



# **Counterfeit Detection of Bangladesh Banknotes**

# Team AM



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# Introduction to Counterfeit Detection

Counterfeit currency threatens economic stability by reducing trust in financial systems and contributing to inflation. In Bangladesh, the growing circulation of fake banknotes has become a serious concern. This project addresses the issue using machine learning to enhance the accuracy of counterfeit detection. It aims to mitigate financial losses and stabilize the economy by ensuring currency integrity.

## Economic Impact

Counterfeit currency undermines trust in financial systems and contributes to inflation.

## Bangladesh's Challenge

The growing circulation of fake banknotes in Bangladesh is a serious concern.

## Machine Learning Solution

This project utilizes machine learning to enhance the accuracy of counterfeit detection.



# Problem Statement

Counterfeit notes result in economic losses, inflation, and instability, undermining trust in financial systems in Bangladesh. A 2016 study indicated that 40% of individuals could not differentiate between genuine and counterfeit banknotes, highlighting a crucial gap in public awareness and detection mechanisms.

1

## Economic Losses

Counterfeit notes lead to financial losses for businesses and individuals.

2

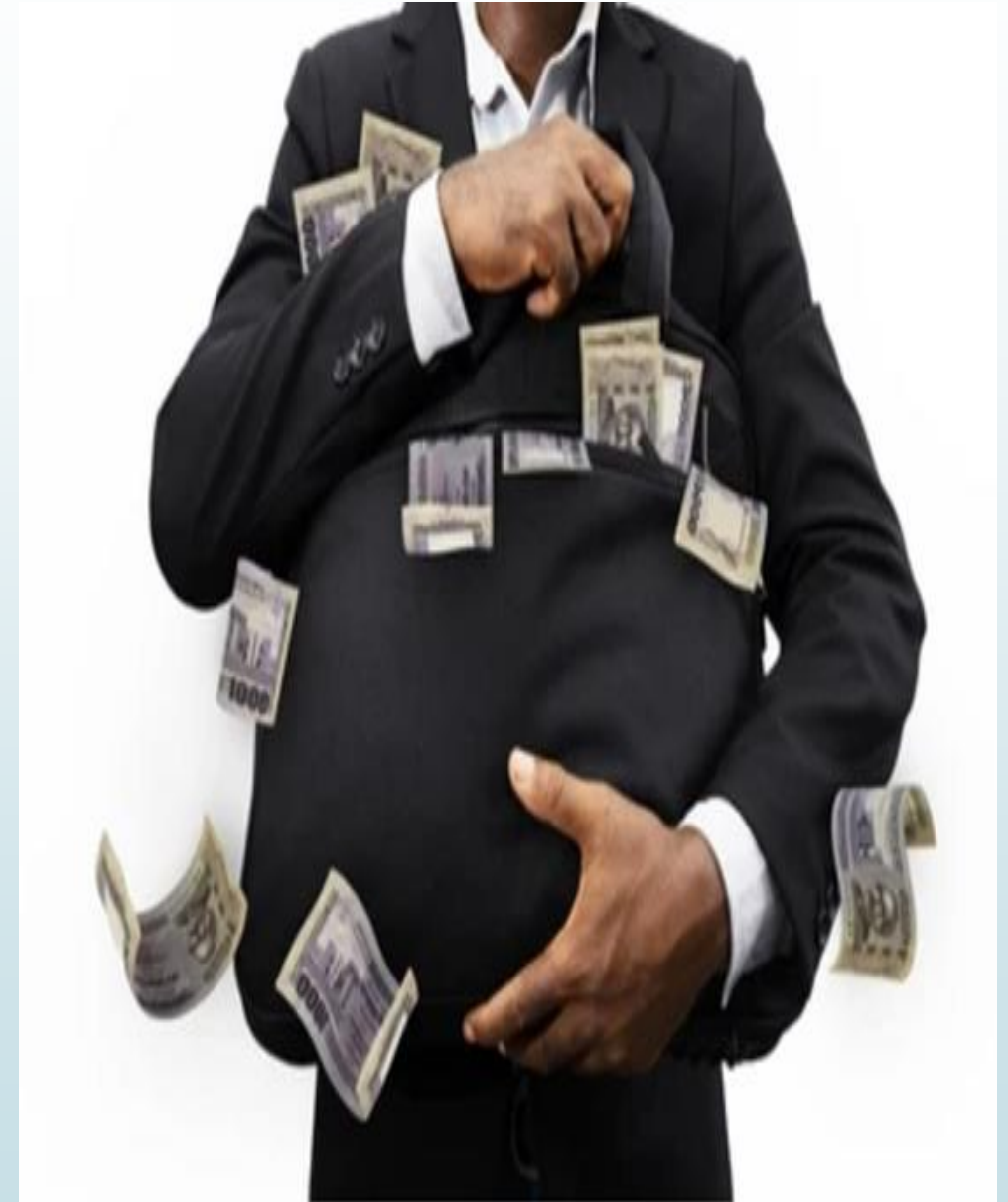
## Inflation

The circulation of fake currency contributes to inflation, eroding the value of money.

3

## Public Awareness Gap

A significant portion of the population lacks the knowledge to distinguish between genuine and counterfeit banknotes.



# Objectives of the Project

## Counterfeit Detection System

Develop a reliable, web-based system for detecting counterfeit banknotes using machine learning algorithms.

## User Empowerment

Provide users with accessible tools to easily verify the authenticity of currency.

## Economic Security

Enhance economic security by mitigating financial losses, reducing the circulation of counterfeit currency, and fostering trust in the financial system.

## Detect Banknote

### Note Detection

Upload an image of the banknote to check its authenticity.

Browse... Fake\_1000Note\_2.jpeg



Check Authenticity

**Prediction Result:**

**Your Bank note is Counterfeit**





# Importance of Detection

1

## Economic Stability

Accurate detection of counterfeit notes is essential for maintaining financial stability and preventing economic disruptions.

