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Snake Species Identification

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Background

- Snakebite incidents remain a major health risk, especially in rural areas.
- Delayed or incorrect snake identification leads to improper treatment.
- Existing tools lack intelligent, real-time species recognition.
- AI/ML-powered identification can reduce preventable injury and improve emergency response.

Problem Importance

- Non-experts struggle to differentiate venomous vs. non-venomous species.
- Misinformation during snake encounters increases panic and risk.
- Limited access to snake experts or reliable field guides.
- Automated identification + safety guidance can save lives.

Objectives

- Develop a CNN model to classify snake species from images.
- Automatically determine venomous status.
- Generate a real-time, species-specific safety card.
- Improve public awareness and speed of emergency decision-making.

SDG Relation

SDG 3 – Good Health & Well-being

- Reduce preventable snakebite morbidity through instant guidance.

SDG 9 – Industry, Innovation & Infrastructure

- Apply deep learning for public safety tools and digital resilience.

SDG 11 – Sustainable Cities & Communities

- Promote safer human–wildlife co-existence and community preparedness.

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Data

Data Sources

- SnakeCLEF 2021: 300k+ images, 700+ species globally.
- iNaturalist: Regional snake observations with verified labels.
- HerpMapper: Supplementary local species images.
- Open licensing ensured (CC-BY / CC0).

Data Collection & Cleaning

- Created species list (species_list.csv) to define targets.
- Scripted pipeline: download images, remove duplicates, ensure valid licensing.
- Offline cleaning: PIL.Image.verify(), resize to 256×256, RGB format.
- Runtime cleaning: SafeImageFolder skips corrupted files.

Exploratory Data Analysis (EDA)

- Dataset structure: number of species, images per class.
- Image quality: resolution, lighting, background clutter.
- Detected class imbalance: common vs rare species.
- Outcome: balanced, clean dataset ready for CNN training.

Feature Engineering & Transformation

- Model-based: EfficientNet / MobileNet automatically extract hierarchical features.
- Color augmentation (brightness, contrast, hue).
- Spatial augmentation (flip, crop, rotation).
- Normalize using ImageNet mean/std.
- Convert images to tensors for CNN input.

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Model

Model Selection

- MobileNetV3-Small: lightweight, fast, good for edge deployment.
- EfficientNet-B0: higher accuracy, balanced compute requirements.
- Strengths: small size, fast inference, easy ONNX export.
- Weaknesses: may underfit fine-grained species cues; sensitive to resolution.

Model Training

Two-stage transfer learning:

- Head Training: train only classification head, backbone frozen.
    - LR: 1e-3, AdamW, Cross-Entropy, 10 epochs.
- Fine-Tuning: unfreeze last backbone block.
    - LR: 5e-4, 5 epochs minimum 2.

Data: processed images, augmented, train/val split 80/20.

Batch size: 64

Model Refinement

- Stronger augmentations, SafeImageFolder for robustness.
- Partial fine-tuning of EfficientNet-B0 / MobileNetV3-Small.
- Learning rate schedule: head 1e-3 → fine-tune 5e-4.
- Batch size tuned (32–64), no full k-fold CV due to time constraints.

