IoT -Based Wild Animals Monitoring and Alert System Using ESP-32CAM

Mr. Puri Santosh Sambhaji, Mr. Shaikh Suleman Daud, Dr. Mrs. M.R. Banwaskar

s23_puri_santosh@mgmcen.ac.in, s23_shaikh_suleman@mgmcen.ac.in, banwaskar_mr@mgmcen.ac.in
MGM's College of Engineering, Nanded
Department of Electronics & Telecommunication Engineering

--***---

Abstract - Crop damage caused by wild animals is a serious problem for farmers, especially in rural and forest-adjacent areas. Traditional protection methods such as manual guarding, scarecrows, and fencing are often ineffective, unsafe, or costly. This paper presents an IoT-based Wild Animal Monitoring and Alert System that uses an ESP32-CAM module, PIR motion sensor, buzzer, and Telegram-based alert mechanism to provide real-time detection, visual confirmation, and immediate deterrence. The system captures images when motion is detected, alerts farmers instantly through a mobile application, and activates a buzzer to scare animals away. The proposed system is low-cost, easy to deploy, and suitable for small and medium farms.

Keywords ESP32-CAM, PIR Sensor, IoT, Smart Agriculture, Wild Animal Detection, Telegram Bot.

I. Introduction

Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer, and stray cattle cause extensive crop damage, leading to financial loss and food insecurity. Traditional crop protection methods, including manual guarding, scarecrows, fencing, and firecrackers, are either ineffective over time or pose safety risks.

Recent advancements in Internet of Things (IoT) technologies provide new opportunities to automate farm security using low-cost sensors, embedded systems, and cloud communication. Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer, and stray cattle cause extensive crop damage, leading to financial loss and food insecurity. Traditional crop protection methods, including manual guarding, scarecrows, fencing, and firecrackers, are either ineffective over time or pose safety risks. Recent advancements in Internet of Things (IoT) technologies provide new opportunities to automate farm security using low-cost sensors, embedded systems, and cloud communication.

II. Literature Review

Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer, and stray cattle cause extensive crop damage, leading to financial loss and food insecurity. Traditional crop protection methods, including manual guarding, scarecrows, fencing, and firecrackers, are either ineffective over time or pose safety risks. Recent advancements in Internet of Things (IoT) technologies provide new opportunities to automate farm security using low-cost sensors, embedded systems, and cloud communication.

Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer, and stray cattle cause extensive crop damage, leading to financial loss and food insecurity. Traditional crop protection methods, including manual guarding, scarecrows, fencing, and firecrackers, are either ineffective over time or pose safety risks. Recent advancements in Internet of Things (IoT) technologies provide new opportunities to automate farm security using low-cost sensors, embedded systems, and cloud communication.

III. System Architecture & Methodology

The Agri-Eye system follows an IoT-based event driven architecture designed for continuous farm monitoring.
A PIR sensor continuously monitors the farm boundary for motion.
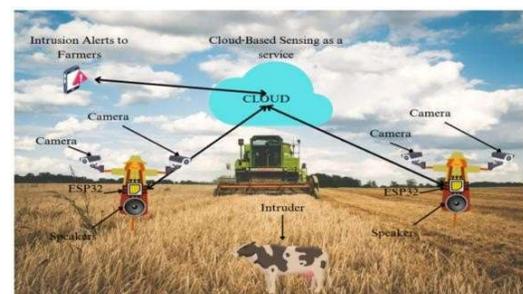
Fig.1 Architectural diagram of intrusion [Animals] detection using an ESP32 cam

A. Hardware Setup

The hardware setup consists of an ESP32-CAM module, PIR motion sensor, active buzzer, power supply unit, and weatherproof enclosure. The PIR sensor is mounted facing the farm entry points and connected to the ESP32-CAM GPIO pin. The buzzer is driven directly by another GPIO pin for immediate sound alerts.
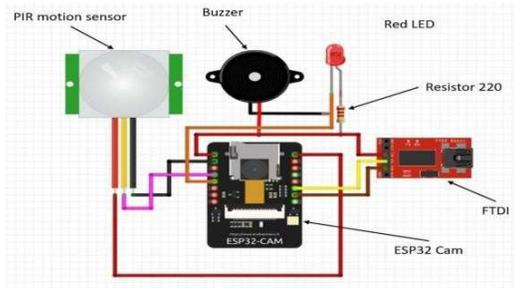

Fig.2 Circuit Diagram using ESP32,Pir Sensor,Buzzer.

B. Data Communication

Data communication is handled via Wi -Fi using the ESP32-CAM's built-in wireless module. Motion events trigger image data transmission through HTTP requests to the Telegram Bot API . This cloud-free communication ensures secure, low-cost, and real-time delivery of alerts In case of connectivity loss, data can be stored locally and sent once the network is restored.

Fig 3.5 AuthToken Recognisation

Fig.3 Auth Token Recognition using Telegram Bot Father

C. Machine Learning Prediction Model

In future-enhanced versions, a machine learning-based prediction model can be integrated using TensorFlow Lite on the ESP32-CAM. Captured images are processed using a lightweight convolutional neural network (CNN) trained to classify animals such as wild boars, monkeys, and deer.

