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COP : TARGET RECKS USING YOLOv8

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Abstract : With the increasing need for effective wildlife monitoring and conservation efforts, computer vision technologies have emerged as powerful tools for automating animal detection in diverse environments. This paper introduces an innovative framework for the detection of Indian exclusive animals—species found exclusively in India—employing the YOLOv8 (You Only Look One-level) object detection model. The proposed system is reinforced by a meticulously annotated dataset created through the Computer Vision Annotation Tool (CVAT), focusing specifically on the distinctive fauna inhabiting the Indian subcontinent. The YOLOv8 model, renowned for its speed and accuracy, is employed to detect animals in images and video frames. The YOLOv8 model is tailored to detect and classify indigenous animal species, ensuring its adaptability to the unique ecological contexts of India. By harnessing the real-time capabilities of YOLOv8, the system enables efficient and timely monitoring of exclusive wildlife populations, addressing the urgent need for accurate and scalable solutions in conservation efforts. The CVAT annotated dataset encapsulates a diverse array of Indian endemic species, encompassing various habitats and environmental conditions. The manual annotation process ensures precision in delineating bounding boxes around animals, contributing significantly to the enhancement of the model's detection accuracy for region-specific fauna. Addressing challenges such as diverse animal poses, complex backgrounds, and varying lighting conditions, our framework demonstrates its adaptability to the specific conditions prevalent in India. This work contributes to the growing body of research in wildlife conservation and monitoring, providing a scalable and accurate solution for automated animal detection. The proposed framework stands as a valuable tool for researchers, conservationists, and wildlife managers dedicated to safeguarding the unique biodiversity of India and its integral role in global ecological balance.

IndexTerms **– Android, Annotations, CVAT, Detection, Endemic species, YOLOv8.**

I. INTRODUCTION

India, with its rich tapestry of diverse ecosystems, stands as a global hotspot for biodiversity, harbouring a myriad of exclusive animal species found nowhere else on Earth. The preservation of this unique fauna is imperative for maintaining ecological balance and sustaining the intricate web of life within the Indian subcontinent. In the face of escalating threats to wildlife, the integration of advanced technologies becomes paramount in fortifying conservation efforts. This paper presents a pioneering initiative in the domain of animal detection, specifically tailored to the detection of Indian endemic species—those exclusive to the Indian subcontinent [1].

In the age of rapid technological advancement and biodiversity challenges, our endeavour converges at the intersection of cutting-edge computer vision and mobile application development to address the unique conservation needs of India's exclusive wildlife. This paper introduces a pioneering project that marries the power of YOLOv8, a state-of-the-art object detection model, with the precision of a manually annotated dataset from CVAT [2]. Going beyond traditional applications, we seamlessly integrate this innovative approach into an Android application, placing the ability to detect Indian endemic species directly into the hands of field researchers, and conservationists.

YOLOv8, renowned for its real-time capabilities, becomes the technological linchpin of our project, offering a dynamic solution for the automated detection of exclusive Indian wildlife [3]. The model's speed and accuracy are particularly pivotal in the fast-paced and unpredictable environments encountered during fieldwork. Crucial to our methodology is the meticulous creation of a dataset through manual annotation using CVAT, ensuring the precision required for training the YOLOv8 model. This dataset spans the diverse habitats of Indian endemic species, providing a rich source of information for the model to adapt to the intricacies of the subcontinent's ecology.

Taking a leap forward in usability, the approach extends beyond the realm of traditional research to manifest as a user-friendly Android application, the application democratizes the process of animal detection through various features such as camera detection, video frames and images, placing the power of YOLOv8 directly in the pockets of those on the front lines of conservation

efforts [4]. This innovation seeks to transform the way we approach wildlife monitoring, making it a dynamic, accessible, and integral part of fieldwork. Through a series of rigorous evaluations, we showcase not just the efficacy of our integrated YOLOv8 and CVAT methodology but also the practicality of its implementation through an Android application. This work represents a bold stride towards empowering conservationists and researchers with a potent, real-time tool for the protection of India's exclusive fauna.

II. RESEARCH METHODOLOGY

The initial model building process involves collecting the raw data in the form of images which helps the model to understand the structuring of an object. This procedure inculcates systematic gathering of unprocessed information from various sources as this helps in pivotal role in gathering insights using this data.

