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VIBRATION FENCING

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ABSTRACT: The Animal Protection System with Vibration Fencing and Solar Power Integration addresses the challenge of safeguarding animals from potential harm caused by traditional electric fencing on farms. This innovative system employs ultrasonic sensors to detect animal proximity and utilizes a vibrator motor to produce fence vibrations, effectively deterring animals without causing injury. The system is equipped with dual power sources of energy and a conventional power supply to ensure continuous functionality. In solar energy, the vibrator motor is powered sustainably, promoting environmental efficiency. The sensors trigger the system, activating the appropriate power source and the vibrator motor. As a result, animals receive a non-harmful stimulus, prompting them to retreat from the fence. This eco-friendly and human approach offers a viable alternative to conventional electric fencing, contributing to animal welfare and crop protection in agricultural settings

Keywords—non-harmful, crop protection, Dual power sources, Agricultural Innovation, Ultrasonic sensor.

I. INTRODUCTION

Human-wildlife conflicts have emerged as a pressing issue at the interface of agricultural development and wildlife conservation. As human populations continue to grow and expand into wildlife habitats, conflicts between farmers and wildlife have become increasingly prevalent worldwide. These conflicts manifest in various forms, ranging from crop damage and livestock predation to human safety concerns and ecological disruptions. Traditional methods of wildlife deterrence, such as fences, chemical repellents, and lethal control measures, have been the primary strategies employed by farmers to protect their crops and livestock. However, these methods often pose ethical dilemmas and environmental concerns, leading to calls for more sustainable and humane approaches to mitigate human-wildlife conflicts.

In response to the limitations of conventional wildlife deterrence methods, innovative solutions are being explored to promote coexistence between humans and wildlife while ensuring agricultural sustainability. One such promising approach is the use of vibration fencing, a novel technology that leverages controlled vibrations to deter wildlife from agricultural areas. Unlike traditional physical barriers, vibration fencing offers a non-lethal and environmentally friendly deterrent that minimizes harm to both wildlife and agricultural ecosystems. By creating an uncomfortable sensation for approaching animals without causing physical harm, vibration fencing provides an effective yet humane means of preventing wildlife intrusion into agricultural fields.

This research paper aims to explore the potential of vibration fencing as a sustainable solution for mitigating human-wildlife conflicts in agricultural landscapes. Through a comprehensive review of existing literature, case studies, and empirical evidence, we will examine the effectiveness, feasibility, and implications of implementing vibration fencing as a wildlife deterrence strategy. Furthermore, we will investigate the socio-economic, environmental, and ethical dimensions of vibration fencing adoption, considering its impact on agricultural productivity, wildlife conservation, and community livelihoods.

Ultimately, this research seeks to contribute to developing innovative and ethical approaches to managing human-wildlife conflicts, fostering coexistence, and promoting sustainable agriculture in a rapidly changing world.

II. LITERATURE SURVEY

The eleAlert system, presented in this study, tackles the critical issue of human-elephant conflict (HEC) prevalent in regions worldwide, including Sri Lanka. By harnessing a network of sensors and innovative communication protocols, eleAlert aims to bolster the efficacy of electric fences in mitigating HEC. Past research has underscored the limitations of existing perimeter intrusion detection systems, necessitating a specialized solution tailored for safeguarding wildlife fences over extensive distances and in rugged environmental conditions. eleAlert offers a comprehensive approach to intrusion detection and alerting, leveraging Remote Transmitting Units (RTUs), bridges, and Location Identification Tags (LITs) to detect and pinpoint breaches in the fence. Noteworthy features include energy efficiency, accessibility for maintenance and repair, remote monitoring capabilities, and scalability. Pilot tests conducted in elephant habitats have yielded encouraging results, affirming the system's potential to significantly curtail human-elephant conflicts and protect both human communities and wildlife. In summary, eleAlert emerges as a novel and practical solution to the challenges posed by HEC, with far-reaching implications for wildlife conservation and conflict resolution efforts on a global scale.[1]

