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Detect and Prevent Unauthorized Use of Electric Fences

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Abstract - The Unauthorized Use Detection and Prevention System for Electric Fences is an Arduino-based security solution developed to enhance the safety and reliability of electric fence installations. The system continuously monitors critical electrical parameters such as voltage and current using dedicated sensors to detect abnormal operating conditions or misuse. Two IR sensors are employed to identify unauthorized tampering or intrusion near the fence area. An I2C LCD provides real-time display of sensor readings and system status for local monitoring. When abnormal electrical behavior or unauthorized access is detected, the system activates a buzzer for immediate alert, disconnects the fence power through a relay controlled via a m-inverter, and sends instant warning messages to the authorized user using a GSM module. Powered by a regulated 12 V supply, the proposed system offers an effective, low-cost, and reliable solution to prevent unauthorized usage and ensure safe operation of electric fencing systems.

Keywords Arduino, Security, Monitoring, GSM, Sensors

INTRODUCTION

The Solar Powered Smart Fencing System for Agriculture Protection using GSM is developed to protect agricultural fields from animal intrusion and unauthorized access. The system uses solar energy to power the fencing unit, making it suitable for remote farming areas where electricity availability is limited. A solar panel charges a battery that supplies power to the sensors, controller, and communication module. The system monitors the fence continuously and detects disturbances or intrusion along the boundary. When such activity occurs, a GSM module sends an alert message to the farmer, enabling quick response. The electric fence generates controlled pulses that act as a deterrent while remaining safe for animals and humans. Overall, the system provides an energy-efficient, reliable, and cost-effective solution for improving farm security and reducing crop damage [1].

The Electric Fence Management System using Wireless Network Technology is designed to improve the monitoring and control of electric fencing systems. The system uses sensors and a microcontroller to measure parameters such as voltage, current, and fence status. These data are transmitted through a wireless network to a central monitoring unit for real-time observation.

If abnormal conditions such as voltage drop, wire damage, or unauthorized access are detected, the system generates alerts for quick action. By using wireless communication, the system reduces manual inspection and simplifies installation over large areas.

Overall, the system provides an efficient and reliable solution for managing electric fences and improving security and maintenance [2].

Virtual fencing technology provides an advanced method for managing livestock such as cattle and sheep without using physical fences. The system uses GPS-enabled collars and wireless communication to create invisible boundaries for grazing areas. When animals approach these boundaries, warning signals are given to guide them back into the designated area.

This technology helps farmers control animal movement, adjust grazing zones easily, and reduce the cost of installing and maintaining traditional fences. It also enables monitoring of livestock location and behavior, improving overall livestock management [3].

The Smart Fence to Protect Farmland from Stray Animals is designed to prevent crop damage by detecting and stopping animals from entering agricultural fields. The system uses sensors to monitor the boundary and identify animal movement near the fence. When an intrusion is detected, the system activates deterrent mechanisms such as alarms or safe electrical pulses to keep animals away. A microcontroller controls the sensing and response process for quick action. Overall, the smart fence provides an automated and reliable solution for protecting farmland and reducing crop loss caused by stray animals [4].

The Electric Fence Security System is designed to protect areas such as farms, fields, and private properties from intruders and animals. The system uses a microcontroller to generate controlled electrical pulses along the fence, which act as a deterrent while remaining safe. Sensors are used to monitor the fence and detect issues such as damage, voltage changes, or tampering. When abnormal conditions are detected, the system can trigger alerts for quick response. Overall, the system improves perimeter security by providing reliable monitoring, efficient operation, and reduced need for manual supervision [5].