2

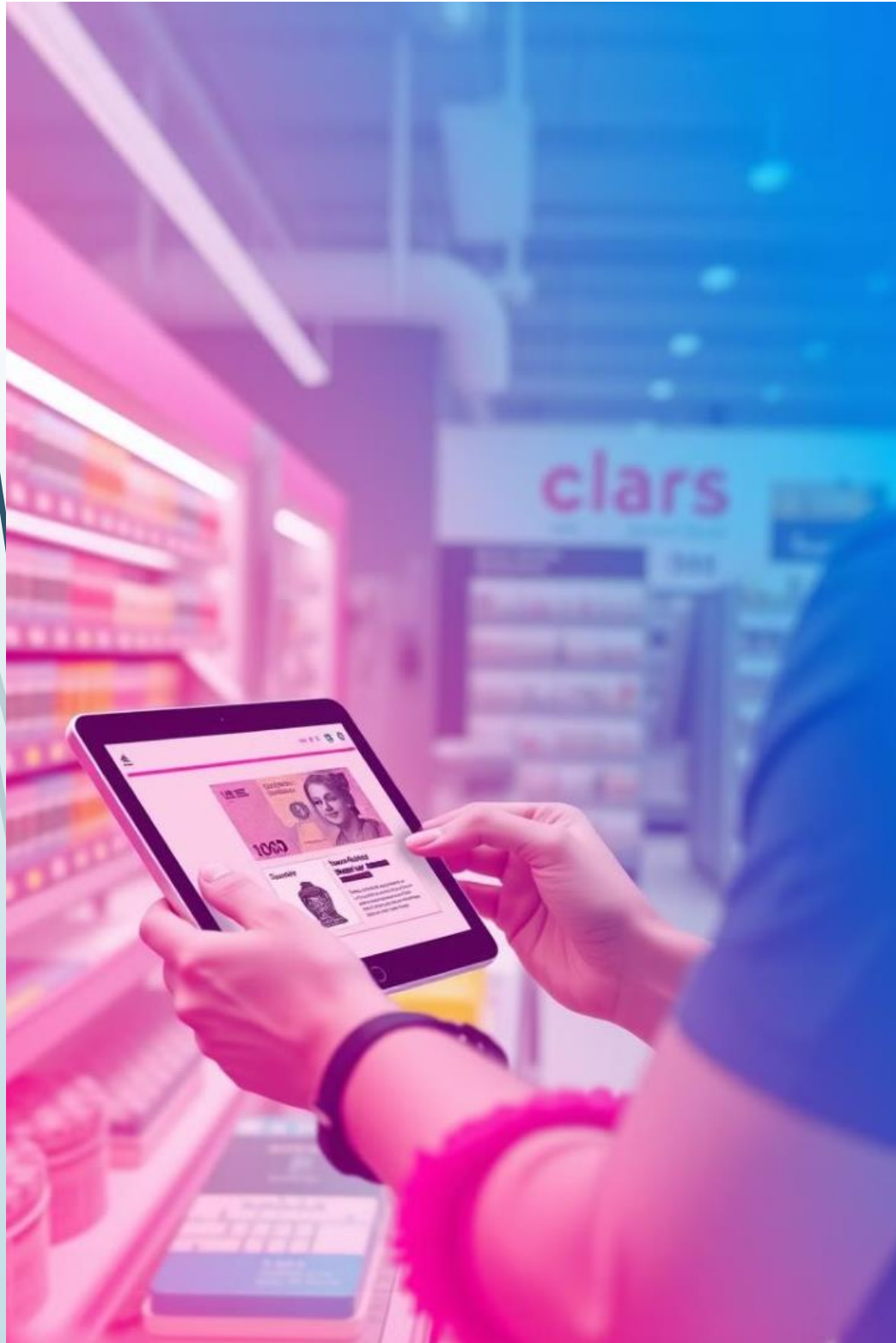
## Public Trust

Effective detection systems enhance public trust in the integrity of the financial system, reducing anxiety and promoting confidence in the economy.

3

## Security Measures

Reliable detection mechanisms bolster security measures, making it more difficult for counterfeiters to operate and circulate fake currency.



# Application in Real Life: Impact and Use Cases



## Banking

The system can be integrated into bank branches and ATMs to enhance security measures during cash transactions.



## Retail

Businesses can use the system to verify high-value banknotes at point-of-sale terminals, mitigating financial risks.



## Individuals

Individuals can utilize the application to verify banknotes received, empowering them to make informed decisions about financial transactions.

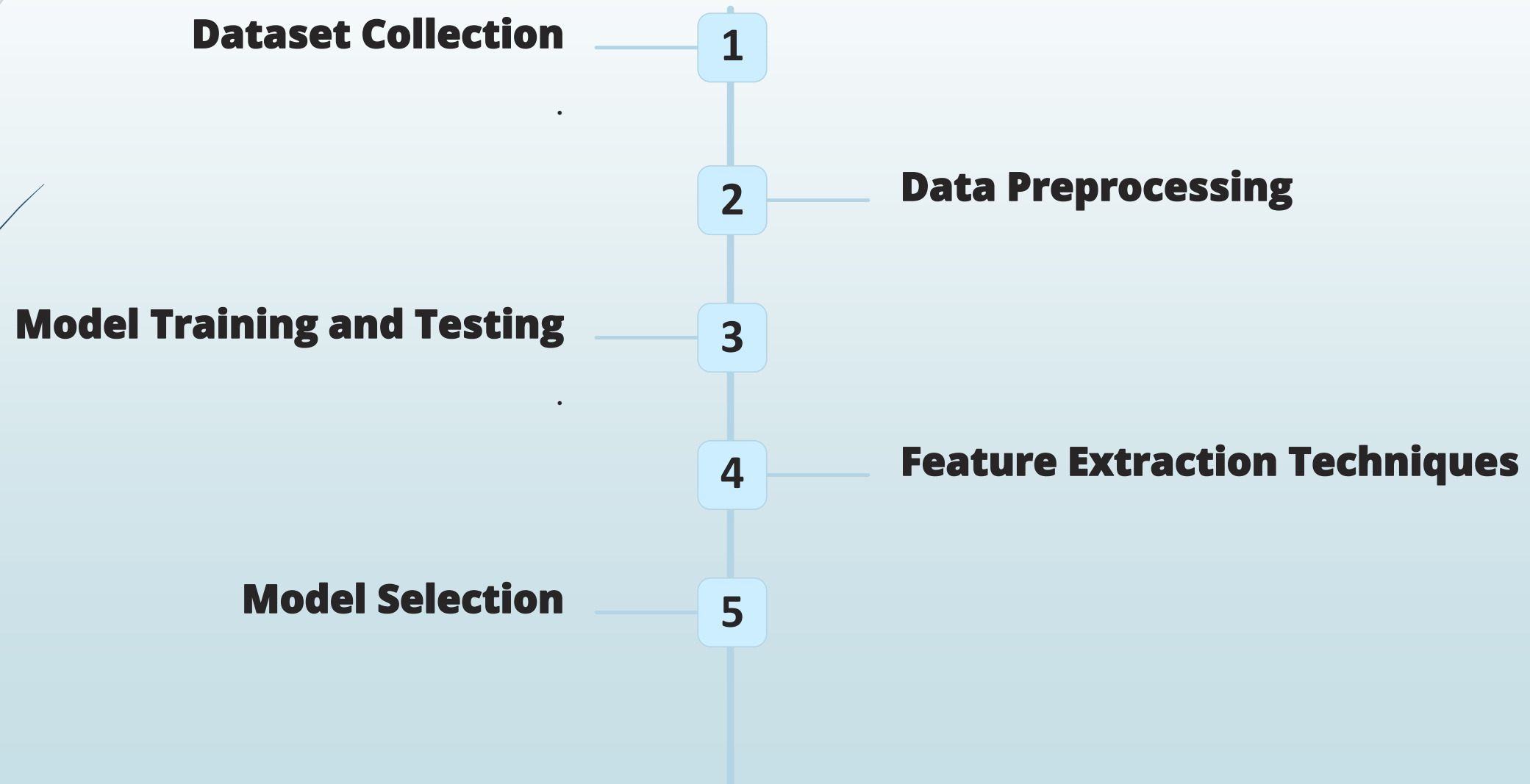


## Law Enforcement

The application can aid law enforcement agencies in detecting and managing the circulation of counterfeit notes.

# Methodology and Implementation

The project employs a comprehensive methodology involving dataset collection, data preprocessing, model training and testing, feature extraction techniques, and model selection.





# Dataset Collection



A dataset of 2,280 images was compiled, consisting of authentic and counterfeit Bangladeshi banknotes. After data augmentation, the total increased to 9,120 images, split into two categories: 500 Taka and 1,000 Taka notes.



Category	Initial Images	Augmented Images
Authentic	1,140	4,560
Counterfeit	1,140	4,560

# Data Preprocessing

Data preprocessing included cleaning and normalizing images to ensure consistency. Techniques such as Gaussian Blur were applied for noise reduction, while images were resized for uniformity in model training.



## Image Cleaning

Removing noise and artifacts from the images.



## Image Normalization

Adjusting the brightness, contrast, and color balance of the images.

