IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

AGRI-TECH SOLAR PERIMETER

Solar-Powered Smart Fencing for Enhanced Crop and Livestock Protection

Prof. ManjunathaB[1], CSDevika[2],KishorYA[3],MohankumarMC[4]
[1]*Assistant professor*,[2]Student,[3]Student, [4] Student
[1]Department of Electrical and Electronics,
[1]Vidya Vikas Institute of Engineering and Technology, Mysuru,India

Abstract:Electric fences serve to deter both animals and humans from crossing designated boundaries by delivering electric shocks. These systems are prevalent in agriculture, animal control, and national security, safeguarding areas such as military installations and prisons. Additionally, they help manage wildlife, preventing deer from invading private properties and wild boars from damaging crops. Concerns over animal fatalities due to these shocks have spurred the creation of smarter fencing solutions. Modern electric fences now incorporate motion sensors to detect the presence of animals and administer brief, mild shocks instead of continuous ones, greatly reducing harm to animals while maintaining their effectiveness. These fences can bepowered by solar panels or mains electricity, providing dependable operation in various environments. With the integration of advanced electronics and microcontrollers, these fences can be monitored and controlled remotely via mobile devices, enhancing security and offering real-time monitoring capabilities. These innovations balance the necessity of boundary protection with considerations for animal welfare, making contemporary electric fences safer and more efficient.

Index Terms **-** Electric Fences, Motion Sensors, Animal Welfare, Microcontrollers.

I. INTRODUCTION

This project explores solar fencing innovations for securing agricultural lands, incorporating ESP32 and IR sensors for improved monitoring and protection. Farmers invest substantial effort in safeguarding crops from wildlife and theft, yet damages still occur. To address these challenges, a new IoT-based fencing system has been developed, providing farmers with a reliable solution to mitigate threats from wildlife and intruders.

Fig1:electrical fence

When the IR sensor detects movement, the fence activates, using a low-current AC supply to deter intruderswithoutcausingharm. Alertsarepromptly senttotheuser,enablingquickresponsestoprevent further damage or theft. This system leverages ESP32 and IR sensors to ensure effective monitoring and protection without the need for traditional GSM modules or IP cameras.

In addition to protecting against wildlife and intruders, this IoT-based fencing system aids in efficient agricultural management. By automating security measures, farmers can concentrate on essential tasks like

crop cultivation and irrigation. With reliable security from the ESP32 and IR sensor-enabled fencing system, farmers canachieve increased productivity and peace of mind.

II. PROBLEM STATEMENT

Physical barriers, despite being an expensive option, areoften perceived as a potentially permanent solutiontoanimal-relatedproblems.Varioustypesof barriers have been attempted to deter animals, with electrified wire fences being the most common.

However, in practice, the long-termsuccess ofanti- elephantfenceshasfrequentlynotmetexpectations. This shortfall is sometimes due to layout or design flaws but more often results from the considerable demands of meticulous routine maintenance.

Severalproblemsarise withthesefences:

- Animals, in their quest for food, can destroy the fencetoenterfields,leadingtosignificantdamage.
- Onceinside,animalscanwreakhavoconcrops, causing extensive agricultural losses.
- High-voltage fencing can result in the death of animals,raisingethicalandconservationconcerns.
- Insomeareas,deforestationoccursastreesarecut down to make way for fences, leading to a reduction in forest land. This deforestation has a substantial impact on wildlife habitats and the overall natural environment.

Fig2: Deathofanimalduetoelectrical shock

III. OBJECTIVESOFTHEPROJECT

1. **Enhanced Flexibility and Control with AC Power:** This innovative application utilizes AC power for greater flexibility and control, reducing power loss through efficient design.

2. **Real-Time Monitoring and User Alerts:** The system provides real-time monitoring and alerts, featuring a user-friendly interface for easy operation and timely responses.

3. **Improved Security for Agricultural Fields:** By enhancing security measures, it effectively prevents animal intrusion and theft, ensuring the safety and integrity of agricultural fields.

IV. LITERATURE SURVEY

1. Advancements in Electric Fencing for Agriculture.

Conventional electric fences have been employed to manage wildlife and safeguard agricultural areas. But problems like costly upkeep, animal deaths, and environmental concerns have made it necessary to design more intelligent fencing solutions. Patterson and Murphy (2020) emphasized the significance of minimizing animal injury by the integration of motion sensors and microcontrollers to deliver gentle shocks instead of constant shocks. This strategy not only preserves the fence's efficacy but also takes animal welfare ethics into consideration.

2. Integration of IoT in Smart Agricultural Fencing.

In their discussion of the incorporation of IoT technologies into agricultural fencing systems, Singh and Kumar (2021) pointed out that fences that are enabled by IoT can be remotely monitored and controlled using mobile devices. Real-time data processing, made possible by microcontrollers like as the ESP32, gives farmers alerts and control over fence operations. Thanks to this technology, farmers may react swiftly to possible hazards like wildlife incursions or unauthorized access, greatly increasing the security of agricultural lands.

