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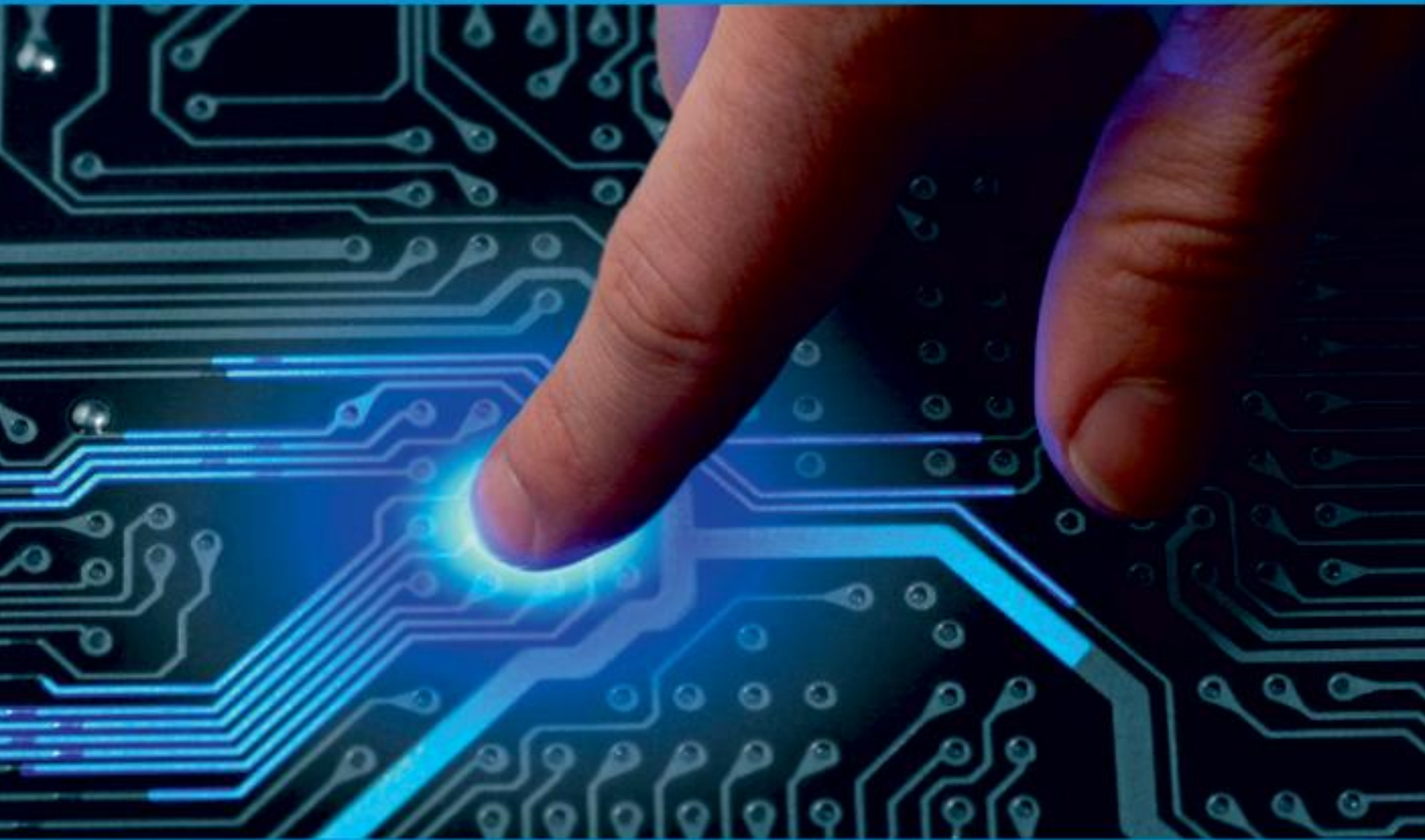

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Drone Detection

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ABSTRACT: Drones also known as unmanned aerial vehicles (UAVs),are flying machines that can carry payloads weighing anywhere from a few grams to several kilograms. These days, small drones are continually being employed for a wide range of jobs due to their expanded in recent years. Drones are becoming a bigger threat to people's safety, privacy at the current time. For the effective detection and identification of drones and birds, a deep learning-based solution is applied to solve these issues. The suggested method is able to identify drones also it will detect if they are present or absent in a given location. GPS tracker modules are used to correctly determine the location in real time.The user will take the necessary measures if the drone is discovered to be unlicensed. The proposed model has an F-1 score of 99.04%, precision of 98.7%, map of 98.6%, recall of 96.72%, and accuracy of 94.20%.