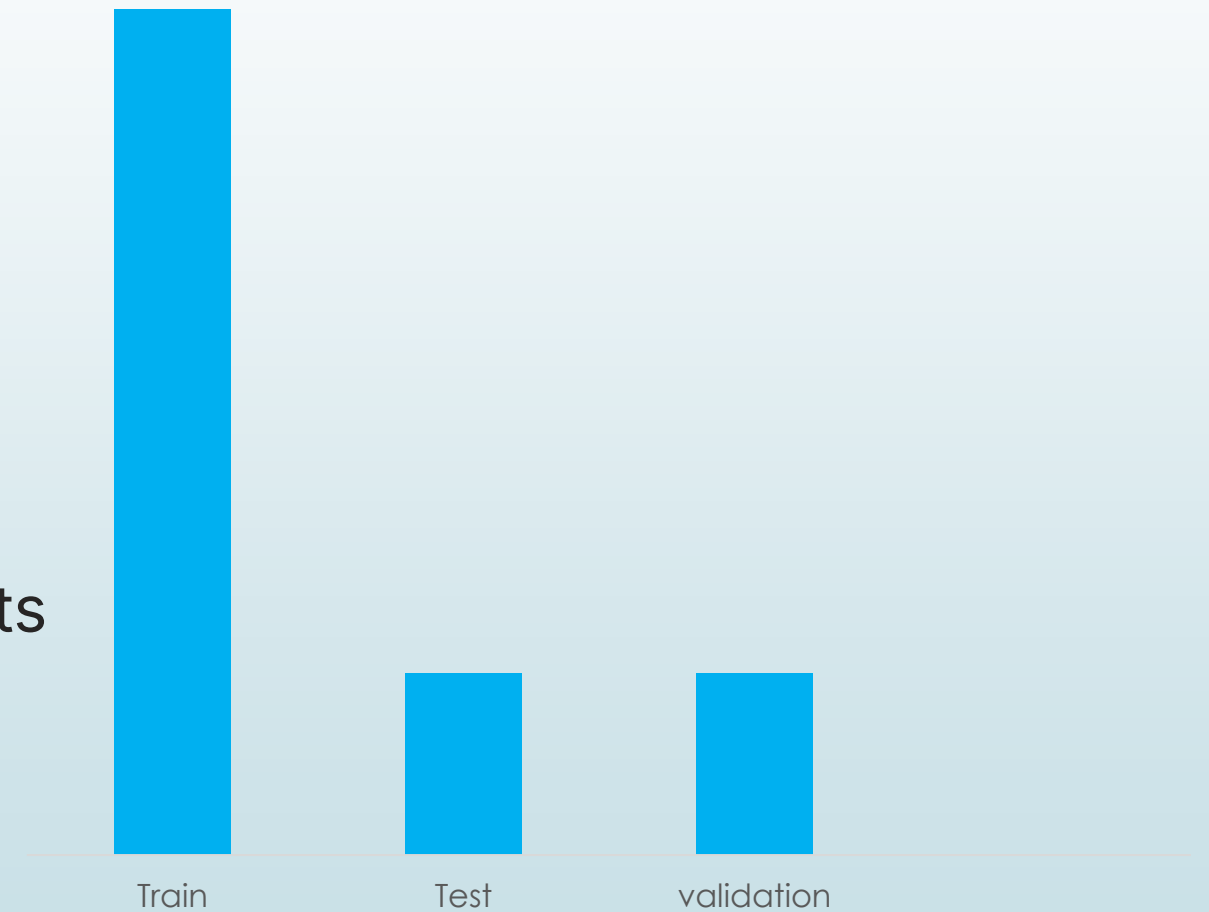


## Image Resizing

Ensuring all images have the same dimensions for consistent model training.

# Model Train and Testing

The training process involved splitting the dataset into train (70%), testing (15%), and validation (15%) sets. The MobileNet model achieved an impressive accuracy rate of 99.08% after rigorous testing, showcasing its reliability in detecting counterfeit notes.





# Feature Extraction Techniques

Feature extraction was performed to identify key attributes of the banknotes, including microprinting, watermarks, and iridescent inks. Using CNN, crucial features were automatically learned without manual intervention, ensuring heightened accuracy in detection.

1

## Microprinting

The model learns to identify the intricate patterns and details of microprinting on the banknotes.

2

## Watermarks

The model extracts features related to the watermarks embedded in the banknotes.

3

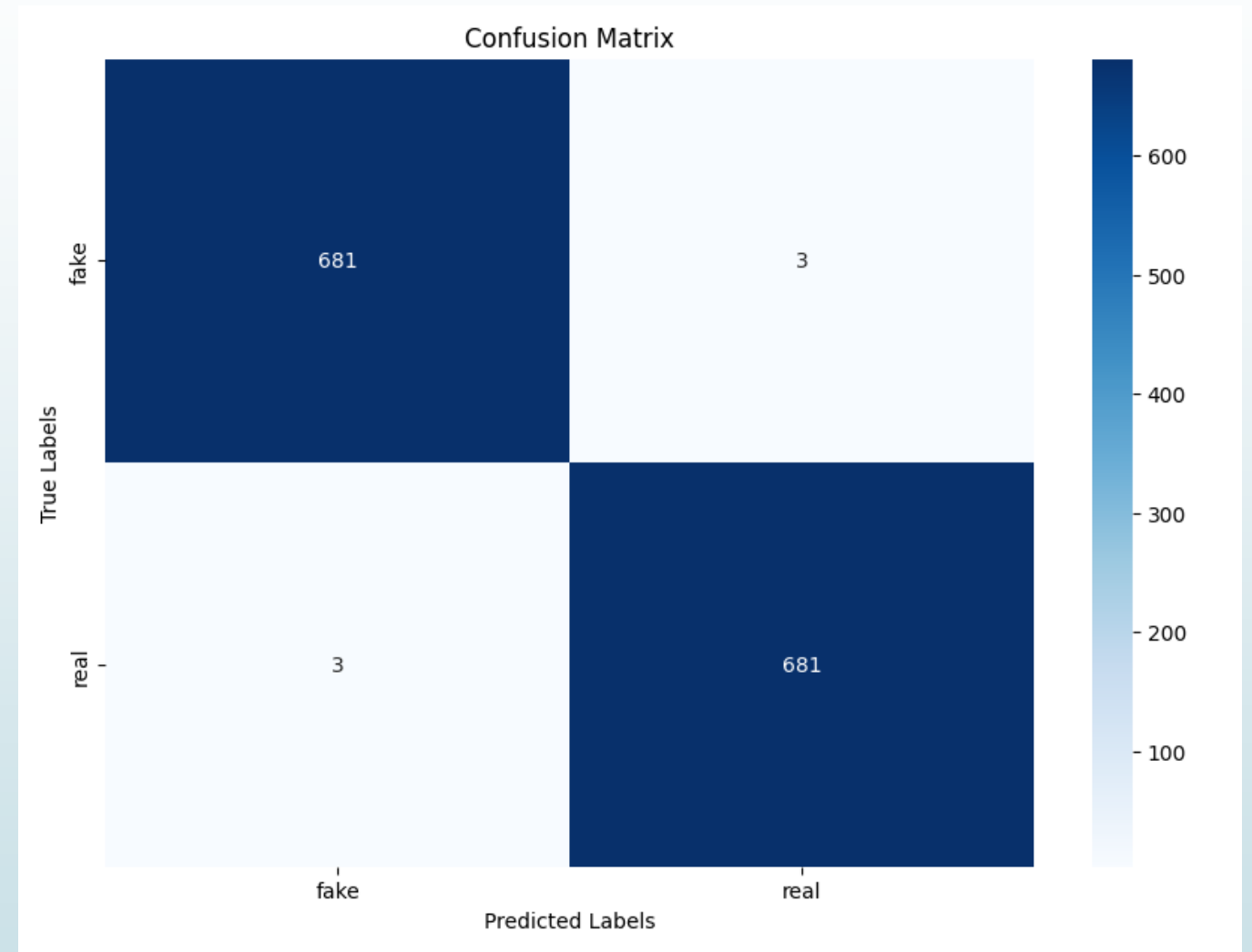
## Iridescent Inks

The model learns to recognize the unique characteristics of iridescent inks used in the banknotes.

