

Real-Time Elephant Movement Detection for Human Safety: An IoT-Integrated Smart Fence Approach

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Abstract

The escalating Human-Elephant Conflict (HEC) in Sri Lanka has necessitated a transition from conventional mitigation methods to more sustainable and humane solutions. This study presents an Internet of Things (IoT)-based smart fence system specifically designed to detect and deter elephants in real-time, aiming to minimize crop damage, property destruction, and loss of life. The system integrates Passive Infrared (PIR) and ultrasonic sensors to identify elephant movement near agricultural fields or village perimeters. Upon detection, it activates sound-based deterrents, speakers emitting frequencies that are irritating to elephants yet harmless to humans and other wildlife. The entire system is solar-powered, making it environmentally sustainable and suitable for off-grid rural areas. A GSM module is incorporated to send real-time alerts via SMS to local farmers and wildlife authorities, allowing for timely intervention. The research methodology includes the installation and field testing of the system in HEC-prone regions to assess its reliability, response time, and deterrence effectiveness. Data collected from these tests provide insights into the system's capability to reduce the frequency and severity of elephant intrusions. Results indicate a significant reduction in elephant activity in monitored areas, highlighting the system's potential as an effective alternative to traditional electric fences, which often pose safety and ethical concerns. The study contributes to the growing field of conservation technology by offering a low-maintenance, cost-effective, and non-lethal approach to wildlife conflict management. With further development and community engagement, this smart fence system could be adapted for use in other regions facing similar human-wildlife conflict challenges.

Keywords: Human-Elephant Conflict; IoT; Smart Fence; PIR Sensors; Acoustic Deterrents