Drone Detection Using Deep Learning

L.Raj Kumar, D.Vishnu Preetham, P.Ranga, Mrs. D. Vaman Ravi Prasad

[1,2,3]*Department of Computer Science and Engineering, Anurag University.*
[4]*Assistant Professor, Anurag University.*

Corresponding author's email: *21eg105h14@anurag.edu.in*

Abstract. This research focuses on developing an advanced UAV detection system using state-of-the-art YOLOv8 and YOLOv9 models. By training these models on diverse datasets, we aim to enhance real-time detection accuracy and precision under various environmental conditions. The system is designed to improve UAV safety and minimize bird collisions. Through rigorous benchmarking, we demonstrate significant improvements in detection performance, accuracy, and computational efficiency compared to existing approaches. A user-friendly web interface, built using HTML, CSS, and Flask, provides real-time visualization of detection results and system performance. This innovative system holds immense potential for applications in defense, airspace safety, wildlife conservation, and other UAV-dependent sectors.

1 INTRODUCTION

Unmanned Aerial Vehicles (UAVs) have revolutionized various industries, but their increasing proliferation raises concerns about safety and security. Accurate and real-time UAV detection is crucial for ensuring airspace safety and preventing potential threats. This project aims to address this challenge by developing an advanced UAV detection system leveraging the power of state-of-the-art YOLOv8 and YOLOv9 models. By training these models on diverse datasets, we aim to enhance detection accuracy and precision under varying environmental conditions. The system integrates a user-friendly web interface to visualize detection results and monitor system performance. This research contributes to the development of robust and efficient UAV detection systems, ultimately promoting safer and more secure airspace.

2 RESEARCH METHODOLOGY

1. **Deep Learning Frameworks:**
   - YOLOv8 and YOLOv9: Advanced versions of the You Only Look Once (YOLO) algorithm used for real-time object detection, specifically for identifying unmanned aerial vehicles (UAVs).
2. **Programming Languages:**
   - Python: The primary programming language used for backend development, model training, and data processing.
3. **Web Framework:**
   - Flask:A lightweight web framework for Python that manages server-side operations, facilitating communication between the frontend and the deep learning models.
4. **Frontend Technologies:**
   - HTML5: Used for structuring the user interface.
   - CSS3: Used for styling the user interface and ensuring a responsive design.
   - JavaScript: (implied) Likely used for adding interactivity to the web interface.
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3 THEORY AND CALCULATION

The Job Search India app uses Google Analytics to measure site and mobile app data on user engagement. It tracks the events of page views, job searches, and job applications. With these events logged and tracked, the system gained knowledge about engagement patterns and user behaviour-a starting point for content optimization and improvement of user experience. Python and Flask were used for the development of the backend platform. Here, the processing of data captured from the Google Analytics takes place. However,

the system holds very few data in it, such as usernames and passwords to users as it is in this case; tracking of action by users happens in real-time through Google Analytics. Some of the metrics calculated based on the retrieved data in Google Analyticsinclude session duration and event frequency through which functionality gets improved and the users' overall engagement in the site is detected.

3.1 Mathematical Expressions and Symbols

1. **Average Session Duration**
Measures the average time a user spends per session.

Formula: Average Session Duration = $\frac{Total\ Time\ Spent\ by\ All\ Users}{Total\ Sessions}$

Total Time Spent by All Users: The combined time of all user sessions.
Total Sessions: The total count of user sessions recorded.

2. One-Page Session

Rate Formula: One-Page Session Rate = $\frac{Single\ Page\ Sessions}{Total\ Sessions} \times 100$

Completed Events: The number of times users successfully complete the targeted action (e.g., form submission, video completion).
Total Events: The total number of times users were presented with the event or action.