The raw data obtained and collected is then uploaded to online data annotation tool named as CVAT. This Computer Vision Annotation Tool helps to annotate the data and convert the raw data to a useful information. This tool provides the output in the YOLO required format as well which helps in ease of operation for the users. Let's understand this YOLO format using an example, consider the following are the some of the labels of an single image

```
1 0.661477 0.523455 0.342703 0.789646
2 0.699660 0.520242 0.600680 0.959517
1 0.503238 0.529180 0.434164 0.779941
```

Fig. 2.1 YOLO Annotation format

This format represents bounding box(x1, y1, x2, y2) which is represented by four values[x_center, y_center, width, height] [5]. Where as the starting index represents the label for that particular bounding box. So let's assume that the index 1 is for label [Nilgiri tahr] and 2 is for label [Indian blue robin]. Now, considering the above example we can understand that in the single image there are two species of animals and that to one of which species consists the count of two. The other four values help in identifying the bounding box around the detected objects.

The next procedure is to integrate the annotated file for multiple animals and form a single file for model training. This integration process helps in forming a single strong model which is capable of detecting various varieties of species using the same model. The only precaution needed to be taken while is that every individual object or entity must have its own different labels. Means that none of the index of the labels should match with the index of the label of other objects. If this index of the labels match with other entities then the model will fail to detect the correct object or animal accurately.

YOLOv8 which represents (You Only Look Once version_8) stands out in the realm of object detection algorithms similar to a vigilant sentinel in a sea of pixels. It is the symphony for real-time object detection while harmonizing precision as well as speed to compose a visual masterpiece. Hence providing the integrated dataset to the YOLOv8 algorithm by training it on specific number of epochs we obtain a model which is capable of detecting the animals precisely on which the model has been trained. As the number of epochs increases the training time also increases gradually but it also shows the growth in the accuracy and precision of the model performance.

The trained model is then further converted into user interactive interfaces using various modern era technologies such as Android studios and Flutter [6]. This helps in converting the model into user usable applications which provides a proper user GUI. This mobile application helps in spreading the presence of the models used for detection of such tasks. The models can be extended in future by adding more variations in the data present while the time of training. Updation of such applications can be a easy task as we just need to change the detection model used in the application [7].

This application helps in the identification of some unique species of various entities which are unknown to everyone. The maintenance of the application also is very essential as it helps in inculcating the addition of newer species to the model, whereas helps in understanding user behavior and updating the user interface in the user required way.

III. BLOCK DIAGRAM

A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks.

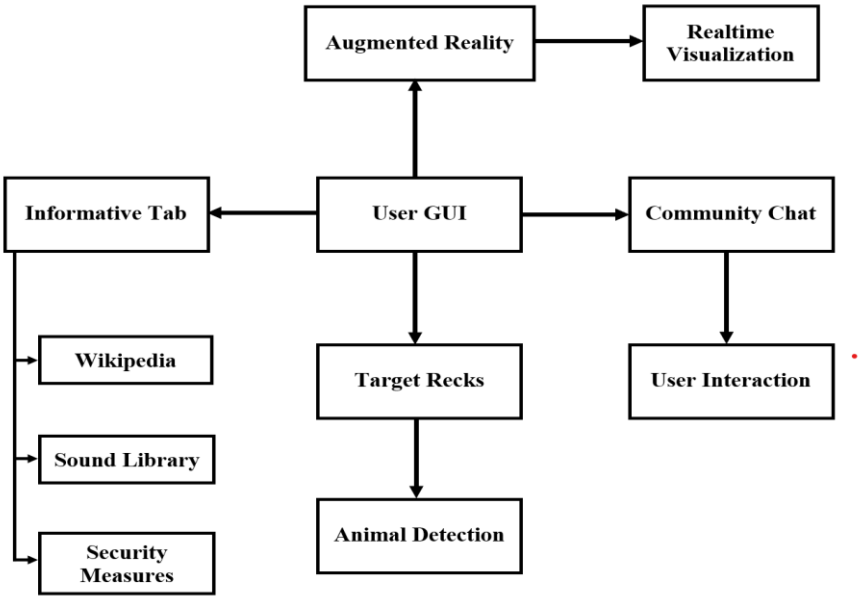

Fig 3.1 TargetRecks Block Diagram

Figure 3.1 depicts the flow of the system by representing how the blocks work together as one. It help to understand the final outcome in the form of an application which helps users to understand the behaviour of different animals and detect some of the extinct species if found in the regions of india.

IV. ADAPTABILITY

The underlying architecture of this framework is inherently flexible, allowing seamless integration with other types of datasets. While the initial focus remains on the distinctive fauna of India, the YOLOv8-CVAT framework can be readily extended to accommodate for many other data just need to train the model with newer data and get ready to localize their elements.

