FieldGuard: A Cross-Modality Approach for Surveillance and Protection Agricultural/Farming Land from Animal Intrusion via UAV

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Abstract

Farmer hardships resulting from wildlife depredation on agricultural lands. Through meticulous observation and analysis, it scrutinizes the impact of wild animals encroaching upon farmlands, causing substantial financial and economic losses to farmers. The study underscores proposed the cross-modality approach for surveillance and protection of Agricultural/Farming land from Animal intrusion. The RGB and infrared sensor helps to detect the animals in day light also in dark light. The UAV can detect the small object in the real-time environment from an aerial perspective by utilizing the cross-modality.

Keywords: Cross-Modality, unmanned aerial vehicle, RGB, Intrusion, Feature Fusion, Agricultural Field

I. Introduction

In recent years, since unmanned aerial vehicles (UAVs) have the advantage of being small, flexible and easy to control, they have become more prevalent in various domains, such as city planning, precision agriculture and humanitarian assistance [1]. The incursion of wildlife into agricultural areas has become a significant challenge, causing extensive crop damage and posing risks to human and animal welfare. Visibility conditions and the vastness of agricultural landscapes often limit traditional wildlife management and surveillance methods [2]. Attacks from various animals and birds constantly threaten agricultural land. Due to the expansion of cultivated land into previous wildlife habitats, crop raiding is becoming one of the most common conflicts antagonizing human-wildlife relationships [3]. Farmers could face significant losses, yet it is hard to guard agricultural products in a farm field 24/7 [4]. The author proposed a UAV-based surveillance system that leverages cross-modality imaging—combining RGB and infrared imaging—to improve the detection of animal intrusions into agricultural fields during the day and at night. The rest of this paper is organized as follows: Section II Proposed System and Methodology. Section III analyses the result of the proposed architecture. Section IV is a conclusion and future work.

II. Proposed System and Methodology

Fig.1 illustrates the primary explanation of the fundamental feature of the proposed system. The system utilizes a UAV equipped with a dual-mode sensor RGB-Infrared Cross-modality detector. This system continuously monitors under various environmental conditions, including low-light and nighttime operations. Our proposed architecture is designed to autonomously patrol predefined areas of agricultural land, providing real-time animal detection. This study presents a UAV with a thermal and visual camera, simultaneously capturing infrared and RGB images for animal detection in agricultural/farm fields. The primary contribution is preventing animal intrusion by detecting the animals in day-night light via UAV by utilizing the RGB-Infrared modality.

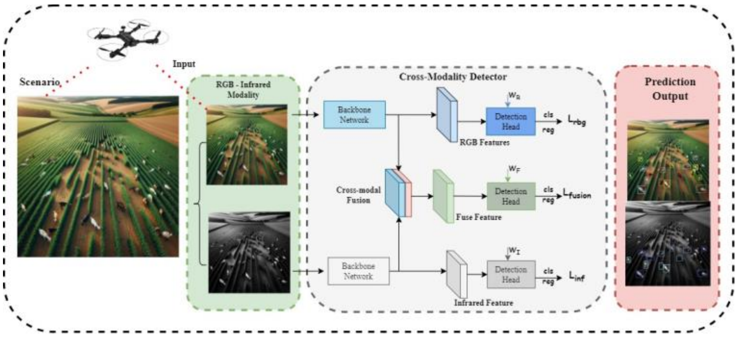

Fig. 1: Architecture of the Proposed System

For Agricultural Field Monitoring. In this scenario, the system addresses instances of animal intrusion causing damage to agricultural fields. A UAV with dual-mode RGB-Infrared sensors captures images simultaneously, integrating features from both modalities. The fused features undergo classification *(cls)* and regression (reg) processes for accurate animal detection and localization. The two parallel backbone networks process the RGB and Infrared Images separately to extract the relevant features. Features from both modalities are fused using a YOLOv8 that enhances the detection capabilities by leveraging the complementary information available from both images. Combining the detection results from RGB and infrared modalities, the fused image can enhance the localization and identification of objects in day-night light. Separate detection heads for both modalities, RGB and Infrared, and fused features compute the final detection probabilities and bounding boxes for wildlife intrusions.

The processed data is compiled into a visual output highlighting detected animals with bounding boxes, classified by type and level of threat to the field.

III. Result Analysis:

The model trains by creating a unique dataset by. Firstly, the videos are collected, and extracted the frames from the video using Python script.

The experiment performs using a UAV with Zenmuse XT 2 camera. Camera consists of a FLIR longwave infrared thermal camera and visual camera, capturing infrared and RGB images simultaneously. During our data collection. We set a different scale, height, lighting, angles to simulate the data distribution in reality. Jetson Orin Nano is attached to the UAV for detection in a real-time environment.

Fig 2. Result of detecting Animals using UAV

IV. Conclusion and Future work

Integrating UAVs with RGB and infrared imaging technologies has proven to be a promising solution for managing wildlife intrusions into agricultural fields. The proposed system enhances detection capabilities and provides a flexible, scalable solution adaptable to different agricultural settings and requirements. The real-time data processing and alert system enable prompt responses, potentially minimizing the damage caused by such intrusions. The future contributions and direction can be used for multi-classes and different scenario and enhance the accuracy.

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