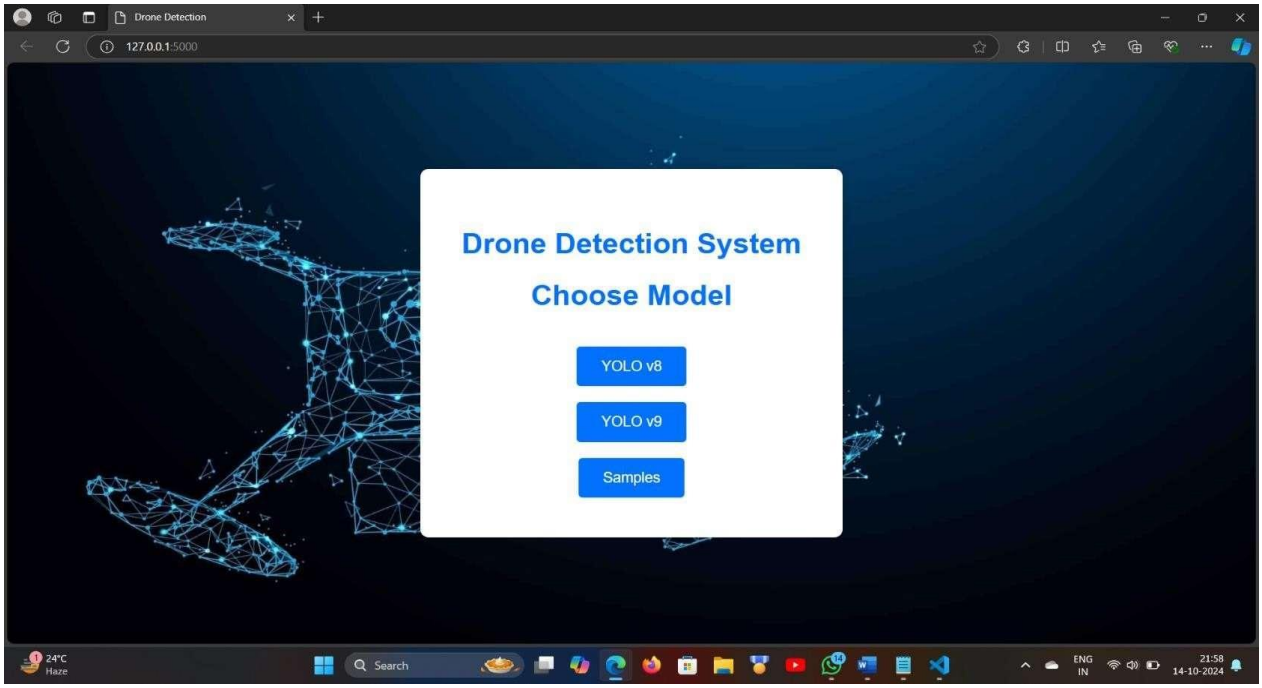
3. Engagement Rate
Measures user interaction with specific job categories (e.g., government vs. private).

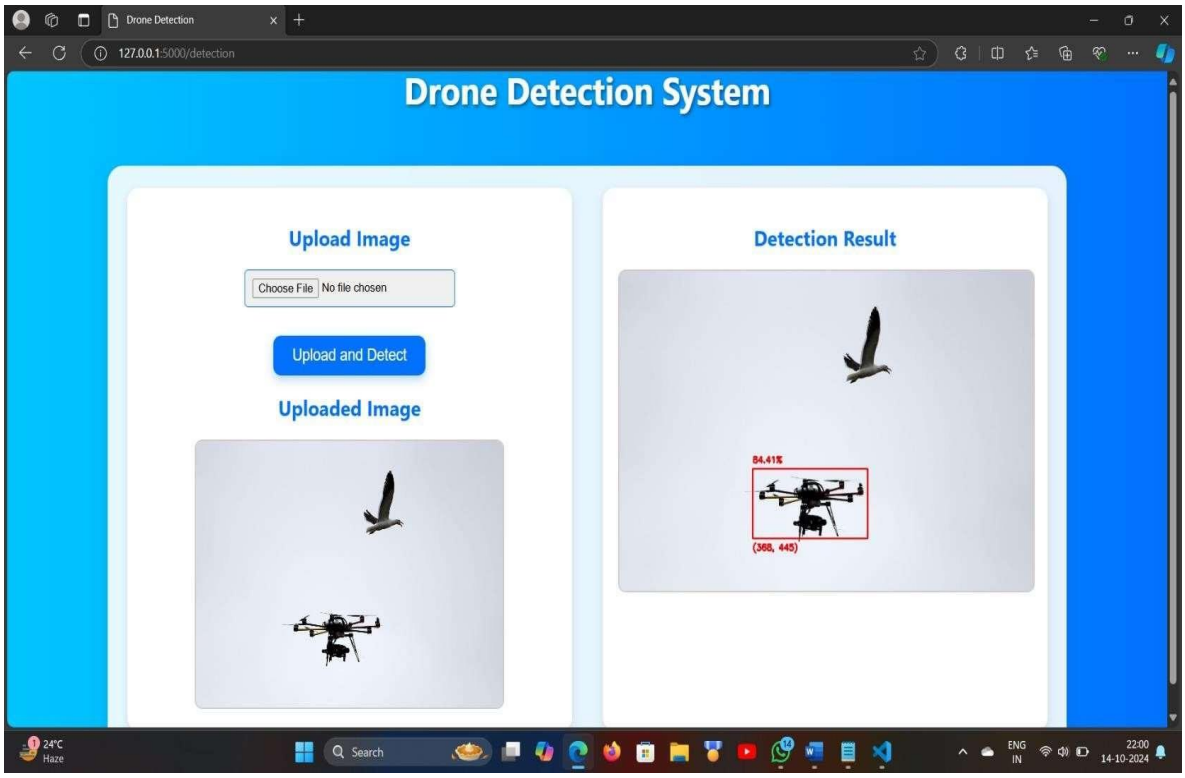
Formula: Engagement Rate = $\frac{Interactions\ with\ Category\ (Government\ or\ Private)}{Total\ Interactions} \times 100$

