

PakhiderChobi: A Comprehensive Dataset for Real-time Detection of Bangladeshi Birds

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Outline

- (1) Unveiling a comprehensive picture of the study's focus.
- (2) Navigating through existing relevant literature and research.
- (3) Challenges of Bird Identification: Unpacking hurdles in discerning bird species.
- (4) Unveiling the intricacies of gathering and labeling data.
- (5) Detailing the systematic approach adopted in the study.
- (6) Unraveling findings and engaging in insightful analysis.
- (7) Summing up key outcomes and outlining future research paths.

Unveiling a comprehensive picture of the study's focus



- City growth have caused a decrease in the places where birds naturally live, endangering bird diversity globally.
- This research deals with precisely finding and categorizing types of birds, a key part of bird conservation work, specifically focusing on Bangladeshi bird.
- We introduce the **PakhiderChobi dataset**, a collection of **8,670 annotated images featuring 33 natively found Bangladeshi bird species**.

Unveiling a comprehensive picture of the study's focus

- This dataset is specially created to identification of birds in scenarios -
 - where **several birds of the same type are present** in one frame.
 - where **different bird species exist** in one frame.
- To assess the quality of our dataset, we utilize an object detection model, attaining a **mean average precision (mAP) of 95.3%**, with quick **inference times of 6.6 milliseconds per image**.
- Furthermore, this trained model can be utilized for educational purposes as well.

Navigating through existing relevant literature and research

- In recent years, deep learning-based object detection algorithms have excelled in various domains.
- Yet the domain of bird detection and species identification **remains relatively unexplored.**

Navigating through existing relevant literature and research

Study	Year	Dataset Details	Models/Techniques Used	Key Findings
Vo et al.	2023	89,885 images, 525 bird species	YOLOv5 + VGG19, Inceptionv3	Computationally intensive and Impractical
Mirugwe et al.	2022	Observations from six locations	SSD, Faster R-CNN, ResNet50, MobileNet-V2, etc.	Faster R-CNN with ResNet152 for precision
<i>Biswas et al.</i>	2021	<i>Transfer learning with six CNNs</i>	<i>DenseNet201, MobileNetV2, ResNet50, etc.</i>	<i>MobileNetV2 as top performer, no live feed data</i>
<i>Islam et al.</i>	2019	<i>1600 images, 27 bird species</i>	<i>VGG-16, SVM, KNN, Random Forest</i>	<i>SVM max accuracy of 89%, room for improvement</i>
Our Contribution	-	33 classes of Bangladeshi birds	YOLOv8 based Object detection	Comprehensive dataset for real-time identification with a mAP score of 95.3%

Navigating through existing relevant literature and research

- We, Introduce a comprehensive dataset with **8,670 images of 33 classes of common Bangladeshi birds.**
- A valuable resource for **both object detection and image classification.**
- Enables **real-time identification of bird species in natural environments by using State of the art YOLOv8 algorithm released in 2023.**

Challenges of Bird Identification: Unpacking hurdles in discerning bird species.

- **In traditional approach**, a single image where **birds are prominently featured**, is used.
- **In practical**, birds often appear as a relatively **small** object within the entire image.
- Conventional algorithms for image classification/identification are **ill-suited** for real-time bird species identification.
- Algorithms like CNNs, ResNet, or ViTs for classification in real-time faces **Memory constraints**.



Fig: Traditional Approach



Fig: Our (Real World) Approach

Challenges of Bird Identification: Unpacking hurdles in discerning bird species.

- **Conventional datasets** tend to **classifying portrait-style images of birds**, does not align with the natural behavior of many bird species.
- **In actuality**, numerous bird species exhibit communal behavior.
- The **PakhiderChobi** dataset includes multiple images of **birds within the same class, as well as instances where multiple bird species coexist within a single frame**.



Fig: Traditional Approach

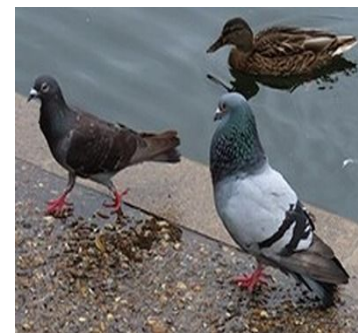


Fig: Our (Real World) Approach

Unveiling the intricacies of gathering and labeling data.

- We focused on **33** frequently encountered bird species native to Bangladesh.
- A total of approximately **22,000 images** were collected, with a focus on preserving class balance.



