

ANIMAL INTRUSION DETECTION AND ALERT SYSTEM

Rohan J S¹, Chandan M N²

PG scholar, Department of MCA, P.E.S College of engineering, Mandya, India¹

Assistant professor, Department of MCA, P.E.S College of engineering, Mandya, India²

Abstract: The Animal Intrusion Detection and Alert System addresses the critical need for effective monitoring of animal intrusions in designated areas, such as agricultural lands and wildlife reserves. Traditional methods often rely on basic motion detection systems, which can lead to false alarms and lack specificity in identifying the types of animals. Our proposed solution leverages advanced computer vision techniques, specifically the Haar cascade algorithm, to accurately detect animals using a Pi Camera and a Raspberry Pi microcontroller. The system processes the video feed in real-time, identifying animal intrusions and immediately notifying users through the Telegram Bot API. These notifications include animal name, providing users with timely information to take appropriate actions.

Keywords: Haar cascade algorithm, Telegram API, Detection, Recognition.

I. INTRODUCTION

Animal intrusions can lead to significant challenges in agricultural and protected areas, causing crop damage and disrupting local ecosystems. Traditional monitoring methods, such as physical barriers and simple motion sensors, often struggle to accurately identify and differentiate between different types of animals, leading to high false alarm rates and inadequate response measures. These systems also typically lack the capability for real-time alerts, further limiting their effectiveness.

THIS paper introduces the "Animal Intrusion Detection and Alert System" an advanced solution designed to enhance the accuracy and immediacy of animal detection. The system integrates a Raspberry Pi microcontroller with a Pi Camera, utilizing the Haar cascade algorithm to detect and identify specific animal features in real-time. Upon detecting an animal, the system sends immediate alerts to users via the Telegram messaging platform, providing the name of the detected animal. This real-time notification system allows for timely and informed responses to potential threats. By leveraging modern computer vision techniques and the widely accessible Telegram platform, our system offers a reliable and efficient approach to monitoring and managing animal intrusions. The following sections will detail the system's architecture, the training process for the Haar cascade classifier, and the integration with Telegram for alert dissemination. The evaluation of the system's performance will highlight its accuracy and reliability in detecting animal intrusions, underscoring its potential as a practical tool for mitigating the impacts of human-wildlife conflicts.

II. SYSTEM ARCHITECTURE

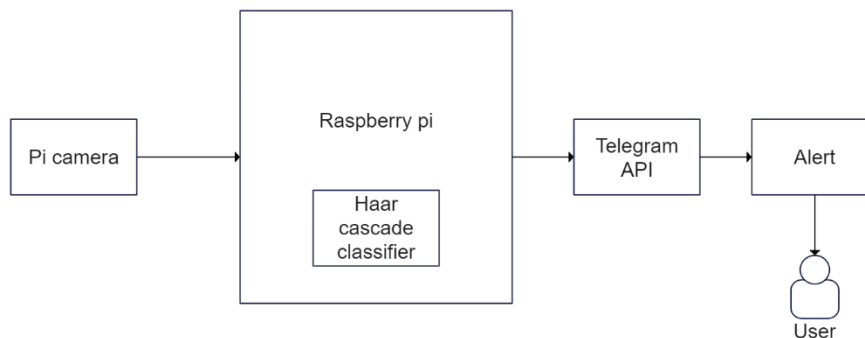


Fig. 1 System architecture

The system architecture of the “Animal Intrusion Detection and Alert system” is designed to effectively integrate hardware and software components to provide a robust monitoring and warning solution. The core of the architecture is the Raspberry Pi, which acts as a central processing unit, controlling data collection and processing. The system uses a camera sensor to continuously take video footage of the monitored area, which is then analysed using the Haar cascade algorithm to detect the presence of animals.

Once a breach is detected, the system uses the Telegram Bot API to send real-time alerts to users and provide them with timely notifications. The architecture also includes a system configuration and management user interface that allows users to modify settings and display alerts. This design ensures that all components work together seamlessly to provide accurate detection, reliable alerts and user-friendly interaction while supporting scalability and future enhancements.

III. IMPLEMENTATION STEPS

1. Hardware setup

- **Setting up the Raspberry Pi:** Install and configure the Raspberry Pi and make sure it has the correct power supply, storage (microSD card) and Raspbian operating system.
- **Camera Installation:** Connect the Pi Camera to the Raspberry Pi and configure it to capture video. Make sure the camera is positioned correctly for optimal coverage of the monitored area.
- **Connecting Peripherals:** Connect any additional peripherals such as a monitor, keyboard and mouse for initial setup.

2. Software installation and configuration

- **Operating System Installation:** Install Raspbian OS operating system on the Raspberry Pi.
- **Software dependencies:** Install necessary software packages and libraries such as OpenCV for image processing, Python for scripting, and any required Telegram API libraries.
- **Development environment:** Set up a development environment such as Thonny IDE on the Raspberry Pi to write and test code.

3. Development of an animal detection algorithm

- **Haar Cascade Algorithm Implementation:** Implement Haar Cascade Algorithm for animal detection in video. Since the custom detection is needed, train the classifier with relevant data.
- **Video Capture and Processing:** Write scripts to capture video images from a camera and process them using the Haar cascade algorithm. Integrate an algorithm for real-time animal detection and recognition.