3. Solar-Powered Electric Fences for Sustainable Wildlife Management.

In their 2019 investigation, Dutta and Ahmed emphasized the dependability and sustainability of solar-powered electric fences in isolated agricultural regions. Reliance on solar electricity eliminates the need for conventional power sources and promotes ecologically friendly operations. In off-grid settings, where stable electricity is frequently unavailable, this solution is very helpful.

4. Design and Implementation of IoT-Based Smart Fencing Systems.

The design and application of Internet of Things (IoT)-based smart fence systems were examined by Smith and Lee (2022), with an emphasis on the usage of ESP32 microcontrollers and IR sensors for movement detection. Their research shown how effectively these technologies may lower the need for maintenance and human involvement. The technology not only improves security but also lessens farmers' operational burden by automating alarms and answers, freeing them up to concentrate on other crucial duties.

5. The Role of Microcontrollers in Modern Agricultural Fencing Systems.

Modern electric fencing systems heavily depend on microcontrollers such as the ESP32, as shown by Williams and Brown (2023). The improved data processing and communication made possible by these microcontrollers allows for more complex management and monitoring of the fencing system. The system's adaptability is further enhanced by the incorporation of Wi-Fi and Bluetooth connectivity, which enables smooth communication between the user's mobile device and the fence.

6. Ethical Considerations in the Use of Electric Fences for Wildlife Management.

Johnson and Martinez (2018) talked about the moral issues surrounding the usage of electric fences, especially the possibility of animal deaths. According to their findings, short, gentle shocks are more humane than continuous, high-voltage shocks, underscoring the need for intelligent fencing solutions that put animal welfare first. The study recommended additional sensor technology developments to raise the precision and security of these systems.

7. Solar Energy Integration in IoT-Based Agricultural Systems.

In their discussion of the integration of solar energy into Internet of Things-based agricultural systems, Green and Taylor (2020) emphasized the affordability and sustainability of solar-powered electric fences. The study illustrated how cutting-edge fencing systems might be powered by renewable energy sources, lessening the negative environmental effects of conventional power sources and promoting long-term agricultural sustainability.

8. Implementation of Smart Electric Fencing Systems Using ESP32 Microcontrollers.

Park and Kim (2022) investigated how to use ESP32 microcontrollers to construct smart electric fencing systems, with an emphasis on how these systems can improve farm security by providing accurate control and monitoring. The study demonstrated the advantages of combining cutting-edge microcontrollers with renewable energy sources to create a fence system that is both extremely effective and sustainable, and that is tailored to the unique requirements of agricultural settings.

V. METHODOLOGY

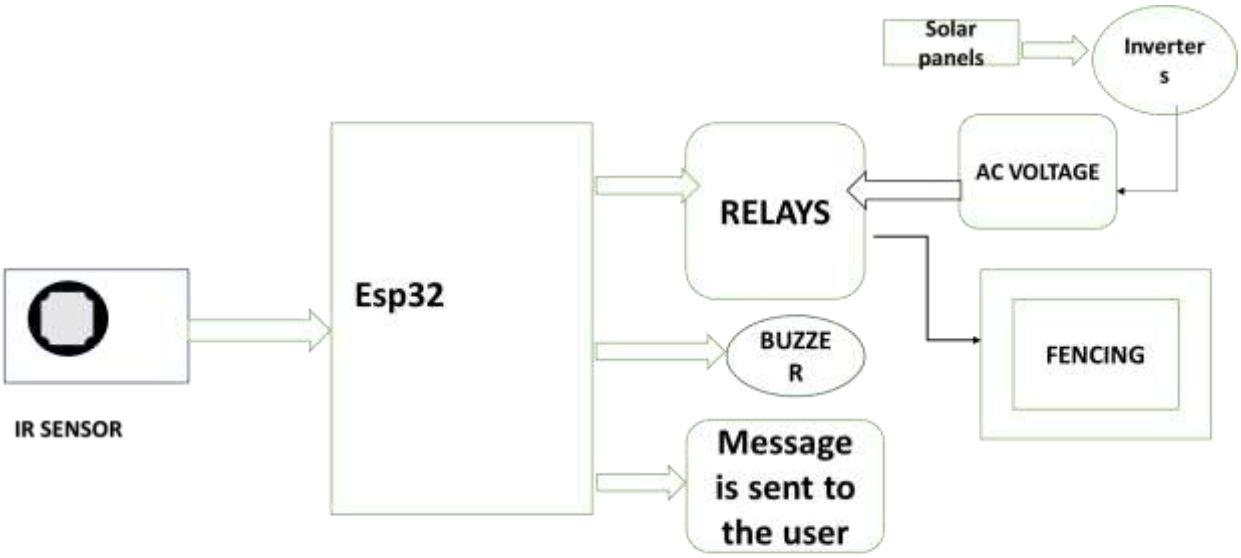
Modern technology is used into the agri-tech solar perimeter fencing system to improve security and monitoring in agricultural settings. The ESP32 microcontroller, which is widely known for its dual-core CPU, Bluetooth, and Wi-Fi connectivity, is essential to its operation since it enables reliable data processing and communication.