Fig: Sample Collected Image (Red Vented Bulbul)



Fig: Sample Clicked Image (Indian Pied Starling)

Unveiling the intricacies of gathering and labeling data.

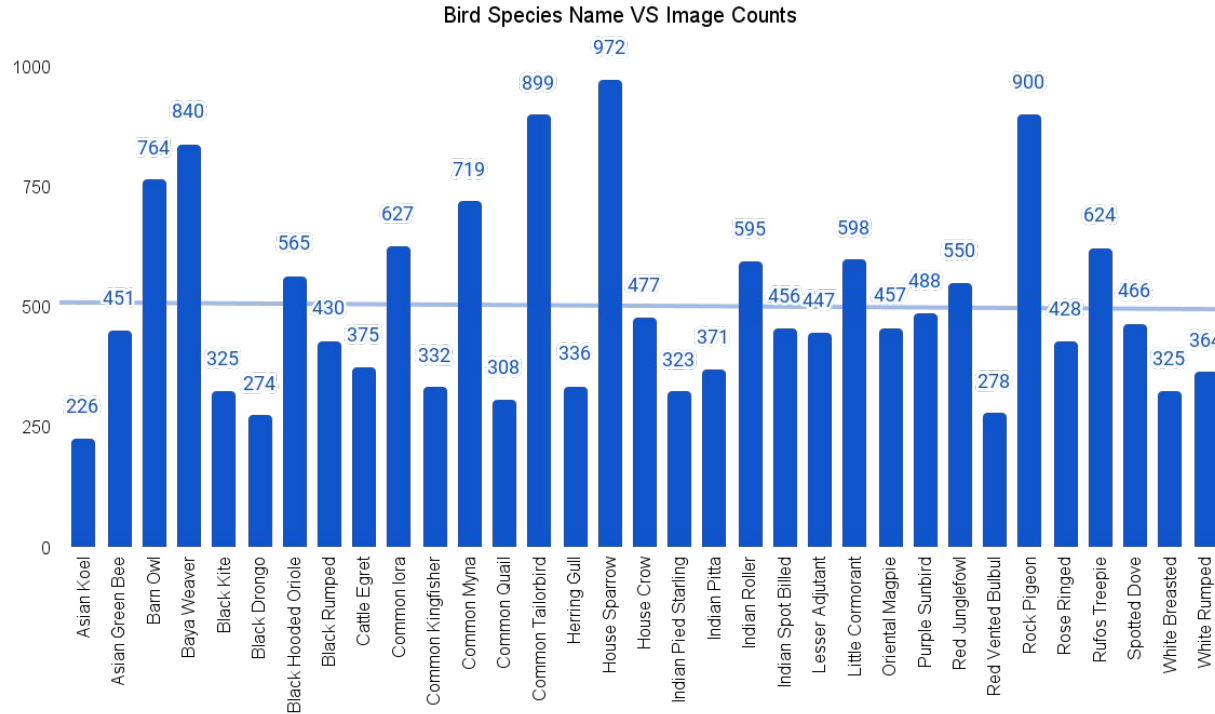


Fig: Bird Species Name VS Image Counts

Unveiling the intricacies of gathering and labeling data.

- The final dataset consisted of **20,837** images, with no augmentation introduced.
- Further annotation was done using “**Roboflow**” platform, employing **bounding boxes** to annotate objects within the dataset.
- A total of **8,670** images were annotated, maintaining class balance of approximately **250 images per class**.



Fig: Sample Annotated Image (Baya Weaver)

roboflow

Fig: Roboflow Platform

Unveiling the intricacies of gathering and labeling data.