KEYWORDS: Drones,Computer vision,YOLOv5,GPS tracker**.**

I. INTRODUCTION

Unmanned aerial vehicles (UAVs), commonly known to as drones, are a form of aircraft intended for pen-air operations that can fly in appropriate areas without the need for a pilot. From the Ground Control Center (GCS), they can be managed through dependable wireless connectivity. Originally, drones came with a camera and PS unit; Drones now have smart driving capabilities, sophisticated GPS models, safety features, and high visibility gear thanks to technological advancements. It is a real risk to national security from these sophisticated drones. An essential component of sophisticated drone security procedures is monitoring by unapproved parties without getting approval from the government. Drones equipped with vision detectors offer a range of observation spots due to their scalability and flexibility. In regard to identify targets, track, and hide their movements, they might carry out poaching operations in unstable areas.

In addition to geotagged data based on measurement, elevation, and focal length, drones offer high-resolution imagery. Certain drones are fitted with "Follow Me" technology, which allows them to trail inquisitive individuals and creates sufficient room to replicate direct shots of any spot, including those that are prohibited. These drones have the ability to spin on their own axis, follow targets from a fixed location in the sky, and track their movements. One Similar to a smartphone, tablet, or GSC, this cutting-edge device may function with a GPS-enabled bias. The embedded GPS unit in the drone may unintentionally perceive the visual study as equal area, time, height, etc. It has certain parameters geotagged, like These days, drones are an essential component of modern warfare. The job of safeguarding the civilian boundary has proven to be difficult, even though border guards are constantly on high alert to foil nefarious plots. The incidents the police reported ranged from adversary hang-self attempts to robberies and narcotics trafficking.

Fig.1. Drone Dataset

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This paper investigates the take of action descriptors for modeling behavior to detect normal drone activity from video sequences. The computational process is mainly divided into drone detection, tracking, activity detection and recognition, and evaluation of accuracy.

II. BACKGROUND STUDY

Traditional methods of drone detection have relied primarily on radar and radio frequency (RF)-based systems. These systems work by detecting the electromagnetic waves emitted by drones or their communication systems. However, they have lot of limitations that difficult their effectiveness in addressing the challenges posed by the proliferation of drones.

The system operates in real-time, analyzing video footage captured by the webcam to detect drones within the field of view area. YOLOv5, known for its speed and accuracy in object detection tasks, is employed to identify drones based on their visual appearance. The model is trained using a labeled dataset of drone images, optimizing its ability to recognize drones in various environmental conditions, lighting conditions, backgrounds, and sizes.A user-friendly interface is developed to display the live video feed from the webcam and indicate the presence of detected drones, enabling users to monitor and respond to potential threats effectively.

III.METHODOLOGY

YOLOv5 is a object detection model that is known for its speed and accuracy. which consists of the following :

