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An AI- based System for Bird and Drone Detection using YOLOv4/v5 Object Detection Models

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Abstract- For this project, we recommend using the YOLOv4 and YOLOv5 models to create a system that can accurately detect and classify drones and birds. The use of drones is increasingly threatening to bird populations, and it is crucial to develop a solution that can identify them. To do this, we will train the YOLOv4 and YOLOv5 models on the training set, using transfer learning. After that, we will assess their performance on the validation set and test their accuracy on a separate test set. Finally, we will compare the performance of the two models and select the best one for bird and drone detection.

I. INTROUDCTION

Birds are a crucial part of our ecosystem and play a significant role in maintaining the balance of nature. However, the increasing frequency of drone flights in their environments poses a considerable threat to them. While drones have brought several benefits, such as aerial photography and surveillance, birds are at risk of displacement, stress, injury, or even death due to drone disturbances. Additionally, drones can damage bird habitats and cause ecological harm.

To address this issue, it is essential to develop a system that can accurately detect and classify drones and birds. Object detection is a challenging task in computer vision, but the YOLO (You Only Look Once) family of models has shown significant improvements in object detection accuracy.In this project, we will explore the detection of birds and drones using YOLOv4 and YOLOv5 models. Our model will be built using Convolutional Neural Networks (CNN) and trained on a large dataset of bird and drone images. The implications of our concept for bird protection and drone security are substantial. By precisely detecting and classifying birds and drones, we can minimize the disturbance to bird populations and reduce the ecological impact of drone flights.

Problem Statement

Object detection models like YOLOv4 and YOLOv5 have been developed to correctly identify and categorize things in photos or videos. However, there are still limitations to these models. False positives or false negatives may occur, making it difficult to accurately detect objects in challenging scenarios, such as low-resolution photos or similar-looking objects. Inaccurate or missing detections are potential issues in these situations.

II. RELATED WORKS

1. Automated Drone Detection Using YOLOv4

https://www.mdpi.com/2504-446X/5/3/95

By

Subroto Singha and Burchan Aydin

Abstract

Drones are increasing in popularity and are reaching the public faster than ever before. Consequently, the chances of a drone being misused are multiplying. Automated drone detection is necessary to prevent unauthorized and unwanted drone interventions. In this research, we designed an automated drone detection system using YOLOv4. The model was trained using drone and bird datasets. We then evaluated the trained YOLOv4 model on the testing dataset, using mean average precision (mAP), frames per second (FPS), precision, recall, and F1-score as evaluation parameters. We next collected our own two types of drone videos, performed drone detections, and calculated the FPS to identify the speed of detection at three altitudes. Our methodology showed better performance than what has been found in previous similar studies, achieving a mAP of 74.36%, precision of 0.95, recall of 0.68, and F1-score of 0.79. For video detection, we achieved an FPS of 20.5 on the DJI Phantom III and an FPS of 19.0 on the DJI Mavic Pro.

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Drone Detection Using YOLOv5

https://www.mdpi.com/2673-4117/4/1/25

By
Burchan Aydin and Subroto Singha

Abstract
The rapidly increasing number of drones in the national airspace, including those for recreational and commercial applications, has raised concerns regarding misuse. Autonomous drone detection systems offer a probable solution to overcoming the issue of potential drone misuse, such as drug smuggling, violating people's privacy, etc. Detecting drones can be difficult, due to similar objects in the sky, such as airplanes and birds. In addition, automated drone detection systems need to be trained with ample amounts of data to provide high accuracy. Real-time detection is also necessary, but this requires highly configured devices such as a graphical processing unit (GPU). The present study sought to overcome these challenges by proposing a one-shot detector called You Only Look Once version 5 (YOLOv5), which can train the proposed model using pre-trained weights and data augmentation. The trained model was evaluated using mean average precision (mAP) and recall measures. The model achieved a 90.40% mAP, a 21.57% improvement over our previous model that used You Only Look Once version 4 (YOLOv4) and was tested on the same dataset.

