Pimpri Chinchwad College of Engineering

FY MTech 2025-26

SUBJECT- DEEP LEARNING

FORMATIVE ASSESSMENT- II

FAKE CURRENCY PREDICTION

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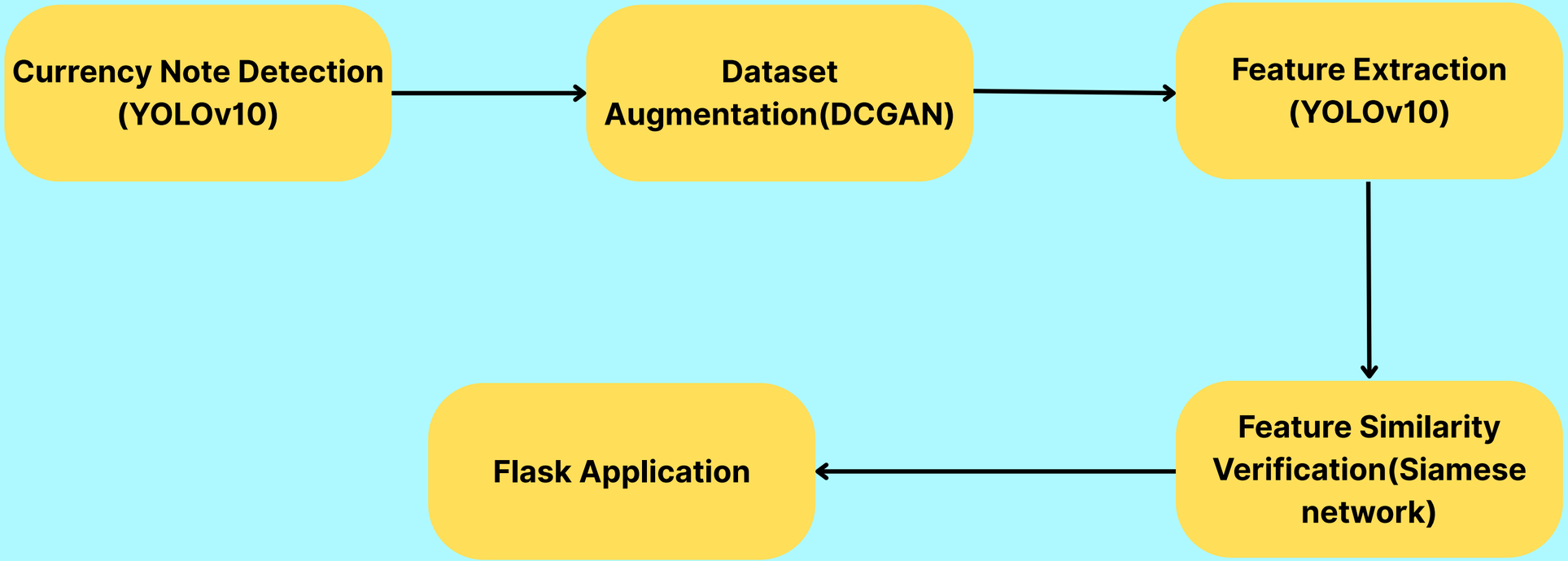
Contents-

Objectives-

- To design, implement, and evaluate a deep-learning based system for detecting fake Indian currency.
- To apply YOLOv10, DCGAN, and Siamese networks for note detection, feature extraction, dataset augmentation, and similarity scoring.
- To deploy the complete pipeline through a Flask web interface for real-time prediction.

Project Workflow-



YOLOv10 Architecture-

Neck(Multi-scale feature aggregation)

Head(Bounding box+ class predictions)

Backbone(Feature Extraction)

Used for->

Currency note detection

Feature detection

Trained for 50 epochs on custom annotated dataset
Outputs: best.pt model for inference

DCGAN Architecture-

Generator

- Converts 100-dim noise → 64×64 RGB image
- ConvTranspose2D + BatchNorm + ReLU
- Final Tanh output

Discriminator

- Conv2D → BatchNorm → LeakyReLU
- AdaptiveAvgPool2D + Sigmoid
- Performs real vs fake classification

Purpose

- Augment dataset from 200 → 5000 feature images
- Improves robustness of Siamese model

Siamese Network Architecture-

Shared CNN Encoder	3 Conv layers → Flatten → Dense(128)
L1 Distance Layer	Computes |EmbeddingA - EmbeddingB|
Similarity Classifier	Dense(1) + Sigmoid
Output	Probability of feature match (Real vs Fake)

Flask Integration-

- Loads YOLO best.pt and Siamese .keras model
- User uploads a note image
- YOLO detects 3 features
- YOLO crops passed into Siamese
- Siamese compares with reference genuine samples
- Final output: REAL or FAKE with bounding box display
- Provides complete end-to-end deployment

Experimental Innovations-

- Multi-stage hybrid deep learning system
- Feature-level analysis instead of whole-image classification
- GAN-augmented dataset improves generalization
- Siamese network captures subtle feature differences
- Real-time prediction via lightweight Flask interface

Results: Note Detection
YOLOv10 performance:

- mAP50 = 0.982
- mAP50–95 = 0.946
- Precision = 0.994, Recall = 0.982

- Very high accuracy for note localization
- Fast inference (0.7 ms/image)
- Strong baseline for feature extraction

Feature Detection Overall metrics:

mAP50 = 0.992
mAP50–95 = 0.899

Class-wise:
Watermark: P = 0.994, R = 1.0, mAP50 = 0.995
Thread: P = 0.942, R = 0.953, mAP50 = 0.988
Number Panel: P = 0.978, R = 0.966, mAP50 = 0.993

Effective fine-grained detection of security features

Results: Siamese Network-

- Trained for 15 epochs
- Accuracy improved from 0.558 → 0.903
- Training loss reduced from 0.697 → 0.234
- Successfully learned discriminative embeddings
- Reliable for genuine vs forged feature comparison

Visualization Results-

Fake Note Detector

Choose File | No file chosen

Upload & Detect

Uploaded Image:

Detected Features (YOLO bounding boxes):

Feature Results:

Uploaded Image:

Detected Features (YOLO bounding boxes):

Feature Results:

Feature	Similarity Score	Status
watermark_window	0.3791	FAKE
security_thread	0.127	FAKE
number_panel	0.357	FAKE

FAKE NOTE

Future Scope-

- Extend to more denominations and global currencies
- Add more security features (micro-lettering, latent image, OVI ink)
- Replace Siamese with transformer-based similarity model
- Deploy as a mobile app using ONNX/TensorRT
- Implement self-learning (continuous addition of new fake patterns)

Conclusion-

- Developed a reliable, real-time fake currency detection system
- YOLOv10 provided high accuracy for notes and features
- DCGAN improved dataset diversity and robustness
- Siamese network enabled fine-grained similarity checking
- Flask deployment made the system user-friendly and practical
- Demonstrates the effectiveness of a multi-stage deep learning pipeline

THANKYOU