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Result

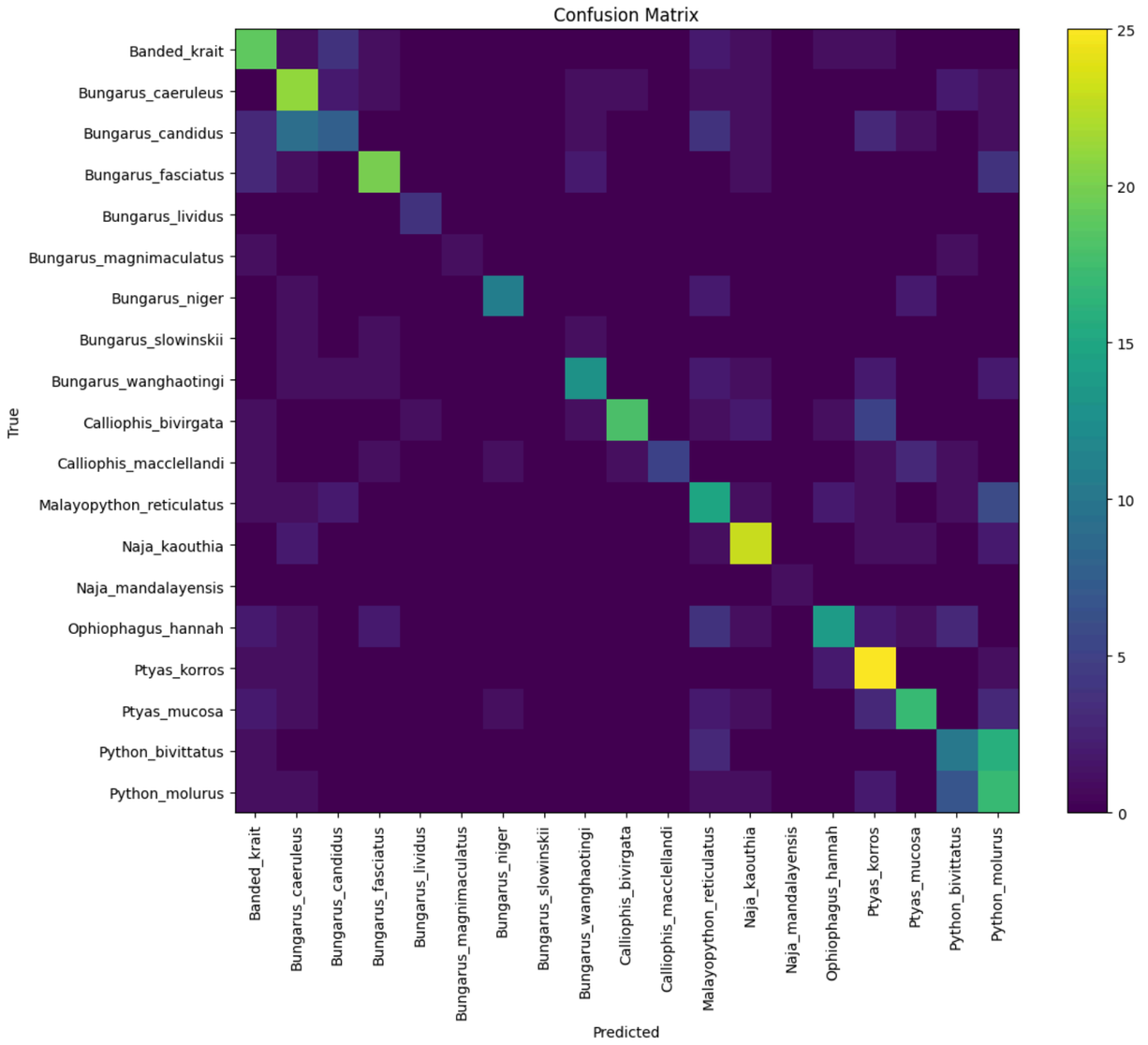
Model Evaluation

```
Test Accuracy: 0.5667

Classification Report:
                          precision    recall  f1-score

            Banded_krait       0.53      0.63      0.58
      Bungarus_caeruleus       0.50      0.68      0.58
       Bungarus_candidus       0.47      0.26      0.33
      Bungarus_fasciatus       0.74      0.65      0.69
        Bungarus_lividus       0.80      1.00      0.89
 Bungarus_magnimaculatus       1.00      0.33      0.50
          Bungarus_niger       0.85      0.69      0.76
     Bungarus_slowinskii       0.00      0.00      0.00
   Bungarus_wanghaotingi       0.68      0.57      0.62
    Calliophis_bivirgata       0.90      0.60      0.72
 Calliophis_macclellandi       1.00      0.36      0.53
Malayopython_reticulatus       0.39      0.50      0.44
           Naja_kaouthia       0.68      0.77      0.72
      Naja_mandalayensis       1.00      1.00      1.00
      Ophiophagus_hannah       0.70      0.47      0.56
            Ptyas_korros       0.54      0.83      0.66
            Ptyas_mucosa       0.68      0.57      0.62
       Python_bivittatus       0.40      0.33      0.36
          Python_molurus       0.32      0.57      0.41
...
```

- Metrics: accuracy, precision, recall, F1-score (macro and weighted), confusion matrix.

Evaluation Results

- High Accuracy for most species, confirmed by bright yellow cells along the diagonal.
- The model struggles to differentiate species within the Bungarus (Kraits) genus.
- Misclassifications are observed between Python_molurus and Python_bivittatus.