4. Development of the Alert system

- **Create a Telegram bot:** Create a Telegram bot by registering with the Telegram bot API. Get bot token and set bot properties.
- **Integration with Telegram API:** Write scripts to send messages through the Telegram bot. Develop a mechanism to trigger alerts when the system detects an animal.
- **Customize Notifications:** Customize alerts to include relevant information such as the type of animal detected and the time of detection.

5. System Testing

- **Test the entire system,** including hardware and software components, to make sure they work together smoothly. Test under a variety of conditions to ensure reliability and accuracy.

6. System deployment

- **Set up the system** in the designated monitoring area and ensure that all hardware components are securely installed and properly connected.

IV. WORKFLOW

The workflow of the "Animal Intrusion Detection and Alert System" is depicted in the diagram (refer to Fig. 2). This workflow represents the sequence of operations designed to monitor specific areas for animal intrusions and notify users in real-time via the Telegram messaging platform.

The steps involved are as follows:

- **Start:** The system begins its operation.
- **Initialize Camera:** The Raspberry Pi initializes the Pi Camera, setting it up to start capturing video footage of the area to be monitored.
- **Video Input:** The camera continuously captures video, providing a live feed of the designated area.
- **Detect Animal Presence:** The system processes the video input using the Haar cascade algorithm, which analyses the frames to detect any animal presence.
- **Animal Detected?:** At this decision point, the system determines whether an animal has been detected. If no animal is detected, the system loops back to continue capturing and analysing the video input. If an animal is detected, the system moves to the next step.
- **Send Alert via Telegram:** When an animal is detected, the system sends an alert to the user via the Telegram Bot API. This alert includes the name of the detected animal, allowing the user to respond appropriately.
- **Stop:** The process concludes, having completed a cycle of detection and alert notification.

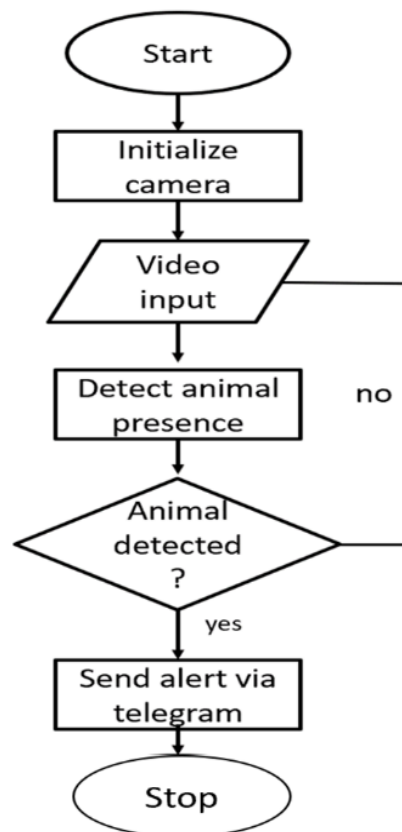


Fig. 2 Workflow of the system

This workflow ensures continuous monitoring and quick detection of animals, with instant alerts sent to users, thereby enabling timely responses to potential intrusions. The integration with the Telegram Bot API enhances the system's effectiveness by providing real-time notifications.

V. RESULTS

The "Animal Intrusion Detection and Alert System" demonstrates its effectiveness through the successful detection of animals and the immediate notification of the user via Telegram. The system captures live video feeds from the Pi Camera, continuously monitoring the designated area. When the Haar cascade algorithm identifies an animal in the video feed, it promptly sends an alert to the user's Telegram account. The following snapshots illustrate the key stages of this process.

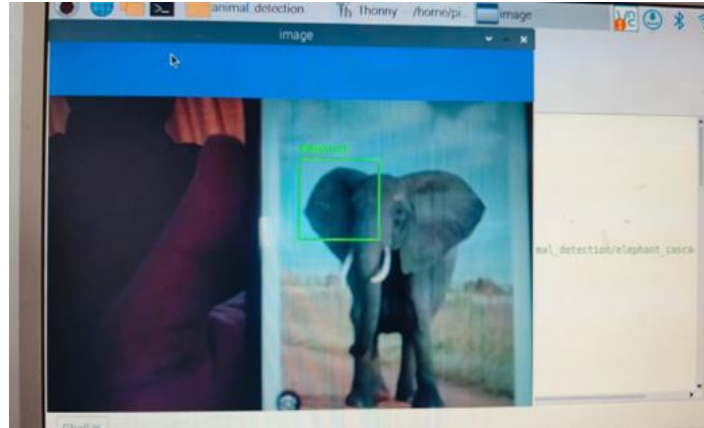


Fig. 3 Animal detection

Fig.3 shows the captures the moment when the system detects an animal in the frame, highlighting the detected animal with the name.



Fig. 4 Alert message in telegram

Fig. 4 represents the real-time alert received by the user on Telegram, specifying the type of animal detected.

VI. CONCLUSION

The Animal Intrusion Detection and Alert System successfully integrates advanced computer vision and real-time communication to address wildlife intrusion in agriculture. Utilizing the Haar cascade algorithm for accurate animal detection and Telegram for timely alerts, the system minimizes false alarms and promptly notifies users of intrusions. It effectively detects animals such as elephants and tigers, providing a practical solution for farmers. Future enhancements could include expanding detectable species, improving algorithms, and adding sensors to further enhance the system's capabilities



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