The study utilizes various approaches to tackle human-elephant conflict (HEC) and develop the eleAlert system. It begins with a review of existing literature to understand the problem and identify gaps. Technology development focuses on creating sensor networks and integrating hardware components. Pilot tests conducted in elephant habitats evaluate the system's real-world effectiveness, while data collection and analysis assess wildlife behavior and system performance. Deep learning techniques are used to develop classification models for animal detection. Experimental design outlines testing procedures for hardware setup, image capturing, and scare-away mechanisms. Evaluation and validation measures accuracy and reliability. The conclusion provides recommendations for future enhancements and research directions to address broader human-animal conflicts and improve system capabilities. Concluding remarks offer recommendations for future enhancements and research trajectories, emphasizing the broader spectrum of human-animal conflicts and the continual refinement of system capabilities.

Pain has been used as a method to alter non-human animal behavior since earliest domestication with pain tools such as the ox-goad in biblical narrative and as a symbol of power as the flail and crook (sheep goad) of the Pharaohs. One of the earliest and most widely adopted modern pain technologies of behavioral modification in livestock production is the electric fence. An early application of lethal electric fencing was the border fence between Belgium and The Netherlands during the First World War. Pain caused by conducted electricity functions by directly stimulating the different axons of the nocio receptors protective system and is not limited by the specialized pain receptors [3].

The methodology employed in the provided text involves a comprehensive review and synthesis of existing literature and knowledge of electrical injuries in animals. Through a systematic examination of scientific literature, textbooks, and expert opinions, the authors have compiled a thorough understanding of the physiological effects of electrical currents on animal bodies. This review likely involved gathering data on various parameters of electrical injuries, such as voltage, current, and duration of exposure, and synthesizing this information to identify common patterns and trends. Additionally, the authors likely drew upon their expertise in veterinary pathology and related fields to interpret findings and provide insights into the diagnostic considerations and implications for veterinary practice. By citing relevant sources and discussing key findings, the text presents a cohesive narrative that enhances our understanding of the causes, mechanisms, and pathological aspects of electrical injuries in animals [5].

The monitoring methodologies for elephant entry into fenced areas and crop-raiding activities included regular patrols along the perimeter of electric fences to identify breaches, tracking fresh elephant tracks, and occasional sightings to estimate elephant incursions. Global Positioning System (GPS) coordinates were utilized to demarcate farmland boundaries, and Arc View GIS software was employed to calculate the affected areas. Daily records were kept to document fence conditions, including wire integrity and functionality, providing insight into fence status and repairs made throughout the study period [2] .

The study proposes a novel system to address the escalating issue of crop damage caused by wild animals in Sri Lanka, which poses significant risks to both humans and animals. Traditionally, farmers have resorted to various methods, including screaming noises, gunfire, and even explosives, to deter animals like elephants, wild boars, and buffalos from raiding their fields. However, these methods are often ineffective, harmful, and sometimes illegal. In response, the study aims to develop an innovative solution utilizing modern technology. By leveraging Convolutional Neural Networks (CNNs) and transfer learning techniques, the system can effectively detect the presence of wild animals, including elephants, wild boars, and buffalos, before they enter crop fields. These CNN models, built upon a pre-trained VGG-16 architecture, are capable of real-time animal detection and classification. The system, integrated with Raspberry Pi and Arduino, captures animal images upon detection using a thermal sensor and triggers scare-away mechanisms, such as sudden flashes of light, ultrasound, and bee sounds [6].