# Results and Impact Analysis

## 1 Performance Metrics Overview

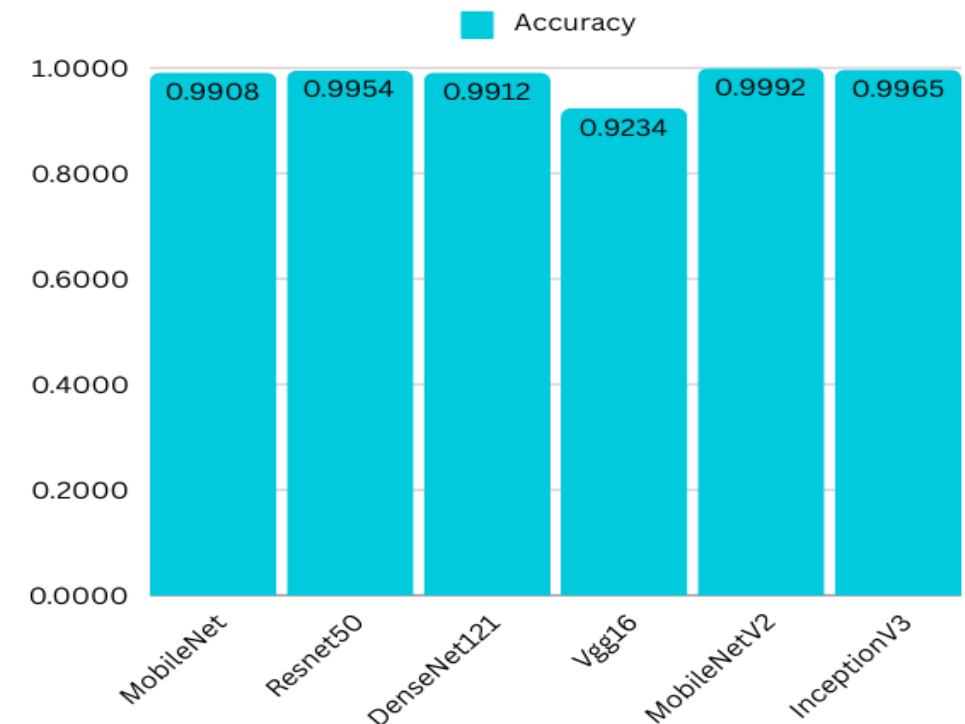
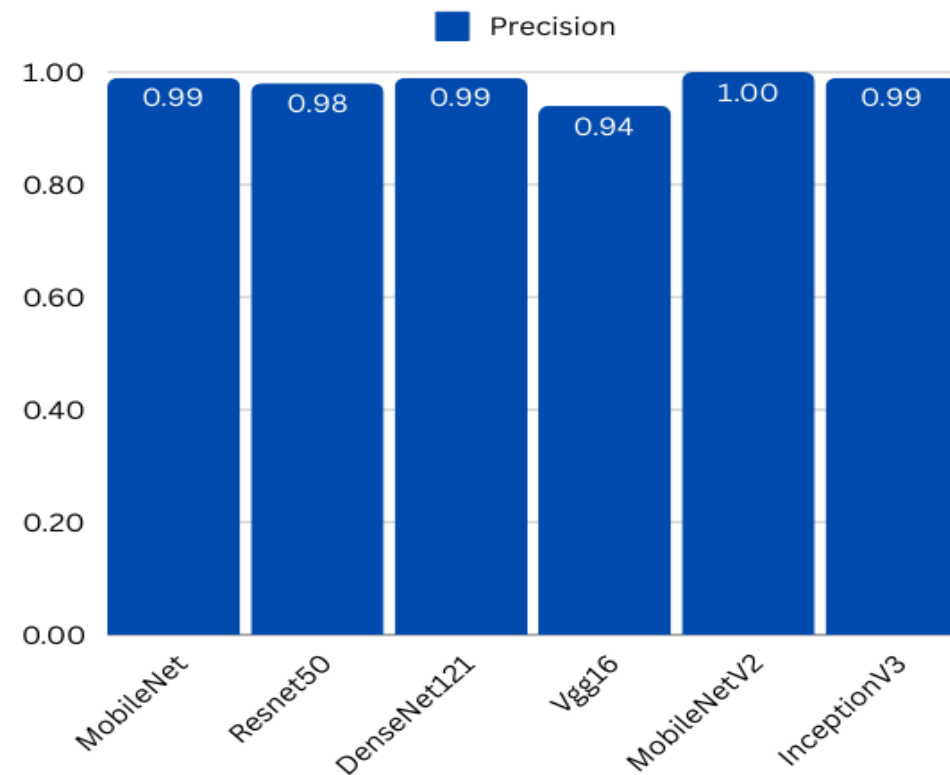
The models' performance was measured using metrics including accuracy, precision, and recall. These indicators are essential for understanding the model's ability to correctly classify genuine and counterfeit banknotes, ultimately guiding improvements in the detection process.



# Results and Impact Analysis

## 2 Accuracy and Precision Analysis

The model achieved an impressive accuracy rate of 99.08% using the MobileNet architecture. Precision metrics indicated that the model effectively minimizes false positives, which is critical in maintaining trust in the detection system and ensuring user confidence.





# Results and Impact Analysis

## 3 Comparative Model Performance

A comparison of several machine learning models, including MobileNet, ResNet50, and DenseNet121, reveals varying performance levels. While MobileNet achieved 99.08% accuracy, ResNet50 excelled with a 99.54% accuracy rate, highlighting the trade-offs between model complexity and performance.

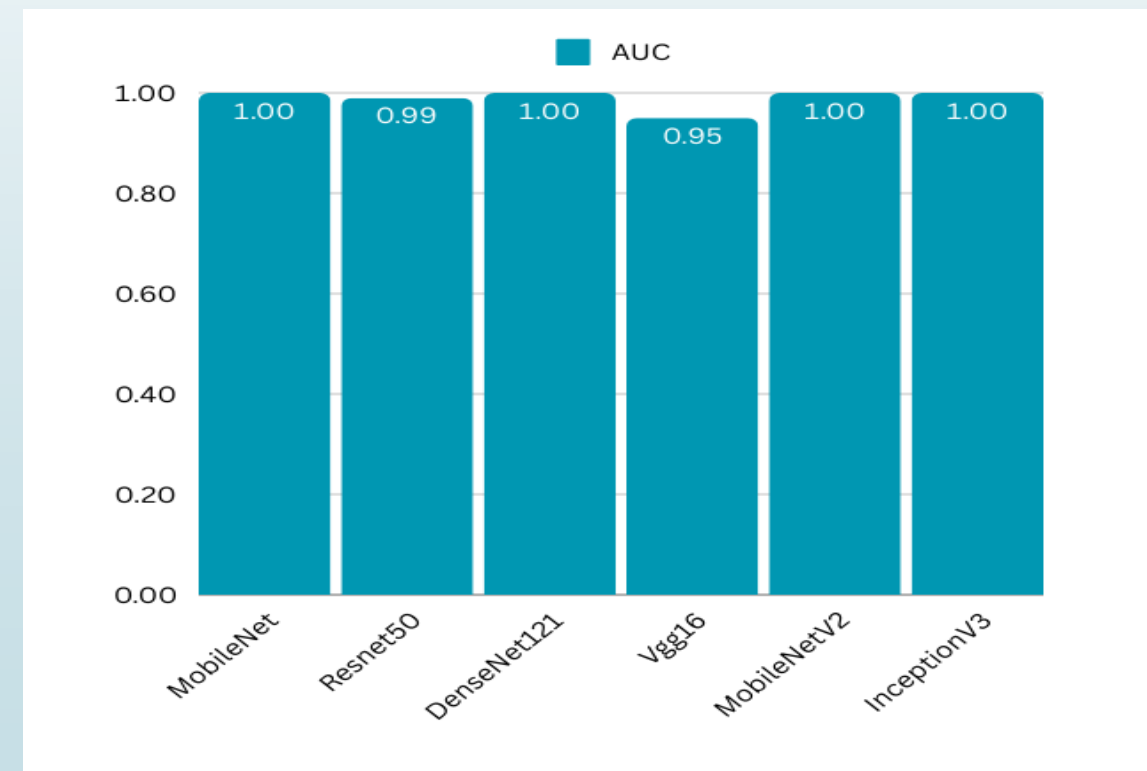
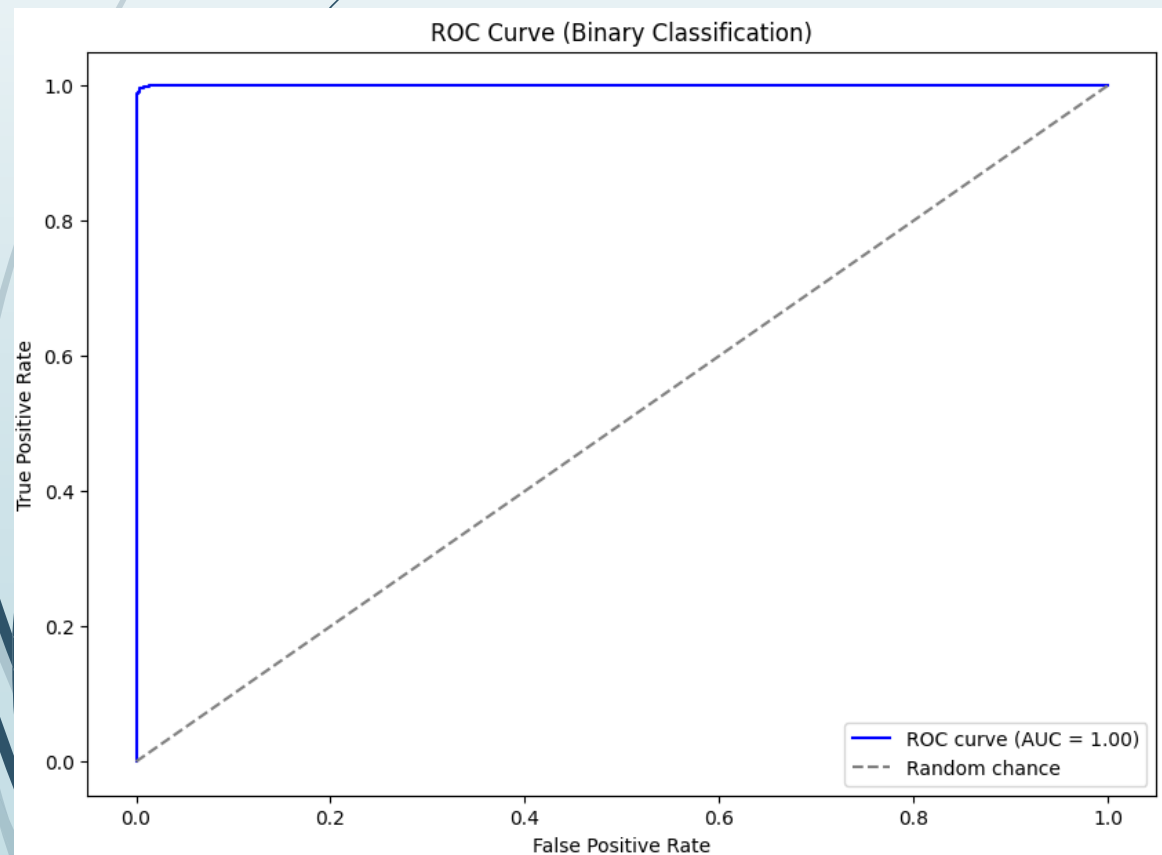
Model	Accuracy	Precision	Recall	F1 score	AUC	Size(MB)
MobileNet	0.9908	0.99	0.99	0.99	1.00	24.6
Resnet50	0.9954	0.98	1.0	0.99	0.99	93.5
DenseNet121	0.9912	0.99	0.99	0.99	1.00	29.6
Vgg16	0.9234	0.94	0.94	0.94	0.95	60.3
MobileNetV2	0.9992	1.00	1.00	1.00	1.00	47.1
InceptionV3	0.9965	0.99	0.99	0.99	1.00	193