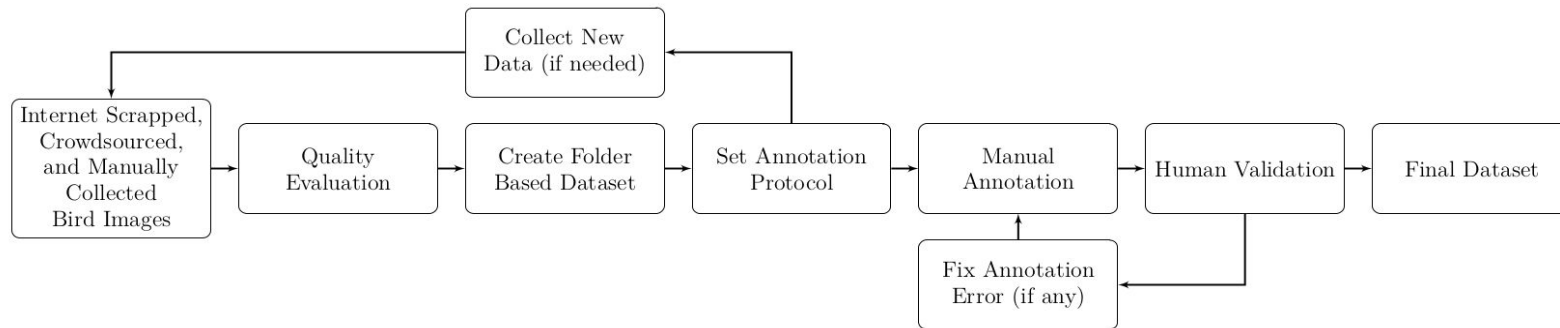


Fig: Data collection and annotation pipeline for the PakhiderChobi dataset

Unveiling the intricacies of gathering and labeling data.

Metric	Value
Images	8,670
Average Image Size	0.17 MP
Annotations	9,518
Annotations per Image (average)	1.1
Classes	33
Median Image Ratio	480x360

Table: Dataset Statistics

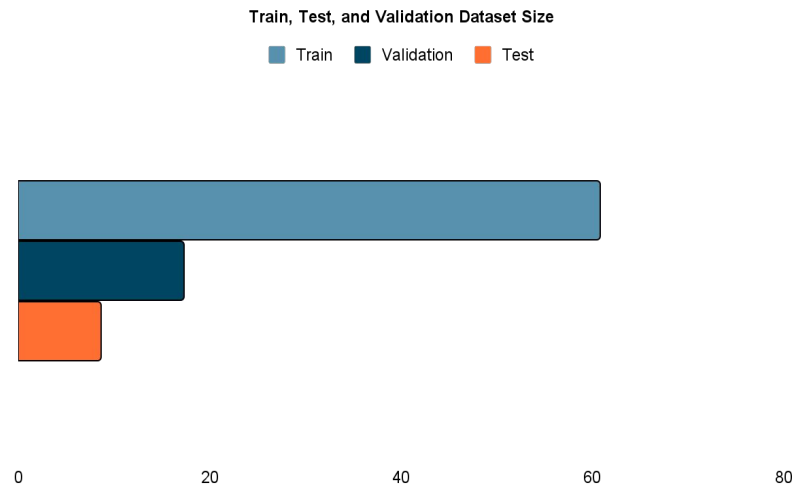


Fig: Dataset Size

Unveiling the intricacies of gathering and labeling data.



Fig: White R. Vulture (Unannotated)



Fig: Indian Pitta (Unannotated)



Fig: Baya Weaver (Unannotated)



Fig: White R. Vulture (Annotated)



Fig: Indian Pitta (Annotated)



Fig: Baya Weaver (Annotated)

Fig: Unannotated VS Annotated Images

Detailing the systematic approach adopted in the study

- You Only Look Once (YOLO), **YOLOv8** model.
- A **state-of-the-art (SOTA)** object detection model introduced in 2023.
- YOLOv8s variant is chosen, featuring 11.2 million parameters is used.

Detailing the systematic approach adopted in the study

- In preprocessing step, **5 types** of augmentations are applied.
- After augmentations the dataset, size became approximately **3x** the original, with a total of **20,832** images.

Augmentation Type	Details
Flip	Horizontal, Vertical
Rotate	90° Clockwise, 90° Counterclockwise, 180° Upside Down
Rotate	-15°, +15°
Shear	±15° Horizontal, ±15° Vertical
Bounding Box	Flip Horizontal, Vertical

Fig: Augmentation Details

Detailing the systematic approach adopted in the study

- For model training, Kaggle cloud **Tesla P100-PCIE-16GB GPU** is utilized.
- The training process spans **50 epochs** and completes in approximately **11 hours**.