Moreover, to ensure timely response and farmer awareness, a mobile application is developed using React Native, connected through the Firebase database, to alert farmers about animal presence in their fields. By combining advanced technology with real-time detection and scare-away mechanisms, this system significantly reduces human-animal conflicts in crop fields. The accuracy rate of the classification model stands at an impressive 77%, offering a more sustainable and eco-friendly approach compared to traditional methods. Ultimately, this innovative system aims to minimize crop damage, loss of human life, and harm to animals, providing a promising solution to mitigate human-animal conflicts and safeguard agricultural livelihoods in Sri Lanka. The solar-based electrical fencing operates through a series of steps to protect agricultural fields from intruding animals. Solar panels absorb photovoltaic energy from the sun, converting it into electrical energy through photovoltaic cells. This energy is stored in batteries via a charge controller during the day, ensuring availability when needed. The battery powers an a stable multi-vibrator with a 555delay timer, generating a square wave. This square wave is then amplified through a push-pull electrifying the fence. When animals touch the electrified fence, they receive a shock due to the high-voltage square pulses, deterring them from entering the field. This system ensures that animals are shocked but not killed upon contact, effectively protecting the agricultural field. In addition to the fencing mechanism, an animal detection system is implemented to further enhance field protection. This system comprises a circuit featuring a passive infrared (PIR) sensor, audio voice recorder and playback (APR) board, speaker, battery, global system for mobile communication (GSM), Raspberry Pi, Pi camera, servo motor, and mobile device. The PIR sensor detects the presence and movement of animals, sending signals to the Raspberry Pi. Upon detection, the Raspberry Pi activates the Pi camera to capture images, which are transmitted via GSM to alert the farmer. The farmer receives immediate alerts on their mobile device and can operate the APR board along with the speaker remotely. The APR board produces frightening sounds to further deter the animals from entering the field. This integrated system effectively combines solar-based electrical fencing with advanced animal detection technology to safeguard agricultural fields against destructive intrusion [7].

III. METHODOLOGY

Due to the usage of electric fencing in farms, animals that try to pass through the fence will be subjected to electrical shock, leading to severe injury and also causing deaths in various cases. Instead, we can use this vibration fencing that runs on solar panels to protect farms and crops from animal hindrance in agriculture. By using a vibrator motor we’re going to produce vibration on the fence. The energy to run the motor can be generated by solar energy. If no solar energy is available we can also run the motor on the normal power supply. To detect the motion of the animals near the fence we’re going to fix sensors. When the animals try to approach the fence, the sensor will activate the motor to produce vibration on the fence. Due to the vibration, the animals will get away without getting hurt.

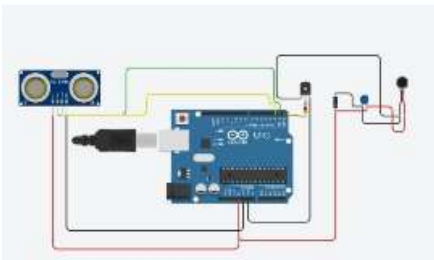

Figure 1.1 prototype of vibration fencing

If the distance is greater than 30 centimeters, indicating amplifier and an ultrasonic sensor is a device that measures the distance to an object by emitting ultrasonic sound waves and then timing how long it takes for the sound waves to bounce back. Here's how it typically works when connected to an Arduino: Setup: Connect the ultrasonic sensor to your Arduino board. Most ultrasonic sensors have four pins: VCC (power supply), GND (ground), TRIG (trigger), and ECHO (echo). Connect the VCC pin to the 5V output on the Arduino, the GND pin to the ground (GND) on the Arduino, the TRIG pin to a digital output pin, and the ECHO pin to a digital input pin. Vibration motor is connected to the Arduino using a capacitor and diode to provide the required energy to switch on and off the motor.

Pin Definitions: Trig Pin: The pin connected to the TRIG (trigger) pin of the ultrasonic sensor. It's set as an output. Echo Pin: The pin connected to the ECHO pin of the ultrasonic sensor. It set as an input. Motor Pin: The pin connected to the motor. It's set as an output. Setup Function: Pin Mode (): Configures the Trig Pin, Echo Pin, and Motor Pin as either inputs or outputs. Loop Function: Ultrasonic Sensor Measurement: Digital Write (Trig Pin, HIGH): Sends a 10- microsecond HIGH pulse to the trig Pin to trigger the ultrasonic sensor. Delay Microseconds (10): Waits for 10 microseconds. Digital Write (Trig Pin, LOW): Sets the TrigPin LOW to end the trigger pulse. Duration = Pulse In (Echo Pin, HIGH): Measures the duration of the pulse on the Echo Pin. This duration corresponds to the time taken for the ultrasonic sound wave to bounce off an object and return.