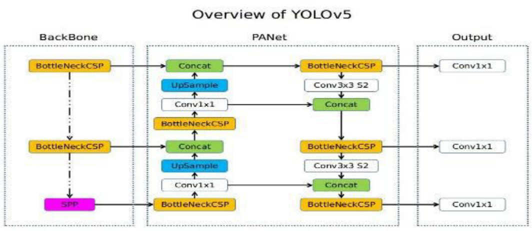

Fig.2. overview of YOLOv5

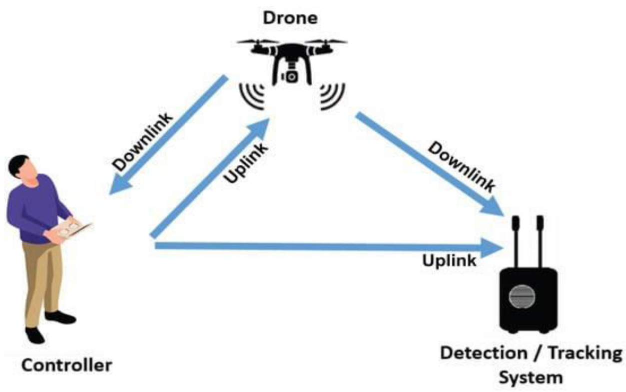

Fig.3. drone detection model

Backbone: This is the part of the network that taken from features from the input image. The image shows a Bottleneck CSP module, which is a type of convolutional neural network (CNN) architecture that is designed to be efficient.
PANet: It is the part of the network that fuses features from different stages of the backbone. The image shows that PANet uses a combination of up sampling and concatenation operations to create feature maps of different scales.
Output: It is the part of the network that makes predictions about the objects in the image. The image shows that the output layer consists of a convolutional layer followed by a 1x1 convolution layer. The 1x1 convolution layer is used to reduce the number of channels in the feature map to the desired number of output classes.

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The YOLOv5 process includes 4 steps.

Data Collection and Preprocessing Module: This module involves collecting a dataset of images containing drones and preprocessing the images to prepare them for training. Preprocessing steps may include resizing, normalization.
Model Training Module: In this module, the YOLOv5 model is trained on the collected dataset of drone images.Model Integration Module: Once the YOLOv5 model is trained, it is integrated into the drone detection system. This involves loading the trained model weights and configuring the model for real-time inference on live video streams. Integration may also include optimizing the model for deployment on the target hardware platform (e.g., laptop).

Real-Time Detection Module: This module is responsible for processing the live video feed from the webcam in real-time and detecting drones using the integrated YOLOv5 model. As frames of the video are captured, they are passed through the model for image detection. When a drone is detected within the frame, the system triggers an alert to notify users of the presence of a drone.

IV. IMPLEMENTATION

1.Hardware Setup: Assemble the hardware components including a laptop equipped with a webcam. Ensure proper connectivity and functionality of each component to form the core infrastructure of the drone detection system.
2.YOLOv5 Integration: Download and install the YOLOv5 object detection framework on the laptop. Configure YOLOv5 to utilize the webcam as the input source for real-time drone detection. Then Verify the compatibility and performance of YOLOv5 with the hardware setup.

3.Dataset Collection and Preparation: Collect a diverse dataset of drone images to be used for training the YOLOv5 model. Ensure the dataset includes images captured in various environmental conditions, lighting conditions, backgrounds, and drone sizes. Annotate the dataset with bounding boxes indicating the location of drones within each image.

4. Model Training: Preprocess the dataset to prepare it for training, including data augmentation techniques such as rotation, scaling, and flipping. Split the dataset into training, validation, and testing sets to examine the performance of the trained model. Train the YOLOv5 model using the annotated dataset to optimize its ability to accurately detect drones in real-time video footage.

5.Real-time Detection Implementation: Develop a real-time detection pipeline to process video feed from the webcam using the trained YOLOv5 model. Power Supply: Provide power to the Node MCU and GPS module. We have to make sure the power source can provide sufficient current for both devices. Write or obtain firmware for the Node MCU that can communicate with the GPS module and perform drone detection algorithms. We can use the Arduino IDE with appropriate libraries for programming the Node MCU.

6. Test and Calibrate: Test the hardware setup to ensure that the Node MCU is receiving GPS data accurately. Calibrate the GPS module if necessary to improve accuracy.

7. Implement Drone Detection Algorithm: Write the drone detection algorithm in the firmware. This could involve analyzing GPS data to detect drones entering restricted areas or exhibiting suspicious behavior.

8. Integration and Deployment: Integrate the Node MCU into your overall drone detection system, which may include communication with other devices or a central monitoring station. Deploy the system in the desired location for drone detection.

