

ABSTRACT

Biogas is a renewable energy source produced through an anaerobic process, where microbes decompose organic matter into gas that can be utilized as an alternative fuel. However, monitoring biogas production still uses conventional methods that have limitations in terms of accuracy and real-time monitoring capabilities. This can lead to decreased production efficiency, safety risks, and difficulties in process optimization. These challenges make the development and adoption of biogas as an alternative energy source suboptimal, especially in the small to medium scale.

This research aims to overcome these limitations by developing an Internet of Things (IoT)-based biogas monitoring system capable of measuring important parameters in real-time and integrated with a website and mobile application. The system is designed to improve the efficiency and safety of biogas production through accurate and real-time monitoring of key parameters such as methane gas content, temperature, pressure, and pH. By enabling remote monitoring and providing more accurate data, the system is expected to encourage the optimization of the biogas production process and increase its adoption as a wider renewable energy source.

The developed system consists of hardware and software. The hardware includes MQ-4 (methane gas), DS18B20 (temperature), BMP280 (pressure), and SEN0161 (pH) sensors connected to an ESP32 microcontroller. Software in the form of websites and mobile applications are designed to visualize data and facilitate remote monitoring. System testing showed satisfactory results. The BMP280 sensor displays an average error of 0.54% when compared to standard measuring instruments. The DS18B20 temperature sensor and SEN0161 pH sensor also showed good calibration results. Quality of Service (QoS) evaluation resulted in an average throughput of 10231.96 bps and an average delay of 222.14 ms for the device connection to Firebase, indicating efficient data transmission. Usability testing using the System Usability Scale (SUS) method resulted in a score of 71 for the website and 75 for the mobile application, indicating a good level of usability. In terms of functionality, the system successfully displays real-time data, historical charts, and provides notifications as planned.

Keywords: Biogas, Internet of Things, monitoring, website, mobile application