# Results and Impact Analysis

4

## ROC Curve and AUC Score

The ROC curve graphically represents the trade-off between sensitivity and specificity for the models. An AUC score of 1.00 indicates an ideal model, signifying that the classification threshold was set optimally to distinguish between genuine and counterfeit banknotes effectively.



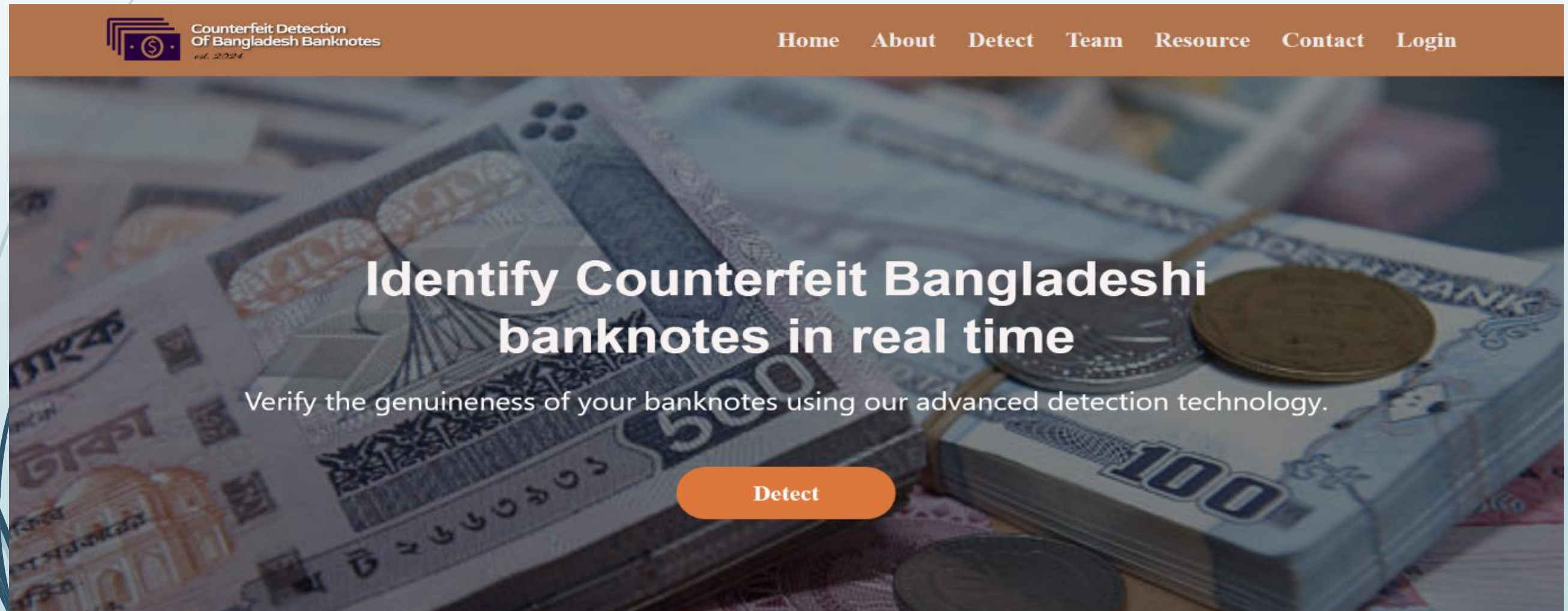
# **Web Application Development & Feature**

The web application was built using HTML, CSS, Bootstrap, and JavaScript to ensure a responsive and user-friendly interface. Python Flask was integrated for backend processes, connecting the application with the machine learning model and managing user authentication seamlessly.

