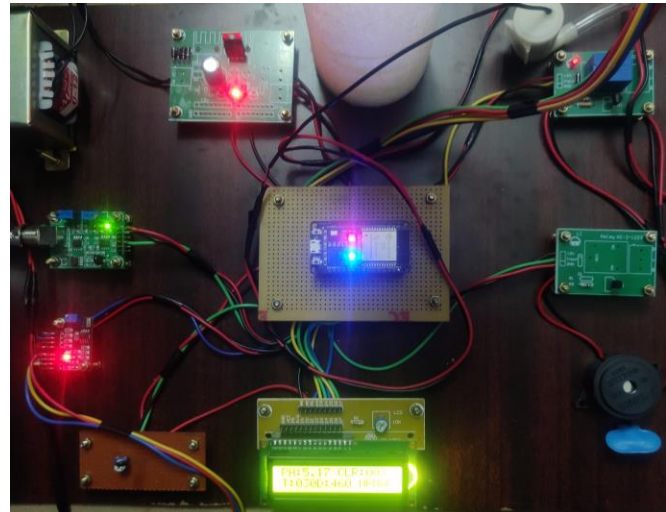

Figure 1:Hardware Steup

RESULTS AND DISCUSSION

This results in Changing the filter media regularly according to the manufacturer's instructions. Therefore, the detection of water quality in sediment filter for water purification system

consists of four different sensors temperature sensor, pH sensor, Turbidity sensor, and colour sensor. The PIC16F866 acts as a controller. The main objective of this system is to monitor the sediment filter in the water purification process with the help of sensors. The temperature has a set range value of below 40° C. The colour sensor has a set range value of above 50μW/m2 (590nm). The pH-resistant sensor has a set range value of below 10. The Turbidity-resistant type sensor has a set range value of below 70 NTU.

Figure 2:Display Information

Figure 3:Software Data

CONCLUSION

The detection of water quality in sediment filter for water purification system is an important step in water purification process ensuring the quality of water which is safe for human consumption. This is important to prevent the clog in the sediment filter and the colour of the sediment filter changes day to day usage of filter due to the dissolved organic matter present in the water. This change in colour of filter affects the taste and quality of drinking water. These are identified with of the sensors. The temperature varies based on the source of water like well water, surface water. The temperature, pH, turbidity is sensed with respective sensor. The each colour has

different wavelength and it is measured with the colour sensor and the intensity of colour is determined with sensor. The various intensity of light is sent and received by the sensor. The intensity of receiving light gets decreased as the sediments settles on the sediment filter based on this the colour of sediment filter is identified and shows the filter replacement. If the colour of the filter is very dark which is below 50 μW/m2 and signal is send to microcontroller it turns off the motor that indicates the sediment filter is very dirt. Based on the source of water to the sediment filter the colour change is rapid and need to change the sediment filter every three to six months. The regular monitoring of sediment filter makes to identify the colour of sediment filter and helps for early detection of problems in the filter. It helps to prevent the filter from becoming clogged which can restrict water flow in filter and increases the effectiveness of the water purification system.

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