The model predicts the type of animal and its threat level, enabling adaptive deterrence strategies. This intelligent prediction reduces false alerts and improves response.

D. Dashboard

The Telegram application acts as the system dashboard. A dedicated Telegram Bot displays timestamped alerts, captured images, and intrusion history in a single chat interface. Farmers can monitor activity, verify system status, and perform manual test commands remotely. This dashboard requires no custom app and works on any smartphone with internet connectivity.
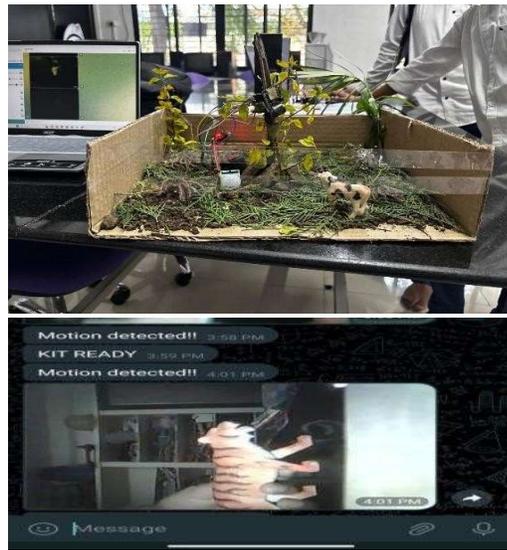
IV. Result

Fig.4   Field-deployed weatherproof node showing ESP32 CAM and PIR sensor

Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer[1] and stray cattle cause extensive crop damage, leading to financial loss and food insecurity. Traditional crop protection methods, including manual guarding, scarecrows, fencing, and firecrackers, are either ineffective over time or pose safety risks. Recent advancements in Internet of Things (IoT) technologies provide new opportunities to automate farm security using low-cost sensors, embedded systems, and cloud communication. Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer, and stray cattle cause extensive crop damage, leading to financial loss and food insecurity.

V. Security & Challenges

- Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer, and stray cattle cause extensive crop damage, leading to financial loss and food insecurity. Traditional crop protection methods, including manual guarding, scarecrows, fencing, and firecrackers, are either ineffective over time or pose safety risks.

VI. Future Scope

- Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers, particularly in rural and forest-adjacent regions. Animals such as wild boars, monkeys, deer, and stray cattle cause extensive crop damage, leading to financial loss and food insecurity. Traditional crop protection methods, including manual guarding, scarecrows, fencing, and firecrackers, are either ineffective over time or pose safety risks. Recent advancements in Internet of Things (IoT) technologies provide new opportunities to automate farm security using low-cost sensors, embedded systems, and cloud communication. Wild animal intrusion into agricultural fields is a persistent challenge faced by farmers.

VII. Conclusion

The proposed IoT-based Wild Animal Monitoring and Alert System provides an effective, affordable, and farmer-friendly solution to crop protection. By combining motion detection, image capture, local deterrence, and real-time alerts, the system enhances farm security while reducing human-animal conflict. The project demonstrates how simple IoT technologies can create a positive impact in agriculture and contribute to sustainable and smart farming practices.

References

[1] Srivastava, Saurabh. "Self - Intrusion Detection System for Protection of Agricultural Fields Against Wild Animals." International Journal of Modern Agriculture 10.2 (2021): 2686-2691

[2] Begum H, Muneera et al. "Internet of Things based Wild Animal Infringement Identification, Diversion and Alert System." 2020 International Conference on Inventive Computation Technologies (ICICT) (2020): 801-805.

[3] Kakade, Mr Vikram M . "Design and Implementation of an Advanced Security System for Farm Protection from Wild Animals." (2019).

[4] Mohandass, S. "Animal Health Monitoring and Intrusion Detection System based on LORAWAN." Turkish Journal of Computer and Mathematics Education TURCOMAT)12.2 (2021): 2397-2403.

[5] P. Manikandan, G. Ramesh, K. P. Sai, G. Puneeth, M. S. Sudheer and K. H. Kumar, "Automatic Accident Detector to Decrease the Death Rate in Highways and Remote Areas," 2021 6th International Conference on Communication and Electronics Systems (ICCES), 2021, pp. 1577- 1581.

[6] Amogh Rau, Jimson Mathew Ashok R Mohan Jairam Sankar, Deepti Das ,2017. "IoT Based Smart Irrigation System.

[7] Kumar, A., "IoT-based Wild Animal Intrusion Detection System Using ESP32CAM for Agricultural Fields", International Journal of Engineering Research & Technology, Vol. 12, Issue 5, May 2024.

[8] Sharma, R., Patel, V., & Singh, K. "Smart Farm Security System Using PIR Sensorand Telegram Bot Integration", Proceedings of ICCPC 2023, International Conference on Computing and Precision Agriculture.

[9] Gupta, S., et al. "ESP32-CAM Based Motion Detection and Alert System for CropProtection", ICEARS 2024, International Conference on Electronics, Automation and Robotics Systems.

[10] Jain, P., Reddy, M., Desai, N. "AIEnabled Edge Computing for Animal Intrusion Detection in Smart Agriculture Using ESP32", Journal of IoT and Edge Computing, Vol. 3, Issue 2, 2024.