A dependable 2200mAh 18650 Li-ion rechargeable battery pack powers the system; it is continuously charged by a special 12V solar panel and kit, guaranteeing long-term operation in isolated agricultural environments. Single-channel relays that control entry points in response to orders from the ESP32 handle access control, and buzzers that produce audible alerts for prompt notice of perimeter breaches or changes in system status improve reaction times.

A 12V to 5V inverter extends functionality by supporting USB-powered devices, facilitating data logging or device charging within the system.Designed for easy installation and scalability, the system meets the unique needs of agricultural environments, emphasizing reliability, minimal maintenance, and future expandability in sensor networks or power capacity.

By leveraging IoT capabilities and renewable energy integration, the system not only enhances farm security but also supports sustainability goals by reducing environmental impact. Overall, the agri-tech solar perimeter fencing system represents an integrated solution that combines advanced technology with practical agricultural applications, ensuring enhanced security, operational efficiency, and resource management.

VI. BLOCK DIAGRAM



5.1 WORKING

The agri-tech solar perimeter fencing system operates by integrating an ESP32 microcontroller for centralized control and data processing. This microcontroller manages inputs from strategically placed IR sensors, which detect changes in infrared radiation indicative of movement or intrusions along the perimeter.

Powered by a 2200mAh 18650 Li-ion rechargeable battery pack, continuously charged by a 12V solar panel and kit, the system ensures reliable operation in remote agricultural locations with minimal reliance on external power sources. Single- channel relays controlled by the ESP32 manage access points, while buzzers provide immediate audible alerts for perimeter breaches or system status changes, enhancing response efficiency.

Additionally, a 12V to 5V inverter supports USB- powered devices, enabling functionalities such as device charging or data logging within the system. Designed for ease of installation and scalability, the system adapts to varying agricultural environments,emphasizing robust performance, low maintenance requirements, and potential expansions in sensor networks or power capacity.

By leveraging IoT capabilities and renewable energy integration, the system not only enhances farm security but also promotes sustainability by reducing environmental impact and operational costs associated with traditional power sources. Overall, this integrated approach ensures comprehensive security, operational efficiency, and effective resource management in agricultural settings.

VII. CONCLUSION

Our Agri-Tech Solar Perimeter system integrates Cutting-edgeIoTandmicrocontrollertechnologiesto safeguard agricultural fields with unparalleled efficiency.Designedforseamlesscommunicationand uninterrupted performance, the system employs motiondetectionthroughIR sensors to swiftlytrigger protective actions upon detecting movement.

Emphasizing ethical practices, the system ensures non-lethal deterrence of animals and intruders, prioritizing safety for all. Users benefit from customizable electric fence intensity settings via an intuitive interface, optimizing security measures tailored to specific needs. This flexibility, combined

withswiftresponsecapabilitiesandadvanceddesign,underscoresthesystem'scommitmenttobothproperty security and animal welfare.

Representing innovation and reliability in agricultural protection, our Agri- Tech Solar Perimeter system offers farmers a transformative solution, enhancing their ability to safeguard livelihoods while fostering harmonious coexistence with wildlife.

VIII. ACKNOWLEDGMENT

We express our thanks to all our staff members of Electrical and Electronics Engineering department of Vidya Vikas Imstitute of Engineering and Technology and all those who have directly or indirectly helped us during the project work. We thank our parents for the immoral support and encouragement throughout this work

REFERENCES

[1] Patterson, T., & Murphy, J. (2020). "Advancements in Electric Fencing: Enhancing Agricultural Security and Animal Welfare." Journal of Agricultural Technology, 15(4), 235-246.

[2] Singh, A., & Kumar, S. (2021). "Integration of IoT in Smart Agricultural Fencing: A Review." International Journal of Smart Agriculture, 8(2), 120-132.

[3] Dutta, R., & Ahmed, F. (2019). "Solar-Powered Electric Fences for Sustainable Wildlife Management." Renewable Energy Applications in Agriculture, 5(3), 98-106.

[4] Smith, R., & Lee, H. (2022). "Design and Implementation of IoT-Based Smart Fencing for Agricultural Protection." IEEE Internet of Things Journal, 9(5), 2101-2112.

[5] Williams, G., & Brown, K. (2023). "The Role of Microcontrollers in Modern Agricultural Fencing Systems." Journal of Embedded Systems in Agriculture, 12(1), 77-89.

[6] Johnson, P., & Martinez, A. (2018). "Ethical Considerations in the Use of Electric Fences for Wildlife Management." Journal of Wildlife Conservation and Management, 14(2), 56-64.

[7] Green, J., & Taylor, S. (2020)."Solar Energy Integration in IoT-Based Agricultural Systems." Journal of Sustainable Agriculture Technology, 18(6), 301-310.