3.**YOLOv5 Based Drone Detection and Identification**

https://www.neuroquantology.com/data-cms/articles/20221207061623pmNQ88318.pdf

By
Shikha Tiwari Kalinga University

Abstract
Drones are one of the popular devices now a days not only for entertainment purposes but also in various of applications such as engineering, security in airport disaster management, delivery of goods and others. In addition to their useful applications, frightening concern regarding physical infrastructure safety and airports surveillance has arisen due to the frequency of their use in nasty activities. These days, there have been numerous incidents of drones being used improperly at airports and interfering with airline operations. This work suggested a deep learning-based solution for the effective detection and identification of two types of drones, birds and helicopter to solve this problem. Evaluation of the proposed approach with the prepared image dataset demonstrates better efficiency compared to existing detection systems in the literature. Furthermore, due to their physical characteristics and behaviours, drones are frequently mistaken with birds and helicopter . The suggested YOLOv5 method is not only capable of determining if drones are present or absent in the given area, but it can also recognize two types ie, multirotor and single rotor drones, birds and helicopters as helicopter has very much resemblance of single rotor drones . The dataset used in this work to train the network consists of 4000 visible images containing two types of drones as multirotors, Single rotor, helicopters, and also birds. The suggested deep learning method can directly detect and recognize two types of drones and distinguish them from birds and helicopter with a precision score of 0.9757, recall score of 0.98, as well as mAP(Mean Average Precision) scores of 0.98 and 0.62 for @0.5 IOU (Intersection Over Union)and @0.95 IOU respectively.

4. Detection of drones with YOLOv4 deep learning algorithm
https://ijnaa.semnan.ac.ir/article_6634_425ceed9a61eb67ca0f30e05f1d12fd6.pdf

By
Ahmed S. Naseri , Nada Hussein M. Ali
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Abstract

Drones or unmanned aerial vehicles (UAVs) have rapidly spread all over the world and are becoming widely popular in major cities for personal and commercial use. It has also been widely used for military purposes in the last decade. Thus, it has become difficult to maintain control over them and the risks they pose to privacy and security. In this paper, we present a solution to detect drones before they can reach a sensitive area or residence using the latest YOLOv4 deep learning algorithm while using Darknet as a backbone. We trained our model on different images at different distances and climatic conditions and trained our model to detect birds and aircraft that are very similar to drones at higher distances

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that may cause confusion, and also train the system at close distances and at very low and high image quality. For all available cases, our dataset was collected from three global and certified datasets in aircraft detection systems and the result was a dataset containing all cases. However, the collection of drones, birds and aircraft datasets is not easy to obtain. The proposed method achieved an accuracy of 98.3% with the main challenge of detecting similar small objects near and far in all conditions.

5. Drone Detection using Deep Learning
https://kth.diva-portal.org/smash/get/diva2:1738770/FULLTEXT01.pdf
By
YATING LIU

Abstract
Drone intrusions have been reported more frequently these years as drones become more accessible in the market. The abuse of drones puts threats to public and individual safety and privacy. Traditional anti-drone systems use radio-frequency sensors widely to get the position of drones. In this thesis, deep-learning-based detection algorithms on surveillance cameras have been investigated to be integrated into the RF anti-drone system. The objective of the thesis is to evaluate state-of-the-art models and training strategies for drone detection. The main challenges in this thesis were detecting small drone targets at long distances and running the model in real-time. It is difficult to find a publicly available dataset of small drones online, so a real-world small drone dataset was constructed and used in this thesis. Different versions of YOLO were compared and tested on the real-world dataset. Modifications on the detection heads of the models were conducted to examine their effects on small object detection. The method of tiling on datasets was also adopted to help with the detection of small drones.

III. BACKGROUND STUDY

Bird and drone detection systems vary depending on the application and environment. The most common methods for detection include visual observation, acoustic sensors, radar and thermal cameras.Visual observation is the standard method for identifying flying birds and drones. However, the usefulness of this method is restricted by factors such as the observer's eyesight, the distance between observation locations and the birds or drones, and the number of places that can be seen in one go.

Acoustic sensors can detect the sound of birds or drones flying in the area. However, they are vulnerable to interference from wind, noise and other environmental factors, and the sounds made by different bird species can sometimes make identification difficult.Radar systems can detect birds and drones in the airspace, but they are costly and complicated to use. Moreover, they are also affected by environmental factors like rain and fog.

Thermal cameras can detect the heat signatures of birds and drones in the airspace. This method is particularly useful for detecting birds at night when visual observation is difficult. However, they are costly and require proper training to operate, and environmental factors such as temperature and humidity can affect their accuracy. In summary, while each method has its advantages, they also have their disadvantages, and choosing the right method depends on the specific requirements of the application and environment.

IV. PROPOSED METHOD

For our machine learning project on bird and drone detection, we propose a system that involves the following steps: collecting datasets of birds and drones, pre-processing the input data, training the models, evaluating the models, developing a user interface, and deploying the system in the target environment.

The proposed system has several advantages, including high accuracy in object identification, as demonstrated by both the YOLOv4 and YOLOv5 models. Additionally, the system allows for non-invasive observation of birds in their natural habitats, reducing the need for intrusive monitoring methods.

