ABSTRACT

Cigarette smoke is a contributor to indoor especially air pollution, posing health risks to both active and passive smokers. Conventional exhaust fans often fail to manage air circulation efficiently and are not responsive to changing pollution levels. To address this, an intelligent control system is required. This study integrates Mamdani fuzzy logic as a flexible and adaptive decision-making method under uncertain conditions, such as fluctuating smoke levels. The prototype employs an Arduino UNO microcontroller with an MQ-2 sensor to detect cigarette smoke (ppm) and a PZEM-031 sensor to measure power consumption. The system controls fan speed automatically at three PWM levels: off (0), low (127), and high (255), based on smoke concentration—low (0–20 ppm), medium (20–30 ppm), and high (>30 ppm)—and the rate of change in smoke levels (ΔPPM): decreasing (-5 to -10), steady (+3 to -3), and increasing (+5 to +10). Tests compared system efficiency with and without fuzzy logic in terms of energy use. Results show that the fuzzy-based system responds accurately to rising smoke levels, achieving an average accuracy of 97.028% and precision of 96.552% compared to the AS8700A reference sensor. It also significantly reduces energy consumption, with a total energy saving of 44.92%. This research contributes to the development of intelligent ventilation systems for smoking areas, promoting healthier and more energy-efficient indoor environments.

***Keywords**: Mamdani fuzzy logic, smoke control, MQ-2 sensor, fan speed, PZEM031 sensor, energy efficiency, smoking area.*