Distance Calculation: The time duration measured by Pulse In () is converted into distance (in centimetres) using the formula: distance = (duration * 0.03436) / 2. This formula assumes the speed of sound to be approximately 343 meters per second (or 0.03436 cm/microsecond).

Motor Control: If the calculated distance is less than or equal to 30 centimetres (adjustable according to the desired range), it means an object is within the specified range. Digital Write (motoring, HIGH): Turn on the motor by setting the motor to HIGH. Delay (10): Waits for a short duration to ensure stable no object within the specified range:

Digital Write (motor Pin, LOW): Turn off the motor by setting the motor to LOW. The components used in creating the vibration fencing prototype comprise a LoRa SX1278 module for long-range wireless communication, two Node MCU boards for control and connectivity, and various essential electronic components like wires, resistors, transistors, and capacitors. Additionally, a vibration motor is incorporated to produce deterrent vibrations, while wood planks and small steel rods are utilized to construct the physical barrier. These components collectively form the foundation of the prototype, facilitating the development and testing of an effective vibration-based fencing solution. The methodology employed in vibration fencing typically encompasses the integration of specialized sensors, alarm systems, and deterrent mechanisms. Vibration sensors are strategically installed along the fence line to detect any movements or vibrations indicative of animal activity. When triggered, these sensors activate alarm systems, ranging from audible sirens to notifications sent to mobile devices or centralized monitoring stations. Simultaneously, deterrent mechanisms are deployed to discourage animals from crossing the fence. These can include ultrasonic emitters emitting discomforting high-frequency sounds, sprinkler systems designed to startle animals with sudden water sprays, or electrified elements delivering non-lethal shocks upon contact. Advanced versions may also incorporate features such as smart sensors for improved accuracy for pattern recognition, and IoT connectivity for remote monitoring and control. Overall, the methodology revolves around the seamless integration of sensing technology and deterrent measures to effectively mitigate animal intrusions and protect the designated area.

IV CONCLUSION

Vibration fencing promotes sustainable agriculture by offering a humane and eco-friendly solution for crop protection. It helps to mitigate human-wildlife conflicts and reduce the need for lethal measures to control crop damage. Vibration fencing can foster positive relationships between farmers and neighboring communities. By effectively safeguarding crops and reducing conflicts with wildlife, farmers can minimize motor operation.

In conclusion, our proposal outlines an integrated strategy for smart agriculture, utilizing low-power hardware and open-source software. This system aims to offer a more effective monitoring and alerting system to safeguard crops from animal attacks, addressing the challenges farmers face due to wild animal invasions. Research into electrical and lightning injuries in veterinary pathology underscores the significance of accidental contact with electrical currents as a major cause of animal deaths, highlighting the need for proactive solutions. With its advantages, including enhanced monitoring capabilities even in remote areas, this proposed system presents a viable and effective alternative to traditional methods for preventing animal trespass into farmlands. By implementing this solution, farmers can potentially mitigate the risks to their livelihoods posed by wildlife encroachment on agricultural fields. Through meticulous integration of hardware components and thoughtful placement of each module, this system operates at peak efficiency. Leveraging highly advanced IC technology and continuous advancements, the successful design and testing of this system underscore its reliability and effectiveness. This culmination of efforts ensures seamless functionality and robust performance, marking a significant achievement in technological innovation. To enhance the system capabilities and effectiveness, real-time monitoring and automated response mechanisms were integrated. Utilizing advanced sensor technologies, the system continuously scans the surrounding environment for animal presence and employs machine learning algorithms to accurately identify potential threats. Additionally, a network of strategically placed deterrent devices, such as sound emitters or non-lethal deterrents, ensures prompt and effective deterrence of detected animals, minimizing crop damage and human-wildlife conflicts. disruptions and frustrations for nearby residents. This can lead to improved community support and cooperation.

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