Another benefit of the system is that it can protect birds from the harmful effects of drones, thus minimizing the negative impact on bird populations. Moreover, the technology can be used to restrict drone flights in bird habitats and nesting regions, helping to safeguard these areas.

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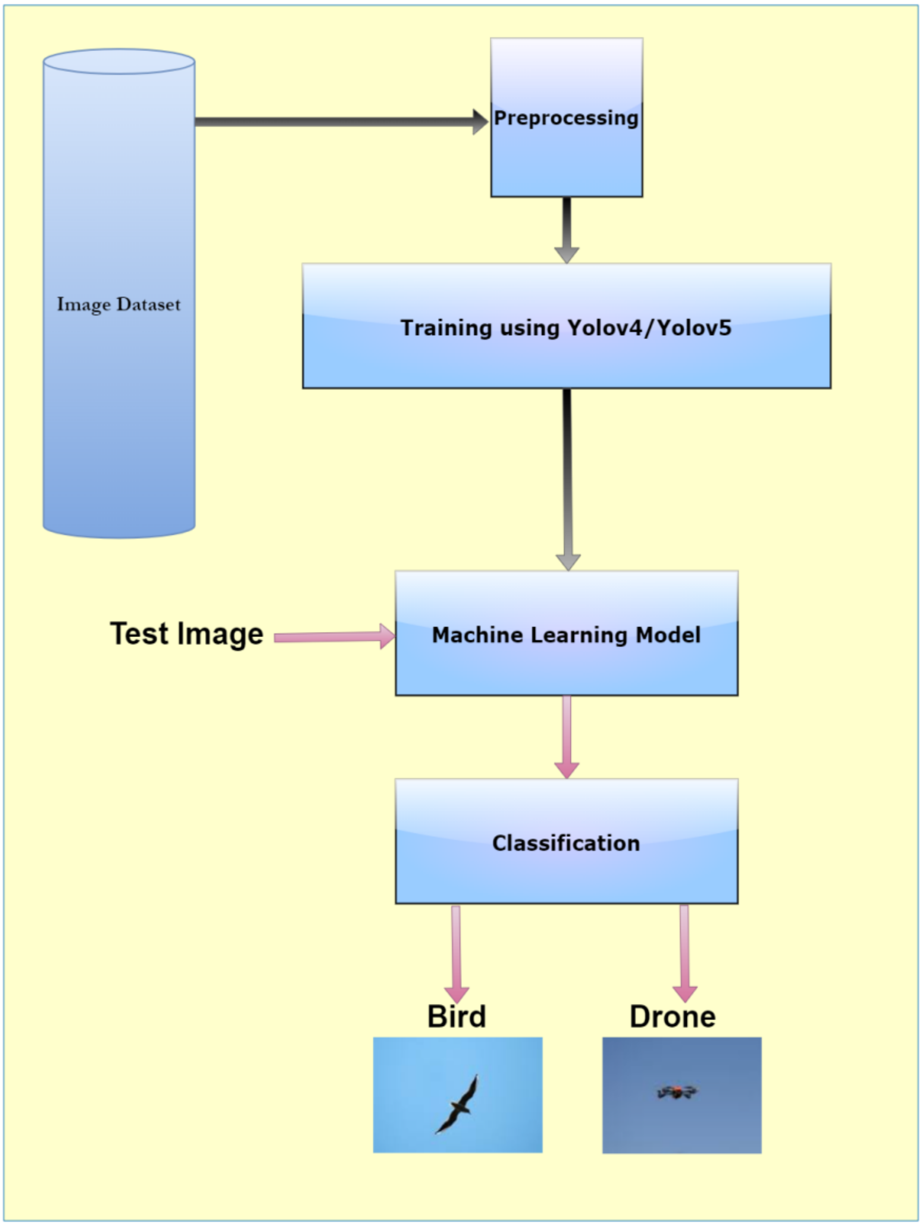

V. CONCLUSION

Our objective for this project is to create a model that can detect birds and drones using YOLOv4 and YOLOv5 models. We plan to use a deep neural network architecture trained on a vast dataset of bird and drone images. To determine the best-performing model for bird and drone detection, we will assess the precision, recall, and F1 score of each model.

This project has significant implications for bird conservation and drone safety. Accurately detecting and classifying birds and drones can help reduce the risk of disturbance to bird populations and minimize the ecological impact of drone flights.

FUTURE ENEHANCEMENT

The system can be improved by not only detecting and classifying birds and drones but also identifying other relevant objects or classes. For instance, it could be extended to differentiate between specific bird species or various types of drones. This would enable us to gather more detailed and precise information, leading to better understanding and decision-making.

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