

Microcontroller-Based Ultrasonic Pest Deterrence System Prototype for Agricultural Applications

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Abstract

This study developed a microcontroller-based ultrasonic pest deterrence system prototype for agricultural applications. The primary objectives were to generate ultrasonic frequencies using a microcontroller, integrate an amplifier module with an ultrasonic speaker, and evaluate the system's functionality by observing rat behavior at distances of 1 meter and 15 meters. Laboratory tests confirmed the system emitted ultrasonic frequencies ranging from 30 kHz to 70 kHz, with a maximum sound pressure level of 120 dB ($\pm 15\%$). Results showed that at 1 meter, frequencies of 60 kHz and 70 kHz elicited significant behavioral responses in 3 rats, with average response scores of 4.8 to 5.0. However, at 15 meters, the effectiveness was moderate and not statistically significant. The system, powered by solar panels and 6 parallel-connected 18650 batteries, is estimated to run continuously for approximately 50 hours under optimal conditions. This research highlights the potential of microcontroller-based ultrasonic solutions for sustainable pest control in agriculture while suggesting that future improvements should focus on optimizing system performance and assessing its long-term efficacy in real agricultural settings.

Keywords: Electronics Engineering, ultrasonic frequency, pest deterrence, rat behavior, Microcontroller-based system, laboratory testing, Philippines