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RELATED WORKS

The Fence Alarm System is designed to improve perimeter security by detecting unauthorized access or tampering along a fence boundary. Sensors monitor the fence line and identify disturbances such as cutting, climbing, or movement.
When such activity is detected, a microcontroller triggers an alarm to alert users or security personnel. This enables quick response to potential intrusions. Overall, the system provides a simple and reliable method for monitoring fence boundaries and enhancing security [6].
The Electric Fence Intrusion Alert System is developed to improve perimeter security by detecting unauthorized access along an electric fence. Sensors continuously monitor the fence for activities such as cutting, climbing, or tampering. When an intrusion is detected, a microcontroller processes the signal and activates an alert such as an alarm or notification. The electric fence also produces controlled pulses that act as a deterrent while remaining safe. Overall, the system provides an effective and automated solution for detecting intrusions and improving security around protected areas [7].
The Electric Fence Fault Finder is designed to detect and locate faults in electric fencing systems. Problems such as wire breaks, grounding issues, or voltage drops can reduce the effectiveness of the fence. The system monitors electrical parameters like voltage and current using sensors and processes the data with a microcontroller to identify abnormal conditions. When a fault is detected, the system indicates the issue to help users quickly locate and repair the damaged section. Overall, the fault finder improves the reliability and maintenance of electric fencing systems [8].
Electric Shock as it Pertains to the Electric Fence explains how electric fences use controlled electrical pulses to deter animals or intruders. When a person or animal touches the fence while grounded, a brief electric shock is produced due to the completion of the circuit. The shock is short and carefully regulated so that it causes discomfort without causing serious harm. Proper control of voltage, current, and pulse duration ensures safe operation. Overall, understanding electric shock in fencing systems helps in designing safe and effective perimeter protection solutions [9].
Electrocution by Electric Fence Controller discusses the potential risks associated with electric fence energizers. These controllers generate high-voltage pulses that travel through the fence to deter animals or intruders, and under normal conditions the pulses are short and safe. However, improper installation, faulty wiring, poor grounding, or damaged equipment can cause excessive or continuous current, increasing the risk of serious electric shock. Following safety standards, using proper grounding, and performing regular maintenance help reduce these risks. Overall, proper design and safe operation of the fence controller are essential to prevent accidents and ensure reliable electric fence performance [10].
The Electric Fence Fault-Finder is designed to detect and locate faults in electric fencing systems used for security and agricultural protection. Since electric fences cover large areas, identifying problems such as wire breaks, leakage, or grounding issues manually can be difficult. The system measures electrical parameters like voltage and continuity along the fence line. When abnormal conditions are detected, it indicates the faulty section to help users quickly locate and repair the problem. Overall, the fault-finder improves the reliability and maintenance of electric fences by enabling faster fault detection and reducing manual inspection effort [11].
The Smart Fence using Sensors and Machine Learning is designed to protect farmlands from animal intrusion and external threats. Sensors placed along the farm boundary monitor movement and environmental conditions near the fence. The collected data are analyzed using machine learning techniques to accurately identify intrusion events and reduce false alarms. When a threat is detected, the system can trigger alerts or deterrent actions to inform the farmer.
Overall, the system provides an intelligent and automated solution for improving farmland security and reducing crop damage [12].
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Overall, the system provides an intelligent and automated solution for improving farmland security and reducing crop damage [13].
The Smart Fence to Protect Farmland from Stray Animals is designed to prevent crop damage caused by animals entering agricultural fields. Sensors placed along the boundary detect animal movement near the fence. When an intrusion is detected, a control unit activates deterrent methods such as alarms, lights, or safe electric pulses to keep animals away. The system can also send alerts to farmers for quick response. Overall, the smart fence provides an automated and effective solution for protecting crops and improving farmland security [14].
The Electric Fence Security System is designed to protect areas such as farms and private properties from animals and intruders. The system generates controlled high-voltage pulses along the fence to create a short, safe shock that acts as a deterrent. A microcontroller manages the fence operation and monitors conditions such as voltage levels and wire status. If faults or tampering are detected, the system can trigger alerts for quick action.
Overall, the system provides an automated and reliable solution for improving perimeter security [15].

PROPOSED METHOD

The proposed model introduces an intelligent Arduino-based unauthorized use detection and prevention system for electric fences. Unlike existing systems, the proposed solution continuously monitors fence voltage and current to identify abnormal electrical behavior or unauthorized usage. Two IR sensors are incorporated to detect tampering or intrusion near the fence area. Real-time system status and sensor readings are displayed on an I2C LCD for local monitoring. Upon detecting unsafe electrical conditions or unauthorized access, the system automatically disconnects the fence power through a relay controlled by a minverter, activates a buzzer

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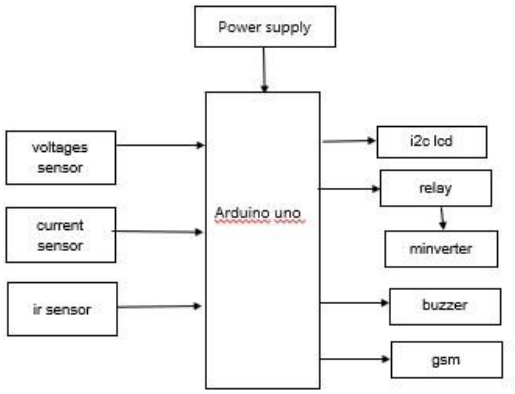
for immediate warning, and sends alert notifications to the owner via a GSM module. This integrated approach improves safety, enables quick response, and prevents misuse of electric fence systems.

BLOCK DIAGRAM



Block diagram

The system is designed to monitor and control an electric fence using an Arduino Uno as the main controller. A voltage sensor, current sensor, and IR sensor continuously monitor the electrical condition of the fence and detect possible intrusions. The collected data is processed by the controller and displayed on an I2C LCD for real-time monitoring. A relay controls a mini inverter that generates the required fence voltage. If abnormal conditions or intrusion are detected, a buzzer provides an immediate alert, and a GSM module sends a notification message to the user. This integrated system improves the safety, monitoring, and protection of agricultural fields.

METHODOLOGY

PRINCIPLE OF FUNCTIONING

The proposed Unauthorized Use Detection and Prevention System for Electric Fences operates to ensure safe and controlled functioning of electric fencing installations. An Arduino Uno acts as the central controller, continuously monitoring the electrical parameters of the fence. A voltage sensor and current sensor measure the fence voltage and current levels to detect abnormal conditions such as power leakage, tampering, or improper usage. In addition, IR sensors are positioned near the fence boundary to detect unauthorized access or physical interference. The collected data is processed by the controller, and the system status is displayed in real time on an I2C LCD. When abnormal electrical conditions or intrusion attempts are detected, the system immediately triggers protective actions including activating an alert and isolating the fence power supply.