Parameter	Value
Batch Size	16
Image Size	800
Pretrained	false
Optimizer	SGD
Warmup Epochs	3.0
Learning Rate	0.01

Table: Training Hyperparameters

Detailing the systematic approach adopted in the study

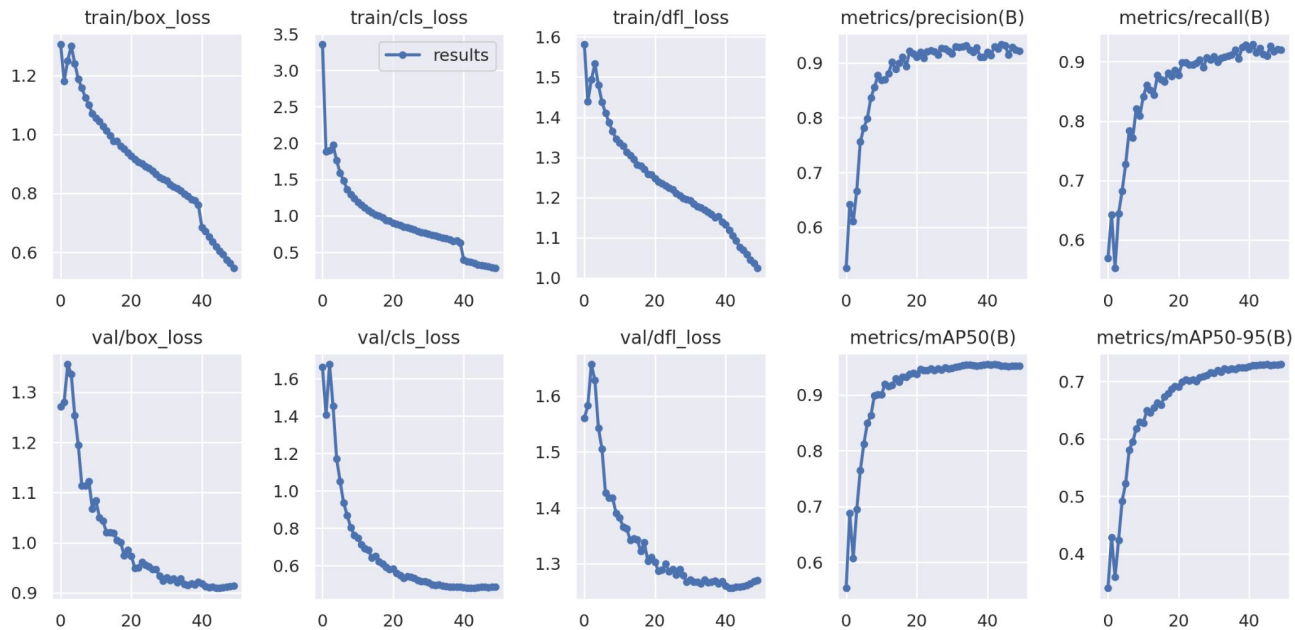
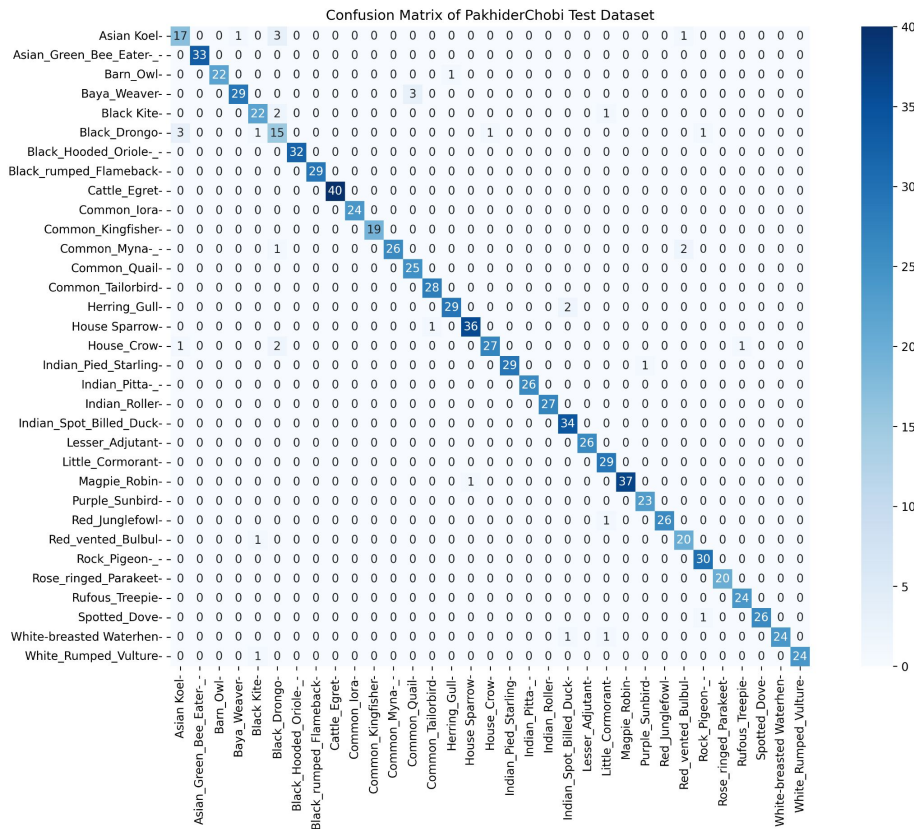