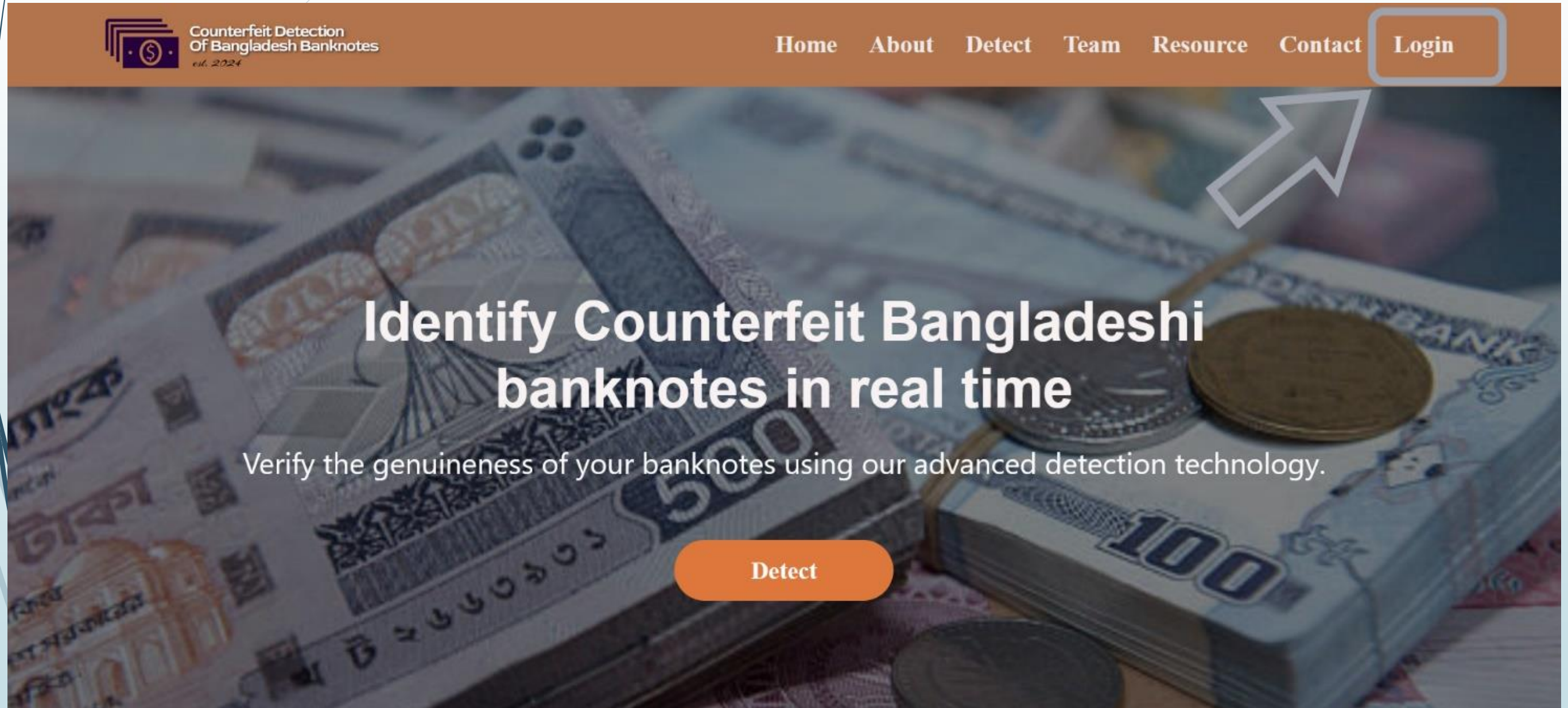


# User Authentication Process

Google authentication provides a secure login mechanism, ensuring users can safely access the application. This method enhances security by allowing user credentials to be managed through Google's authentication servers instead of storing them locally




# User Authentication Process





# User Authentication Process

 Sign in with Google

## Sign in


to continue to [Detect Note](#)

[Forgot email?](#)

[Create account](#) [Next](#)


English (United States) ▼


[Help](#) [Privacy](#) [Terms](#)


 Google এর মাধ্যমে সাইন-ইন করুন


## একটি অ্যাকাউন্ট বেছে নিন


[Detect Note](#)-এ অব্যাহত থাকার জন্য

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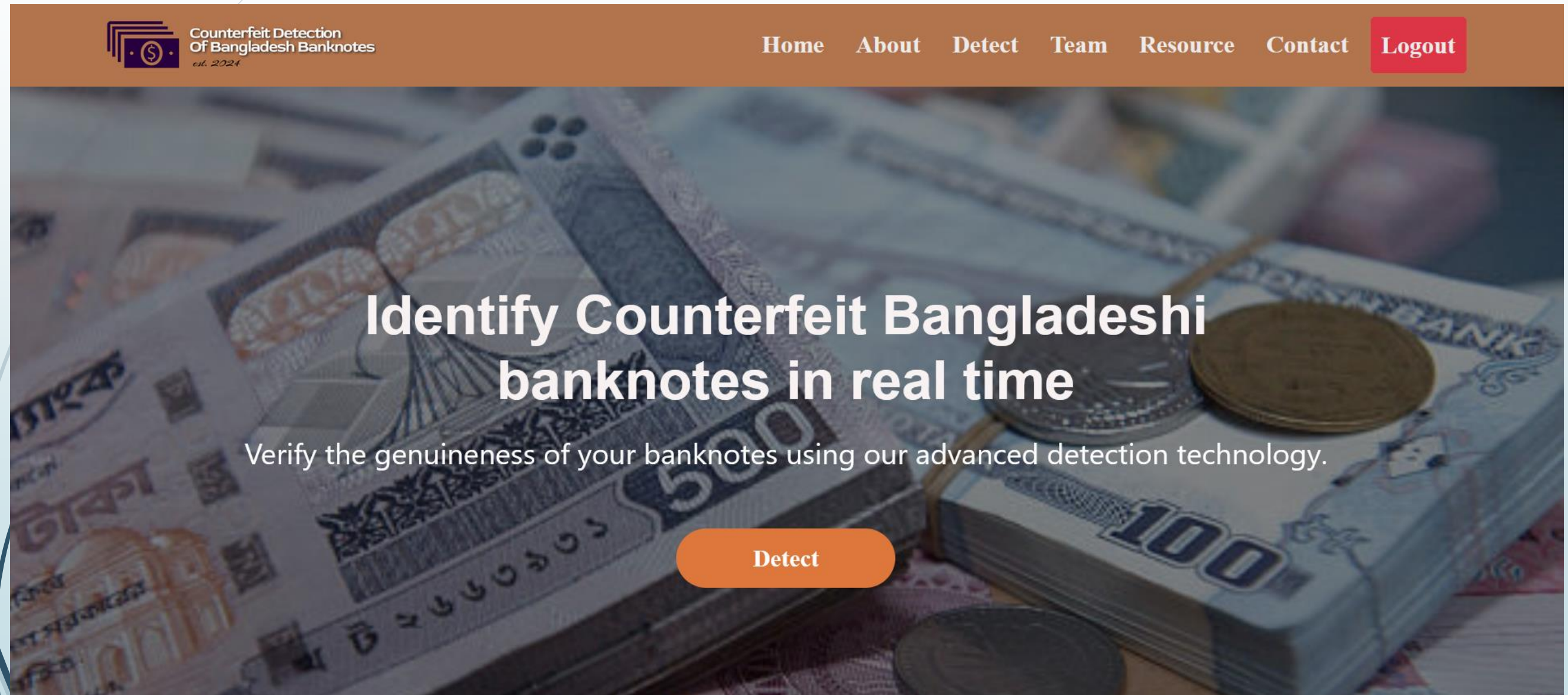
 অন্য একটি অ্যাকাউন্ট ব্যবহার করুন

বাংলা ▼

[সহায়তা](#) [গোপনীয়তা](#) [শর্তাবলী](#)



# Interface After Authentication



# Image Uploading and Processing

Users can upload images of banknotes for verification. The application processes these images after resizing and normalizing them for uniformity, applying techniques to enhance their quality before feeding them into the AI model for detection.