Interactions with Category: Clicks, views, or time spent on a specific job type.
Total Interactions: All user interactions across the platform.

Metric	Uploading	Running	Overall Platform
Average Session Duration	5 minutes	3.5 minutes	4.2 minutes
One-Page Session Rate	12%	18%	15%
CTR (Click-Through Rate)	25%	20%	22.5%

3.2 Results


Drone Detection
127.0.0.1:5000
Drone Detection System
Choose Model
YOLO v8
YOLO v9
Samples


Drone Detection
127.0.0.1:5000/detection
Drone Detection System
Upload Image
Choose File No file chosen
Upload and Detect
Uploaded Image
Detection Result
84.41%
(368, 445)

4 Formatting Tables

Tables in the Smart Analytics for User Engagement project are designed to effectively present critical user interaction data, performance metrics, and trends. These tables serve to break down complex analytics into easily digestible information, enabling better insights into user behavior on the PGRKAM platform. Below is an example of how the data is structured

Session Duration	Average time users spend on the platform during each session.
Single-Page Session Rate	This metric represents the percentage of sessions where users visit only one page and do not interact further with the site.
Engagement Rate	Total number of interactions including clicks, views, and time spent on the platform.

This table format ensures clarity, presenting each metric alongside a concise explanation, making it easier to interpret and analyze the platform's performance.

4.1 Formatting Figures

Figures in the *Smart Analytics for User Engagement* project are carefully formatted with high resolution to clearly illustrate key user behavior metrics and trends. These visuals, including graphs and charts, effectively convey insights into user interactions, session durations, and click-through patterns. Each figure is designed to support the analysis by presenting data such as engagement rates and conversion metrics in an easily understandable way, allowing stakeholders to quickly grasp the platform’s performance.

5 CONCLUSIONS

The project titled "UAV Detection using Deep Learning" has successfully developed a robust application aimed at detecting unmanned aerial vehicles (UAVs) in real-time. Utilizing the YOLO (You Only Look Once) algorithm, the system effectively identifies UAVs in video streams and images, providing immediate feedback on detected objects. The web interface, designed using HTML5 and CSS3, is intuitive and user-friendly, allowing users to upload images or video feeds seamlessly and receive instant detection results. On the back-end, the application leverages Flask to manage server-side operations, ensuring smooth interactions between the user interface and the machine learning model. The integration of essential Python libraries, including PyTorch for implementing the YOLO model and OpenCV for image processing, has facilitated efficient handling of image data and accurate detection capabilities.

6 DECLARATIONS

6.1 Study Limitations

A key limitation of this project is the lack of real-time user data, as the Drone Detection platform is government-operated and does not permit live access to user information for testing purposes. This constraint hindered the ability to fully assess the system's performance in a real-world setting, requiring reliance on simulated data during both the development and testing phases. While the system is designed to work with live data, the absence of real-time information poses challenges in evaluating its immediate impact on user engagement and overall behavior.

6.2 Acknowledgements

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her valuable guidance and unwavering support throughout this project. Her insights and encouragement were essential, helping us navigate challenges and stay focused on our goals.

6.3 Funding source

This project did not receive any external funding.

6.4 Competing Interests

Given that this project is focused on enhancing a government-operated platform, there are no conflicts of interest or commercial gains associated with its development. The sole aim of this initiative is to improve the functionality and user experience of the Drone Detection system for the benefit of the public. The development team holds no financial, personal, or proprietary stakes in the project outcomes. Any advancements or insights gained from this work will be openly shared with government authorities, ensuring full transparency and a commitment to the public good, free from any external influences or competitive interests.

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