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AI based Drone Detection

Nandini S R[1], Harsha M Gowda[2], Namith P[3], Revanth Gowda R[4] and Sanjay Kumar P[5]
[1]Assistant Professor, Dept of CSE BGSIT Adichunchanagiri University, Mandya
Email: nandinisr@bgsit.ac.in
[2-5]Students, 8th Semester, Dept of CSE BGSIT Adichunchanagiri University, Mandya
Email: harshamanju234@gmail.com, namithpgowda@gmail.com, revanthgowdar5465@gmail.com, sanjaykumarp5555@gmail.com

***Abstract*— Unmanned Aerial Vehicles (UAVs), commonly known as drones, have witnessed a significant surge in popularity across various sectors. Issues related to abuse have been put forward by the fast-growing number of drones operating in the national airspace, including those used for commercial and recreational purposes. Autonomous drone detection systems present a likely way to find the solution to the problem of possible drone abuse, including drug smuggling and privacy violations. Because drones and other objects in the sky might seem similar, it can be challenging to identify drones. Furthermore, to achieve high accuracy, automated drone detection systems must be trained with enough data. Additionally, real-time detection is required, but this calls for highly configured hardware, such a GPU. Concerns about privacy invasion, security lapses, and airspace violations have also increased with this spike. By utilizing sophisticated object recognition model called YOLOv5 (You Only Look Once version 5), this study presents a novel approach to drone detection. With the utilization of webcam feed and artificial intelligence, YOLOv5 is employed to recognize and detect drones in real time. The project contributes to improved security and privacy management in the era of UAV proliferation by integrating YOLOv5 with laptop accurate warnings.**

***Index Terms*— YOLOv5; autonomous drone detection; GPU; Real-time Detection unmanned aerial vehicle (UAV)**

I. INTRODUCTION

The utilization of drones has gone up and in demand than ever before. In response to this growing demand, new drone products have been created and produced at a price point that allows people to purchase them for multiple uses (such as pleasure, research, etc.). Regarding this change, the commercial drone market is still expanding.
There are a number of shortcomings to the widespread production of commercial drones to meet the demands of citizens. The increased visibility of drones in outdoor environments has raised worries about safety. These include drone invasions of regions forbidden by the government in addition to incidents involving drones injuring people. Furthermore, individuals may underestimate the threat posed by drones given that a well-organized fleet of drones can perform a multiple and several functions [1]. The increasing number of drones in public spaces has made it more difficult to safely and legally manage them. The detection and identification of drones in the air is crucial for regulation.
A radar is the first device that springs to mind when discussing detection. Among the many types of radars, some are specifically made to find small aircrafts which are tiny in size for people to be on board. These radars do have limitations, though. It is unable to differentiate between drones and birds, to start. This necessitates the employment

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of an alternate method for precise drone detection.
As a substitute for the current approach, we suggest a machine learning-based complete drone detection system in this work. This method uses object detection to recognize the unknown drones as objects in the picture. It then uses machine learning to match the acquired drone image to the vendor catalogue to recognize the model type of the unknown drones. The illustration following reveals how our solution may be used in a drone surveillance setting. The surveillance drone uses a camera to capture images of its surroundings while on mission. If an unidentified drone was present, object detection would locate it on the video frame and the technology would mark it. The indicated frame is then utilized once more. The system uses machine learning to identify different drone models, and it uses these models to determine which drone is unknown. This kind of technology may be used in conjunction with other surveillance systems, as [2], to enhance their capacity to detect unidentified flying objects.
Artificial intelligence (AI)-based drone detection is a state-of-the-art technology that uses sophisticated sensor systems and AI to detect and react to unmanned aerial vehicles (UAVs) or drones. Effective drone recognition technology are becoming more necessary to maintain security and privacy in a variety of settings as drone use grows in both recreational and commercial sectors. Drones may now be more precisely and intelligently identified among the dynamic and complex sky thanks to the incorporation of artificial intelligence into drone detection technologies. The inability of conventional drone detection techniques, such radar or manual monitoring, to discern between drones and other aerial vehicles frequently results in false alarms.