Fig: Model Progression Over Training Epochs

Unraveling findings and engaging in insightful analysis

- The confusion matrix is based on the test set results
- The model achieves a **mean average precision (mAP)** of **95.3%**, with **precision** of **93.2%** and a **recall** of **91.0%** on the **test set**.
- The model exhibits efficient inference times, averaging **6.6 milliseconds** per image.

Unraveling findings and engaging in insightful analysis



Metric	mAP	Precision	Recall
Value	95.3%	93.2%	91.0%

Fig: Model Performance Metrics

Pre-process	Inference	Post-process
0.2 ms/image	6.6 ms/image	1.7 ms/image

Fig: Model Inference Speed Analysis

Fig: Confusion matrix for PakhiderChobi test dataset

Unraveling findings and engaging in insightful analysis

- The **Asian Koel** and **Black Drongo**, both exhibiting **black** plumage and nearly identical sizes, pose a significant challenge for accurate detection.
- The **Baya Weaver** and **Common Quail** share similar coloration, with the Common Quail being larger in size.

Summing up key outcomes and outlining future research paths

- This dataset contains **8,670** meticulously annotated images (**20,832** images with **5** types of augmentation) across **33** distinct classes.
- It encompasses instances of multiple birds within the same class, as well as scenarios where various bird species coexist within a single frame.
- Leveraging the State-of-the-Art (SOTA) YOLOv8 model, and achieved remarkable, mean average precision (mAP) of **95.3%**.
- **Surpassing any existing works in either scale and diversity, result, or inference speed.**

Summing up key outcomes and outlining future research paths

- Exploring the distinctions between **male and female birds** within a species.
- The **Slicing Aided Hyper Inference (SAHI)** algorithm, designed for small object detection, holds potential for further improvement.

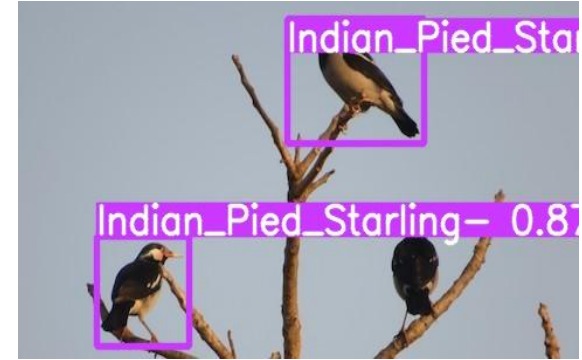


Fig: Male Vs Female Asian Koel

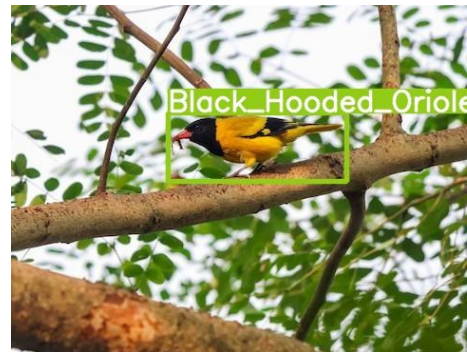
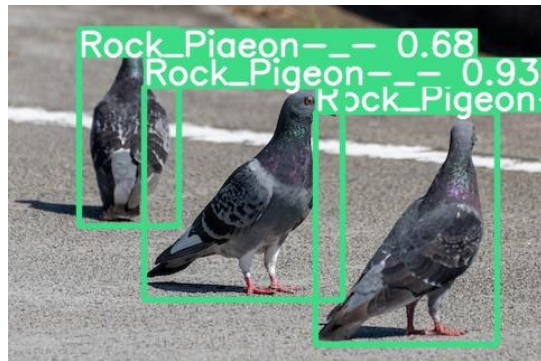


Fig: Male Vs Female Baya Weaver

Demo



Demo



Thank You!

Slides and Code <https://cutt.ly/kwlzJcBh>