V. TRAINING RESULTS

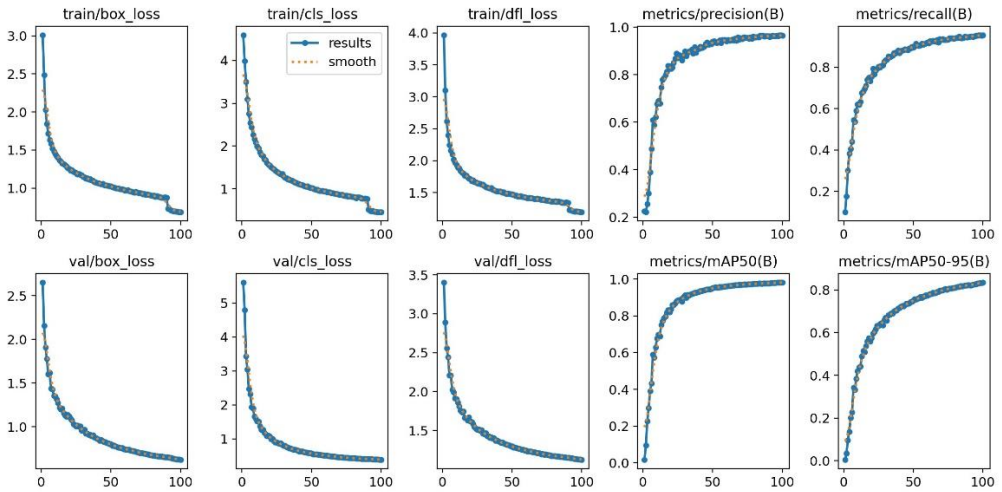

Fig. 5.1: Results of training model

The Results of training model Fig 5.1 presents a comprehensive view of the loss occurred while training the model for 100 epochs. It shows that after every epoch the loss of the model seems to be decrease proportionally. Along with it we can see a significant growth in the precision metrics of the model which tends this model to be accurate after every cycle and prevents the model from catching outsider noise.