## Detect Banknote

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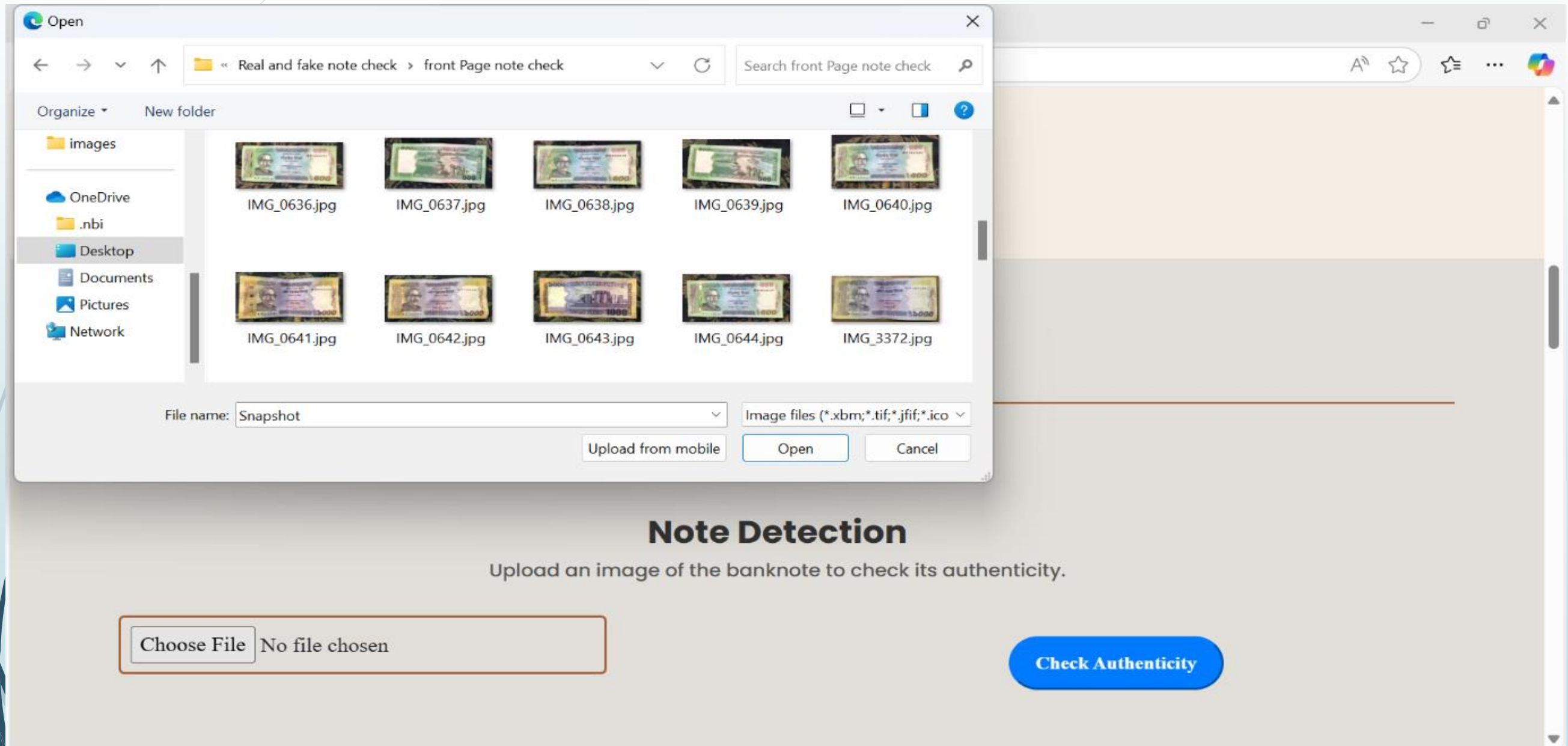
### Note Detection

Upload an image of the banknote to check its authenticity.

Browse... No file selected.

Check Authenticity

# Image Uploading and Processing



# Image Uploading and Processing

## Detect Banknote

### Note Detection

Upload an image of the banknote to check its authenticity.

Browse... IMG\_0618.jpg



Check Authenticity



# AI Detection Mechanism

The AI detection is powered by a trained convolutional neural network (CNN) model using images of real and fake banknotes. The model processes uploaded images to accurately classify them as genuine or counterfeit based on learned features such as microprinting and watermarks.

# Results Display

The application provides immediate feedback on the authenticity of uploaded banknotes. Results are displayed visually with clear indications of whether the note is genuine or counterfeit, enhancing user experience and confidence in the tool's accuracy.

## Detect Banknote

### Note Detection

Upload an image of the banknote to check its authenticity.

Browse... IMG\_0618.jpg



Check Authenticity

Prediction Result:

Your Bank note is Original

# Results Display

The application provides immediate feedback on the authenticity of uploaded banknotes. Results are displayed visually with clear indications of whether the note is genuine or counterfeit, enhancing user experience and confidence in the tool's accuracy.

## Detect Banknote

### Note Detection

Upload an image of the banknote to check its authenticity.

Browse... Fake\_1000Note\_2.jpeg



Check Authenticity

Prediction Result:

**Your Bank note is Counterfeit**

# About Section

## ABOUT

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### Counterfeit Detection of Bangladesh Banknotes

The Counterfeit Detection of Bangladesh Banknote project allows users to verify the authenticity of 500 and 1000 taka banknotes. When you upload an image, our system automatically assesses security elements like watermarks and holograms using advanced deep learning techniques. Our goal is to provide a simple, user-friendly solution for combating counterfeit currency and raising awareness about financial fraud prevention.

[Learn More](#)



# Team Section

## Our Team



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# Educational Resource Section

## Educational Resource



### Understanding Banknote Security Features

Banknotes incorporate watermarks, security threads, and microprinting as essential security elements to deter counterfeiting. These elements offer various levels verification...

[Read More](#)



### Counterfeit Detection Techniques

The identification of counterfeit currency depends on the utilization of machine learning models to examine the characteristics of banknotes, combined with UV/IR scanning to unveil concealed security...

[Read More](#)

### The Negative Impact of Counterfeit Currency



### The Impact of Counterfeiting on the Economy

Counterfeiting undermines economic stability by weakening confidence in currency, resulting in financial losses due to decreased tax income and increased security costs and hampers overall economic growth and increases the burden on law enforcement and..

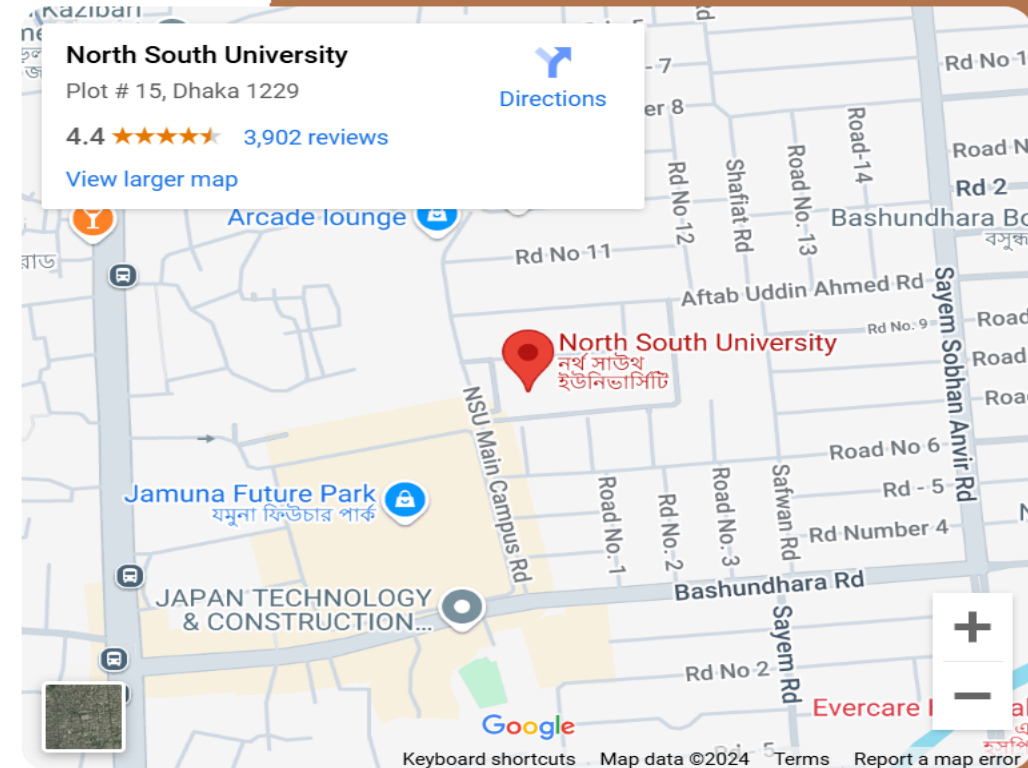
[Read More](#)