II. Literature Review

A scrutiny of the text that encompasses published pieces. The IEEE Explorer, journals, and works cited in the listed papers were all used in the search.
For object detection, Haar Featruebased Cascade Classification [3] is used. There are three important characters of this approach. One is that the detector's features can be calculated rapidly with Integral Image, making its calculation complexity O (1). The second technique involves building the classifier by employing a learning algorithm to identify a minimal number of significant features, resulting in a highly effective classifier. The third technique is a remarkably quick way to combine progressively more sophisticated classifiers in a cascade pattern.
Deep learning has been utilized recently in several image processing projects. Convolutional Neural Networks (CNNs) are among the deep neural network mesh that have attracted the most attention due to their capability to automatically identify significant characteristics during their learning phase. It has already demonstrated improvements in object identification [5] and picture categorization [4]. CNN's capacity to extract abstract features is the reason it performs so well when extracting features. This enables it to process more quickly and accurately [6].
The study presents a distinct approach that employees Artificial Intelligence (AI) approaches to identify drone defects based on vibration patterns. The technology may detect possible abnormalities or issues in the drone's mechanical parts by analysing vibration data using AI algorithms. This method makes use of the innate relationship that occurs between particular vibration signatures and possible problems with the drone's propulsion system or construction. AI improves defect detection efficiency and accuracy, enabling real-time monitoring and prompt response. With the use of vibration analysis and artificial intelligence, this novel approach offers a viable means of proactive defect identification for drone safety and dependability. [7]
This study investigates drone detection, providing a thorough review of current methods and a glimpse into potential future developments. The emphasis is on how drone technology is developing and the growing threats to security that illegal drone activity poses. The study examines the state-of-the-art detection techniques, including computer vision, radio frequency analysis, and radar systems. It explores the benefits and drawbacks of each method, emphasizing the necessity of a multifaceted strategy to handle the wide range of capabilities of contemporary drones. In the section on future views, it is anticipated that developments in sensor technologies, artificial intelligence, and machine learning would likely revolutionize current attempts to identify and reduce the dangers related to unmanned aerial vehicle operations. [8]
Using an affordable Software-Defined Radio (SDR) platform for continuous coverage in the 2.4 GHz ISM band, the research presents a unique way to drone identification. Drones frequently operate in this frequency band, and the suggested sensor seeks to offer continuous monitoring while guaranteeing thorough detection capabilities. The SDR platform's affordability and accessibility are improved by its cost-effectiveness, which provides a scalable and reconfigurable technology that is adaptable to drone technology without incurring large hardware costs. The system's scalability facilitates deployment in many contexts, and its integration ability with variety of sensor technologies enhance its overall efficacy. However, challenges such as detection range limitations, potential signal interference, and the need for robust security measures highlight areas for consideration to ensure accurate and

reliable drone detection in real-world applications. The system's adaptability, upgradeability, and adherence to regulatory compliance underscore its potential as a creative solution for addressing the growing challenges of drone detection. To guarantee precise and dependable drone identification in practical applications, and several factors to take into account, including detection range restrictions, possible signal interference, and the requirement for strong security measures. The system has the potential to give creative response to the mounting difficulties associated with drone recognition since of its versatility, upgradeability, and adherence to regulatory compliance. [9]

The study presents a novel approach to road damage identification from drone photos by employing a two-layer optimizer to evolve a pre-trained Convolutional Neural Network. By use of a dynamic optimization process, the technique aims to improve the road damage detecting accuracy and efficiency. The base is the pre-trained CNN, and the two-layer optimizer adds flexibility and evolutionary enhancements to the model. The target of this development process is to improve the ability to identify and comprehend minute details related to road damage in drone photos. The deployment of a dual-layer optimizer implies an intricate optimization approach, enabling the framework to adjust and enhance its parameters for enhanced efficacy. using the utilization of sophisticated optimization techniques and pre-trained models, the suggested method presents a proactive solution to tackle road damage identification problems using drone based. [10]

The employment of depth maps for drone localization and detection while in flight is examined in this research. Real-time recognition and localization of nearby drones is made possible by the system by utilizing depth information gathered from sensors like LiDAR or stereo cameras. The statement that the answer is onboard suggests that the detecting drone has the sensors and computational power required to carry out these activities on its own. Thanks to this technology, drones can operate more securely and successfully in unpredictable areas since it improves their situational awareness. The study emphasizes the importance of depth maps in enhancing onboard drone detection and localization capabilities and presumably dives into the practical data of the system, experimental findings, and possible applications. [11]