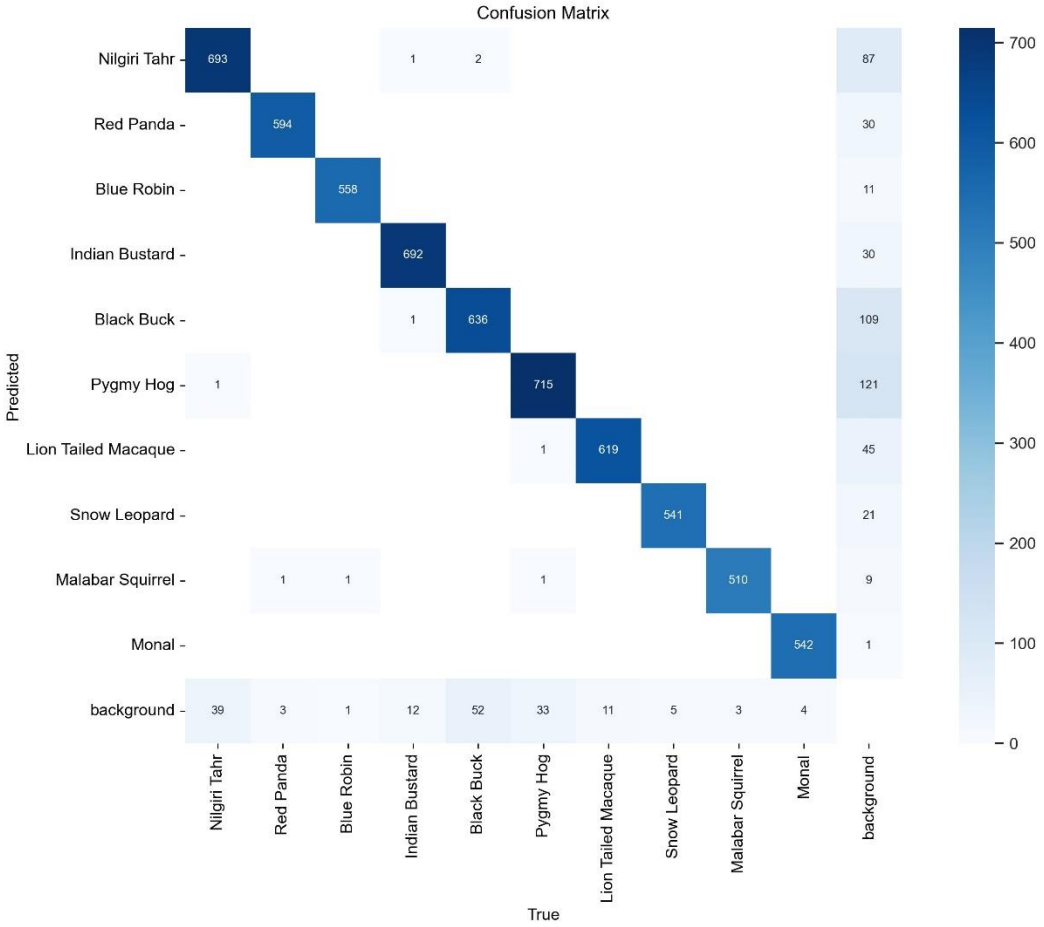

Fig. 5.2: Confusion Matrix

The confusion matrix above Fig 5.1 presents a comprehensive view of the classification performance of a machine learning model for animal detection. It also depicts the names of the animals on which the entire model has been trained. It also represents the background present while the time of training.

VI. Application Results

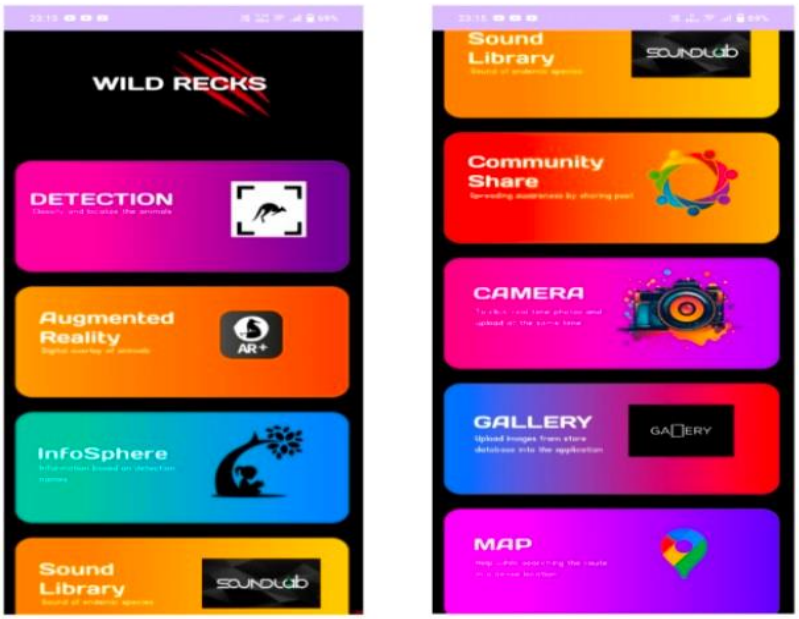

Fig. 6.1: User GUI

Fig. 6.1 shows the user GUI along with the options available for user to detect the animal either in real-time or using media picker from device.