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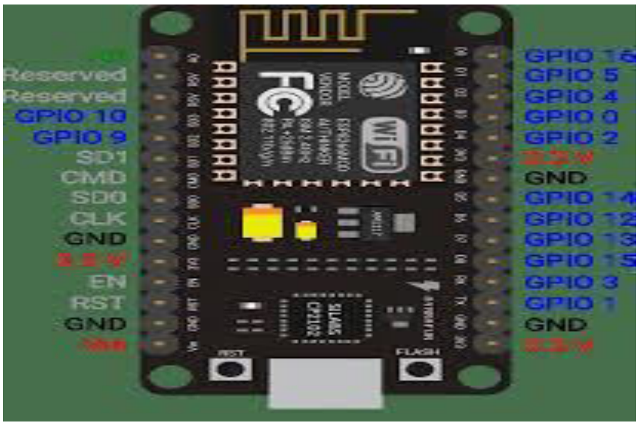

Fig.5. Node MCU

There are few concepts on YOLOv5 calculation like IOU, ROC curves, F1 scores, Precision and Recall.

V. RESULTS

AI drone detection systems face several challenges and limitations. These include false positives/negatives, limited detection range, computational complexity, and environmental factors such as weather conditions and terrain obstacles. Addressing these challenges requires ongoing research and development efforts to improve detection accuracy and efficiency. Successful deployment of AI drone detection systems requires integration with existing regulatory frameworks governing airspace security and drone operations. Collaborations with regulatory authorities, law enforcement agencies, and industry stakeholders are essential to ensure compliance with regulations and standards while effectively deterring unauthorized drone activities.

The literature survey identifies several promising avenues for future research in AI-based drone detection. These include the development of real-time detection algorithms, the integration of AI with drone identification and tracking systems, the exploration of novel sensing modalities, and the investigation of adaptive detection techniques to counter evolving threats posed by drones. Ethical and privacy considerations surrounding AI drone detection systems are also discussed in the literature. Balancing the need for airspace security with individual privacy rights and civil liberties remains a critical challenge. Research in this area emphasizes the importance of developing transparent andaccountable detection technologies that uphold ethical standards and respect user privacy.

Iteration (%)	Train set	Test set	Precision (%)	Recall (%)	F1 score	mAP	Accuracy
1	380	120	98.1	98.75	98.423	98.34	98.34
2	380	120	98.7	96.72	97.69	97.68	97.68
3	380	120	97.35	97.5	97.42	98.25	98.25
4	380	120	98.15	99.45	98.79	99.5	99.5
5	380	120	98.5	95.6	97.02	99.3	99.3
6	380	120	96.25	96.5	96.3748	99.5	99.5
7	380	120	98.6	99.5	99.0479	99.15	99.15
8	380	120	97.6	98.35	97.973	99.6	99.6
9	380	120	96.3	97.75	97.0195	98.3	98.3
10	380	120	97.2	97.9	97.5487	98.1	98.1
Average	380	120	97.675	97.802	97.73069	98.772	98.772

Table 1.Results for epochs 500

The total number of trainsets used is 380.The toral number of Test set used is 120.The average precision value obtained is 97.67. The average Accuracy value obtained is 98.772.

We get highest precision of 98.7% for iteration 2, highest recall of 99.5 % for iteration 7, highest F1 score of 99.04 for iteration 7,highest accuracy of 99.5% for iteration 4.

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VI. CONCLUSION

The proposed drone detection system offers a comprehensive solution to address the challenges posed by unauthorized drone activity in various environments.

By implementing artificial intelligence (AI) and computer vision techniques, particularly the YOLOv5 object detection model, the system achieves high accuracy and reliability in detecting drones in real-time. The integration of hardware components such as a laptop, webcam enables seamless operation and effective alerting mechanisms upon detecting a drone. The user-friendly interface enhances usability, allowing operators to monitor live video feed and respond promptly to potential security threats.

Furthermore, the system's scalability, adaptability, and compatibility with existing security infrastructure make it suitable for deployment in diverse environments, including critical infrastructure, public events, and commercial facilities. By providing real-time alerts and proactive security measures, the drone detection system contributes to enhancing security, safety, and privacy in the age of unmanned aerial vehicles (UAVs).

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