In this study, a new drone detection network using a Tiny Iterative Backbone architecture is presented. The goal of this research is to identify drones more accurately and efficiently by enhancing the network's backbone structure. The phrase "Tiny Iterative Backbone" refers to a simplified and iterative method of creating the detection system's main framework. Deep learning techniques are probably used by the network, and it may even use iterations for optimization and refinement. The focus on a "tiny" backbone implies a lightweight, technologically productive approach that is implemented in real-time. The suggested Drone Detection Network's architecture specifics, training approaches, and performance assessments are probably covered in this study. With an emphasis on effectiveness and efficiency, this novel strategy depicts promise for tackling the difficulties associated with drone detection. [12]

The study looks at a unique method for enhancing drone landings that uses super resolution reconstruction and marker detection based on deep learning. Using cutting edge deep learning algorithms, the main goal is probably to enhance the truthfulness of drone landing tactics. The target of super-resolution reconstruction is to improve picture quality and resolution, offering more exact visual information for landing process guidance. Furthermore, it is probable that the article investigates the employment of DL skills for marker recognition, hence enhancing the precision of landing target identification. By tackling issues with picture quality and marker identification, this integrated method may be able to improve drone landing procedures overall. It is anticipated that the study would explore the deep learning-based strategy's technical features, experimental outcomes, and prospective applications. [13]

III. EXISTING SYSTEM

The exploitation of pre-existing drone detection systems is essential in mitigating the increasing difficulties brought about by the widespread deployment of unmanned aerial vehicles (UAVs). As drones become more widely available and have a wider range of applications, it is critical to have efficient detection technologies in place to protect privacy and security in a diversity of industries. These systems use a collection of cutting-edge technologies to recognize, locate, and react to drone activity in various settings.

The airspace is monitored by a number of sensors used by current drone detection systems, including as radar, optical cameras, radio frequency (RF) detectors, and sound sensors. The distinct data points contributed by every type of sensor create a complete network that improves the accuracy and dependability of the system as a whole. These systems' capabilities are further enhanced by integration with already-existing surveillance infrastructure, which offers an all-encompassing method of monitoring and safeguarding airspace.

IV. PROPOSED SYSTEM

The suggested artificial intelligence (AI)-based drone detection system is a cutting-edge solution that combines cutting-edge sensor technology with sophisticated AI algorithms to improve security and safety. The fast expansion of unmanned aerial vehicles (UAVs) in diverse fields has made it crucial to identify drones promptly and precisely to protect vital infrastructure, public gatherings, and sensitive locations.

By incorporating artificial intelligence into the detecting process, this cutting-edge technology overcomes the drawbacks of conventional techniques and offers a more reliable and flexible solution. The basis of the suggested system is made up of a multiplicity of sensors that are carefully positioned to gather extensive data from the nearby airspace, including cameras, radars, and acoustic devices. Subsequently, this sensor data is analysed by sophisticated ML procedures that have been taught to discover the distinct traits and behaviours connected to drones.

V. SYSTEM ARCHITECTURE

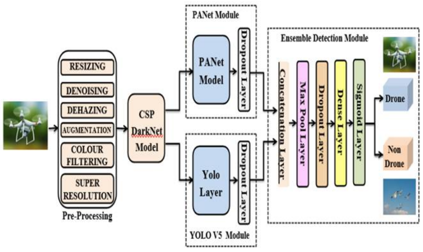

Figure. 1

An ensemble detection module is a part of a machine learning system that aggregates predictions from many models, frequently to enhance overall performance. The target is to enhance the accuracy, robustness, and generalization of the system by utilizing the variety of many models. An Ensemble Detection Module may be exploited to aggregate predictions from various detectors or exhibits in the context of object detection or classification tasks. There are numerous ways to do this, including voting, averaging, and weighted combinations. Because ensemble approaches may lessen the drawbacks of individual models and provide more dependable and accurate predictions, they are prominent in the sphere of machine learning. In contests and real-world settings where attaining peak performance is essential, they are frequently utilized.

VI. DATA FLOW DIAGRAM

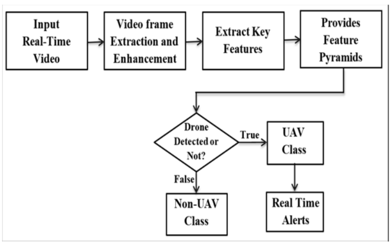

Figure. 2

- *Input Real-Time Video*

Real-time video refers to live or immediate video streaming, where the content is transmitted and viewed as it happens. This technology enables users to watch events or receive information in real-time, without significant delay. Real-time video is commonly used in applications like video conferencing, live broadcasting, surveillance, and interactive online experiences. It requires low latency to ensure a seamless and timely viewing experience.