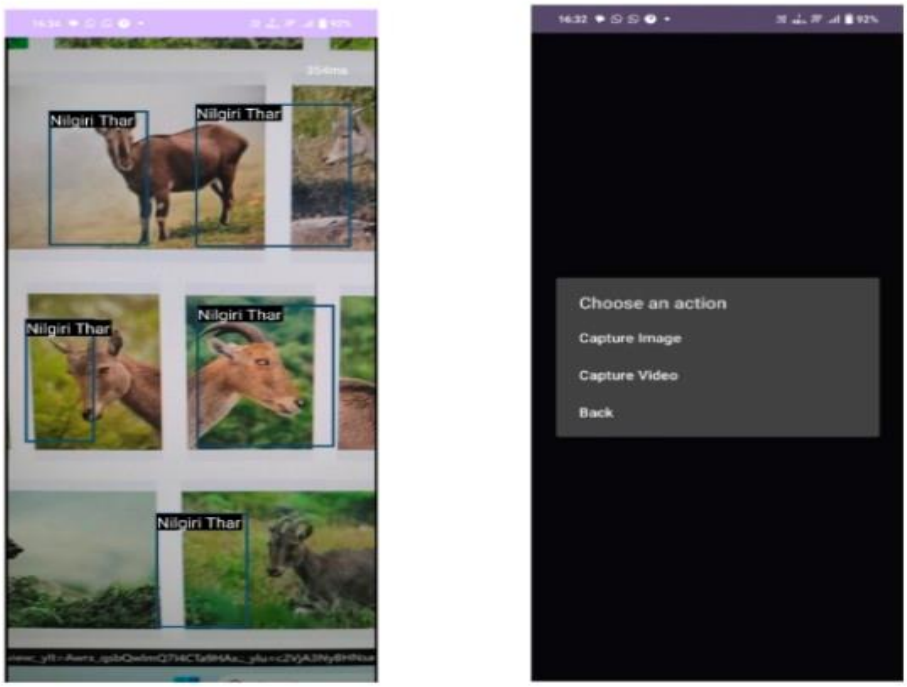

Fig 6.2: Real-time Detection

Fig. 6.2 shows the real-time detection of the animals using the TargetRecks option which uses a trained YOLOv8 model. It also shows the Camera option of the Application.

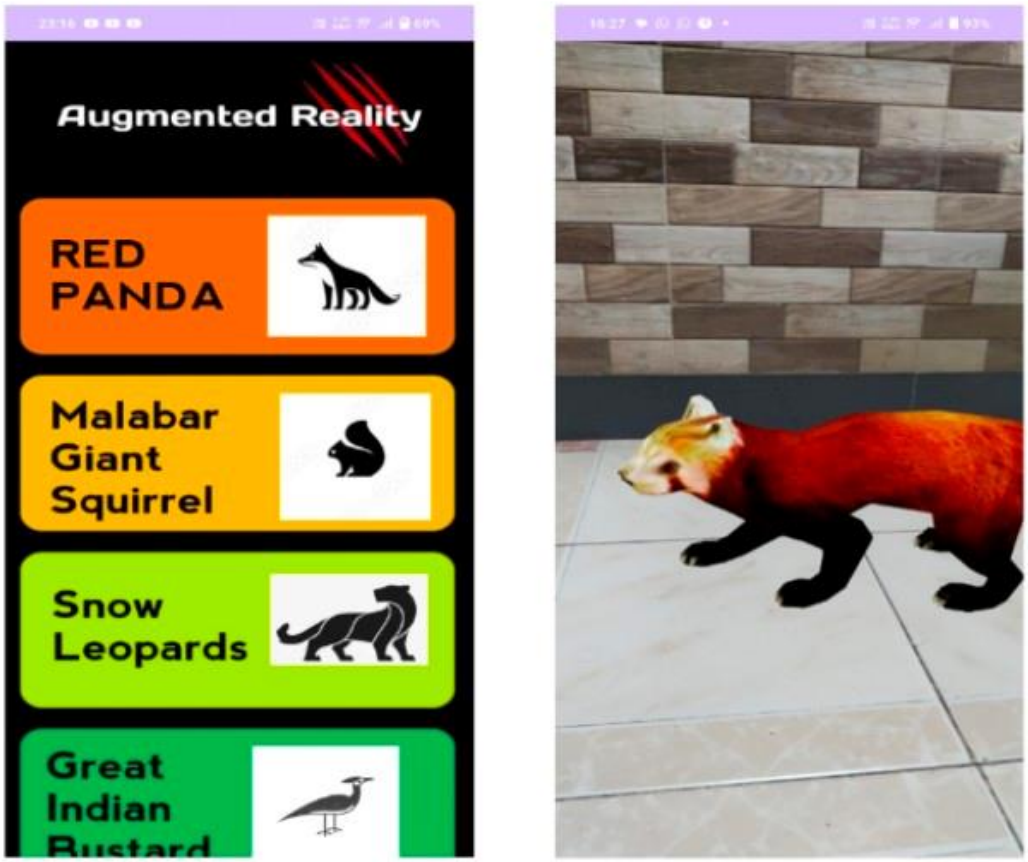

Fig 6.3: Augmented Reality

Fig. 6.3 shows the AR functionality of the proposed system.

VII. CONCLUSION

The YOLOv8-CVAT framework, encapsulated within an Android application, stands as a beacon of technological innovation with successful implementation of YOLOv8-CVAT within an Android application propelled the boundaries of wildlife monitoring but has also laid the foundation for a transformative paradigm in conservation efforts [8]. Initially tailored for Indian exclusive species, reveals its potential for cross-domain application by seamlessly integrating with various other datasets. This work sparks further collaborations, adaptations, and innovations, leading to a future where advanced technology becomes an integral ally in the ceaseless effort to protect and preserve the diverse and unique wildlife that graces our planet.

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