Hardware & Alerts:

The hardware components of the system include an Arduino Uno, voltage sensor, current sensor, two IR sensors, I2C LCD display, relay module, mini inverter, buzzer, GSM module, and power supply unit. The Arduino processes the sensor inputs and controls the system responses. The I2C LCD provides real-time information about voltage, current, and system status. If unauthorized access or abnormal electrical activity is detected, the buzzer generates an audible alert, while the relay module disconnects the fence power through the mini inverter to prevent hazards. Simultaneously, the GSM module sends an alert message to the authorized user to notify them about the detected issue.

Power Requirements

The system operates using a regulated 12 V power supply, which provides stable power to the Arduino controller, sensors, GSM module, display unit, and other electronic components. Proper voltage regulation ensures accurate sensing, reliable communication, and safe operation of the electric fence monitoring system. This power configuration enables the system to function continuously, offering a reliable, low-cost, and efficient solution for detecting unauthorized use and maintaining the safety of electric fence installations.

Performance Comparison Table:

Parameter	Specification / Metric	Description
Central Controller	Arduino Uno	Acts as the main control unit that processes sensor data, monitors fence conditions, and manages alert and protection mechanisms.
Voltage Monitoring	Voltage Sensor	Measures the fence voltage continuously to ensure proper operation and detect abnormal voltage levels or power disturbances.
Current Monitoring	Current Sensor	Monitors the current flow in the electric fence line to identify leakage, overload, or abnormal electrical behavior.
Intrusion Detection	IR Sensors (2 Units)	Detects unauthorized movement or tampering near the fence area to prevent misuse or intrusion.
Status Display	I2C LCD Display	Provides real-time display of voltage, current readings, and system status for

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		easy local monitoring.
Power Control	Relay Module & Mini Inverter	Disconnects the electric fence power supply during abnormal conditions to ensure safety and prevent damage.
Alert System	Buzzer	Generates an audible alarm when intrusion or abnormal electrical parameters are detected.
Remote Notification	GSM Module	Sends alert messages to the authorized user when unauthorized access or system faults occur.

Table 1 *Performance Comparison Table*

Table 1 The proposed electric fence security system uses an Arduino Uno as the main controller to monitor and manage fence operations. A voltage sensor and current sensor continuously measure electrical parameters to detect abnormal conditions such as leakage or overload. Two IR sensors are used to identify unauthorized movement or tampering near the fence. The system status and sensor readings are displayed on an I2C LCD for real-time monitoring. When abnormal conditions or intrusion are detected, a buzzer provides an alert and a relay connected to a mini inverter disconnects the fence power for safety. A GSM module sends notification messages to the authorized user. The entire system operates using a regulated 12 V power supply, ensuring reliable and safe operation.

Table 1: Comparative Analysis of Conventional Techniques and the Developed Approach

Parameter	Existing Methods	Proposed Approach (Our System)
Fence Monitoring	Manual inspection of electric fences; faults or misuse often detected late.	Continuous monitoring using voltage and current sensors connected to an Arduino Uno for real-time detection of abnormal conditions.
Intrusion Detection	Basic physical barriers or manual surveillance around fence areas.	Two IR sensors automatically detect unauthorized movement or tampering near the fence boundary.
Fault Detection	Electrical faults identified only after system failure or manual checking.	Real-time analysis of electrical parameters enables early detection of leakage, overload, or abnormal fence operation.
Alert Mechanism	Dependence on manual observation; no immediate warning system.	Buzzer provides instant audible alerts when intrusion or abnormal electrical conditions are detected.
Power Control & Safety	Fence power remains active even during faults, increasing safety risks.	Relay module connected to a mini inverter automatically disconnects the fence power during abnormal conditions.
Remote Notification	No remote communication ; user must physically inspect the fence.	GSM module sends instant alert messages to the authorized user for remote monitoring.

Table 2 The proposed smart electric fence system improves security and safety by combining real-time monitoring, automated intrusion detection, and remote alerts. Voltage and current sensors detect electrical faults early, while IR sensors identify unauthorized access. A buzzer and relay module provide immediate local alerts and safe power shutdown, and a GSM module sends instant notifications to the user, eliminating the need for manual inspection. This approach enhances reliability, responsiveness, and overall fence protection compared to conventional methods.

RESULTS

CONCLUSION

The proposed Unauthorized Use Detection and Prevention System for Electric Fences provides a reliable and cost-effective solution to enhance perimeter security and operational safety. By integrating voltage and current monitoring with intrusion detection using infrared sensors, the system ensures both electrical fault detection and physical

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tamper identification. The use of an Arduino-based controller enables real-time processing and coordinated response actions. Upon detecting abnormal conditions, the system activates a buzzer, disconnects the fence power through a relay mechanism, and sends instant alerts via GSM communication. This multi-layered response minimizes risks associated with unauthorized access and electrical misuse. The system is particularly suitable for rural and agricultural environments where low-cost and standalone operation are essential. Overall, the proposed design improves safety, automation, and reliability in electric fence installations.

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