ABSTRACT

Sulfur water is a natural water source widely utilized for health and tourism purposes. However, changes in water quality caused by environmental factors and natural processes may affect its safety for public use. This study aimed to design and develop a sulfur water quality monitoring system based on the ESP32 microcontroller integrated with the Internet of Things (IoT) as an alternative to manual measurements, as well as to determine the safe quality limits of sulfur water used in hot spring baths. The developed system employed a pH-4502c sensor, a DS18B20 temperature sensor, and a SEN0189 turbidity sensor to monitor water quality parameters. Measurement results were displayed on an LCD and transmitted in real time through a Telegram bot. The testing results showed that the pH-4502c sensor achieved an average error of 2.25%, the DS18B20 temperature sensor 0.41%, and the SEN0189 turbidity sensor 1.63%. These error values were below 5%, indicating that all sensors performed well and were suitable for use in the monitoring system. Field testing on clear sulfur water produced pH values of approximately 6.2, temperatures ranging from 50 to 50.1°C, and turbidity values between 7 and 18 NTU, resulting in a "Moderate" sulfur content status while remaining within the safe range for hot spring use. In contrast, testing on turbid sulfur water produced pH values of 6.5 – 6.6, temperatures of 40.1 – 41.5°C, and turbidity values ranging from 145 to 187 NTU, resulting in a "Low" sulfur content status; however, the water did not meet the utilization requirements due to turbidity levels exceeding the permissible limit. The results demonstrate that the developed system is capable of monitoring sulfur water quality in real time and providing rapid, continuous, and easily accessible information regarding water conditions..

Keywords**:** *sulfur water, ESP32, Internet of Things, pH, temperature, turbidity, water quality monitoring*.