# Contact & Footer Section

## Contact Us

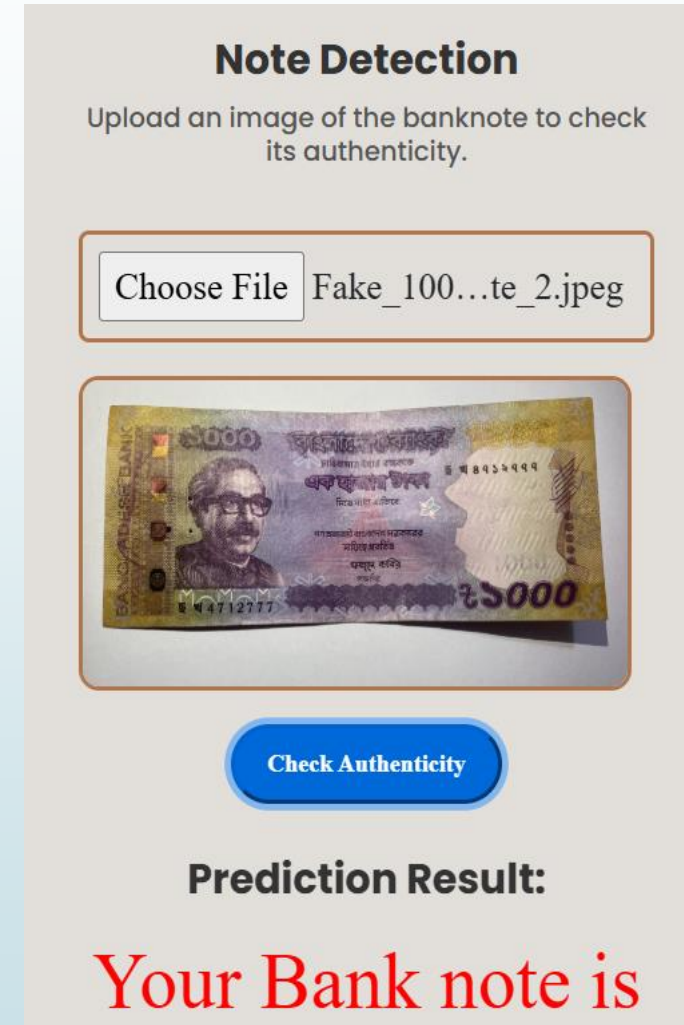
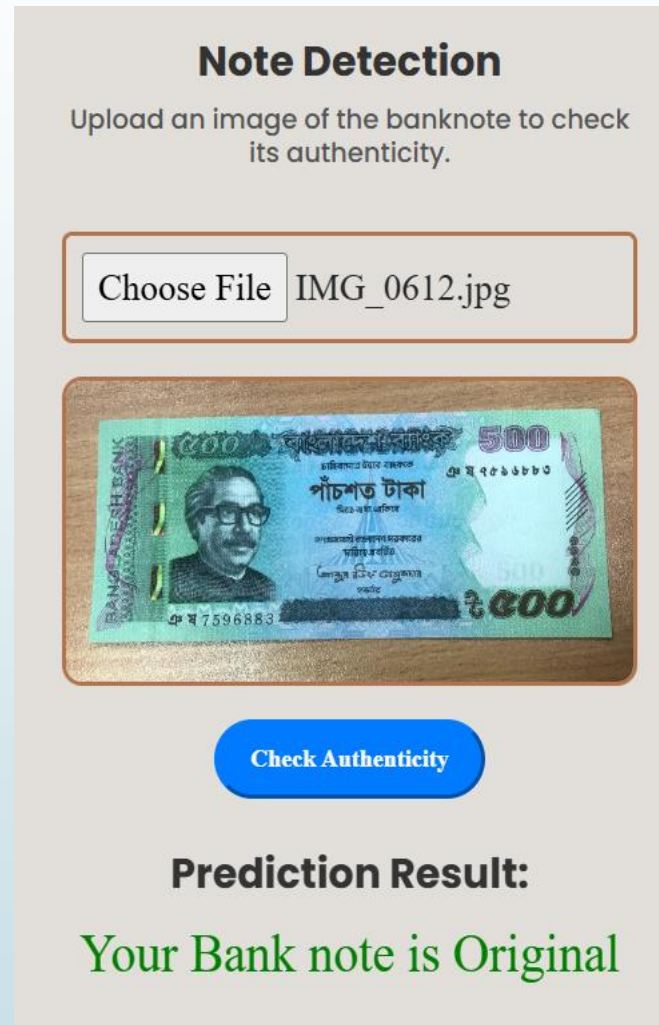
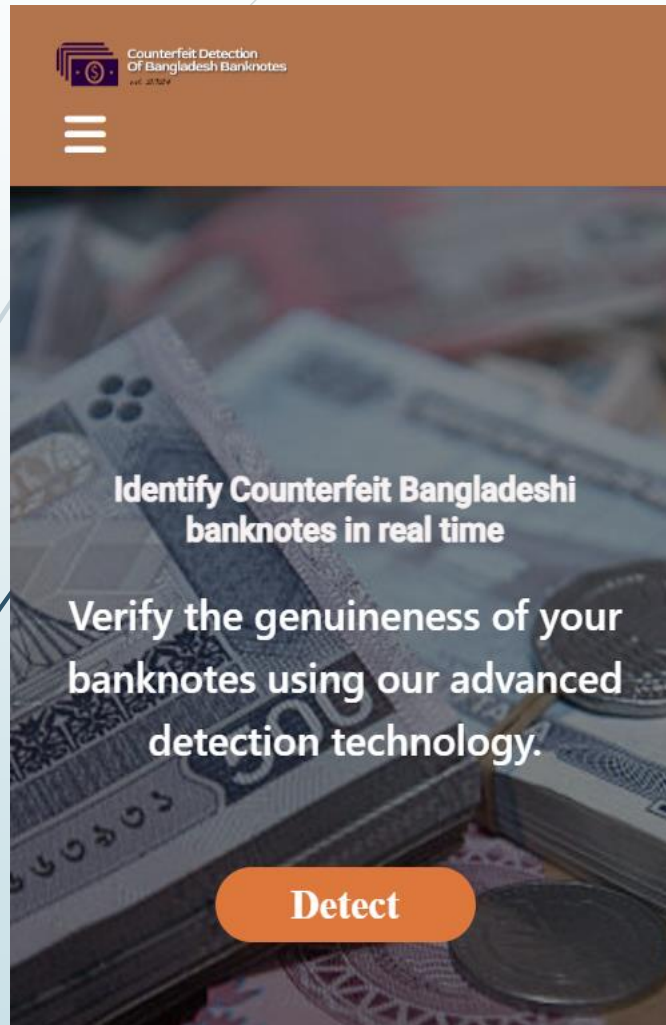
Please provide your name, email, and a message, and we'll get back to you as soon as possible.



Designed By **Team AM**

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# Responsive interface





# Implementation Challenges

Developing the counterfeit detection system faced challenges such as limited dataset availability, ensuring data diversity, and optimizing model performance under real-world conditions. These factors hindered effective training and resulted in potential biases in model predictions.

# Future Directions: Continuous Improvement and Expansion

1

## **Dataset Expansion**

Expanding the dataset with a wider range of banknotes and counterfeit variations will enhance the model's accuracy and generalizability.

2

## **Backside Detection**

Developing the capability to detect counterfeit notes based on the backside of banknotes will further enhance the system's effectiveness.

3

## **Scanning Integration**

Integrating scanning functionality into the web application will improve usability for users.

# Next Steps: Expanding the Project's Impact



1

## Real-World Deployment

Deploying the system in real-world settings, such as banks, businesses, and law enforcement agencies, will be crucial for its impact.

2

## Public Awareness

Raising public awareness about the counterfeit threat and the use of the system can contribute to its widespread adoption.

3

## Collaboration & Partnerships

Collaborating with financial institutions, businesses, and government agencies can further enhance the project's reach and impact.

# Conclusion

The integration of machine learning in counterfeit detection represents a significant advancement in financial security. As technology continues to evolve, continuous updates and additions to the system are essential to adapt to emerging counterfeiting techniques and to protect the economy.



**Any**



**Question**



The image features a central, glowing orange text that reads "THANK YOU" in a bold, sans-serif font. The text is set against a dark, complex background that resembles a futuristic circuit board or a digital interface. The background is filled with intricate, glowing blue and red lines and patterns, suggesting a high-tech or cybernetic environment. The overall aesthetic is modern and digital, with a strong emphasis on the glowing elements.

THANK  
YOU