- *Video frame Extraction and Enhancement*

Video frame extraction involves capturing individual frames from a video sequence. Each frame represents a specific stationary figure from the video. Enhancement implies to the manner of improving the quality or characteristics of these frames. This can incorporate undertakings for instance increasing sharpness, adjusting contrast, reducing noise, or enhancing specific features. Both frame extraction and enhancement are techniques often used in computer vision, video processing, and image analysis to amend the overall visual quality or extract valuable information from video content.

• *Extract Key*

Features Extracting key features from data involves identifying and isolating the most relevant and informative elements within a dataset. In the context of video processing, key features could include objects, patterns, or traits that are vital for analysis or understanding. The specific features to extract depend on the goals of the task, such as object recognition, activity detection, or content summarization. Techniques like computer vision algorithms and machine learning replicas are habitually employed to spontaneously obtain profound aspects from video data, aiding in tasks like video analysis, recognition, and classification.

• *Provides Feature*

Pyramids Feature pyramids are hierarchical representations of image features at multiple scales. They are commonly used in computer vision and image processing tasks. The idea is to create a pyramid like structure where each level of the pyramid corresponds to a distinctive range of the image.

• *UAV Class*

UAV stands for Unmanned Aerial Vehicle. It refers to an aircraft that operates without a human pilot on board. UAVs can be remotely controlled or operate autonomously based on pre-programed flight plans or more complex dynamic automation systems. UAVs have a wide range of applications, including surveillance, reconnaissance, aerial photography, environmental monitoring, and even package delivery. The classification of UAVs can be based on various factors, such as size, range, payload capacity, and purpose. Common UAV classifications include.

• *Non-UAV*

Class "Non-UAV" doesn't represent a specific class or category on its own. Instead, it generally refers to anything that is not an Unmanned Aerial Vehicle (UAV). If you have a specific context or type of object in mind, please provide more details so I can offer more accurate information.

• *Real Time Alerts*

Real-time alerts refer to immediate notifications or warnings generated and delivered as events occur.

• *Security Systems*

Instant alerts for unauthorized access, breaches, or suspicious activities.

VII. Block Diagram

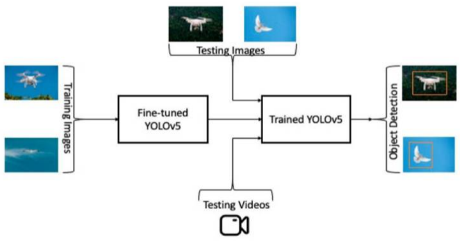

Figure 3.

This diagram illustrates the course of guidance and analyzing an object detection model, specifically YOLOv5. The diagram has three main components:

• *Training Images*

Four different pictures of birds and planes are used to fine-tune YOLOv5.

• *Fine-tuned YOLOv5*

This box represents the fine-tuned YOLOv5 model.

• *Testing Videos*

This input is represented by a camera icon and is handled to test the fine-tuned YOLOv5 model for object detection.

• *Trained YOLOv5*

This box represents the trained YOLOv5 model.

• *Testing Images*

Two pictures (a drone and a bird) are exploited to trial the trained YOLOv5 model for object detection.

• *Object Detection*

This output is illustrated by bounding boxes around objects in images.

VIII. CONCLUSION

Drone detection systems that utilize AI provide a viable way to improve security by promptly recognizing and addressing any unapproved drone activity. These systems use sophisticated techniques, such computer vision and ML, to examine the traits and actions of drones. Even if they are very successful, continual developments in drone technology and AI detection techniques highlight the necessity of regular upgrades and enhancements to keep up with changing threats. Including these systems in larger security frameworks can help develop all-encompassing counter-drone tactics. Additionally, AI-based drone detection systems may be employed in a variability of settings, from public event security to the protection of important infrastructure, thanks to their scalability and real-time processing capabilities. Notwithstanding its benefits, problems including false positives, environmental influences, and privacy issues call for continued study and improvement. It is imperative that AI specialists, security experts, and politicians collaborate together to undertake these issues and guarantee the proper use of AI-driven drone detection systems in diverse settings.

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