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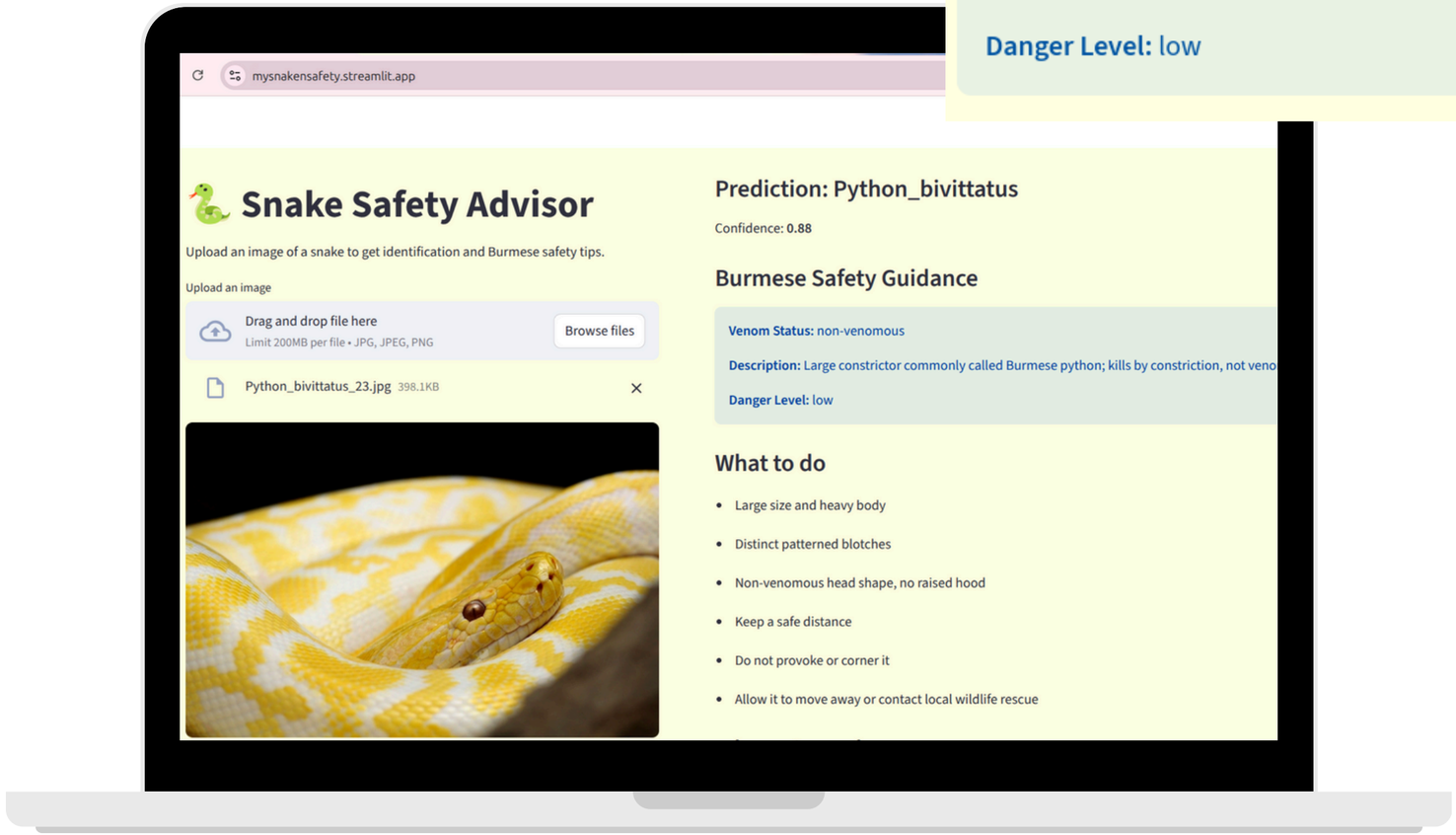
Deployment



Venom Status: non-venomous

Description: Large constrictor commonly called Burmese python; kills by constriction, not venom.

Danger Level: low

What to do

- Large size and heavy body
- Distinct patterned blotches
- Non-venomous head shape, no raised hood
- Keep a safe distance
- Do not provoke or corner it
- Allow it to move away or contact local wildlife rescue

What NOT to do

- Do not attempt to catch or handle
- Do not poke or throw objects at it
- Do not separate from young if found with them
- If bitten: wash wound with soap and water
- Apply clean dressing

Deployment Overview

- Trained snake ID models exported to ONNX with dynamic batch axes for flexible inference.
- Class metadata (artifacts/class_map.json) preserved for consistent label mapping.
- Artifacts enable drop-in integration: HTTP API, batch scripts, or edge inference.
- Supports CPU-only deployment, cloud, on-prem, or embedded edge devices.

API Integration

- POST /predict endpoint accepts image upload (multipart/base64).
- Returns JSON: top-k species + probabilities.
- Stateless server; class mapping ensures consistent outputs.

Security & Monitoring

- Authentication & authorization (API keys / OAuth2).
- TLS for transport security.
- Rate limiting & request size checks.
- Monitor latency, throughput, error rates, confidence distributions.

Challenges & Mitigation

Bungarus Species

Challenges & Mitigation

- Class imbalance → augmentation & sampling.
- Visual features → similarity in Color bands, Head shape, Body texture
- Fine-grained species cues → partial fine-tuning.
- Real-time inference → ONNX + efficient preprocessing.

Conclusion

- Introduces an AI-driven solution for snakebite safety.
- Bridges the gap between research and real-world emergency response.
- Provides fast, reliable, species-based safety instructions.
- Supports SDGs and public health resilience.

Future Work

- Expand species coverage and regional datasets.
- Data preprocessing and augmentation improved generalization.
- Add video-based recognition for live encounters.
- Refine first-aid safety card with richer protocols.
- ONNX export & optional INT8 quantization enables real-world inference.

Thank you!

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