DEERWALK INSTITUTE OF TECHNOLOGY

Tribhuvan University

Faculty of Humanities and Social Sciences

NEPALI CURRENCY DETECTOR APPLICATION

A PROJECT REPORT

Submitted to

Department of Computer Application

DWIT College

In partial fulfillment of the requirements for the Bachelor's in Computer Application

Submitted by

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6-2-1175-53-2018

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DWIT College

DEERWALK INSTITUTE OF TECHNOLOGY

Tribhuvan University

Faculty of Humanities and Social Sciences

DWIT College

SUPERVISOR'S RECOMMENDATION

I hereby recommend that this project prepared under my supervision by KRISTINA MAHARJAN entitled **"NEPALI CURRENCY DETECTOR APPLICATION"** in partial fulfillment of the requirements for the degree of Bachelor's in Computer Application be processed for the evaluation.

……

Shristi Awale

Program Head, Senior Year

DWIT College, Sifal, Kathmandu

Tribhuvan University

Faculty of Humanities and Social Sciences

DWIT College

LETTER OF APPROVAL

This is to certify that this project prepared by KRISTINA MAHARJAN entitled **"NEPALI CURRENCY DETECTOR APPLICATION"** in partial fulfillment of the requirements for the degree of Bachelor's in Computer Application has been well studied. In our opinion it is satisfactory in the scope and quality as a project for the required degree.

…… Shristi Awale Program Head, Senior Year DWIT College	…….. Bhoj Raj Joshi Senior Lecturer Patan Multiple Campus
…… Shristi Awale Program Head, Senior Year DWIT College	…….. Hitesh Karki Chairman DWIT College

ABSTRACT

The Nepali Currency Detector App offers a groundbreaking solution tailored to assist foreigners in effectively identifying and distinguishing Nepali banknotes. Designed to address the challenges encountered by non-native individuals in discerning the nuances among Nepali currency, this app harnesses sophisticated image recognition technology coupled with intuitive user interfaces to bridge the gap in currency comprehension. By leveraging the power of smartphones and cutting-edge artificial intelligence, the app provides an accessible and reliable means for foreigners to navigate and manage Nepali banknotes confidently.

The development of the Nepali Currency Detector App involved extensive research in image recognition and cross-cultural usability, ensuring seamless functionality for users from diverse backgrounds. Leveraging machine learning algorithms trained on a comprehensive dataset of Nepali currency images, the app guarantees accurate identification, empowering foreigners to engage in financial transactions, travel, and daily activities within Nepal with ease. With its emphasis on accessibility and user-centric design, this app reshapes the landscape for foreigners, fostering a sense of inclusivity and familiarity in handling Nepali currency.

Keywords: *Nepali Currency Detector App, Foreigners, Image Recognition, Cross-Cultural Usability, Financial Transactions*

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Kristina Maharjan
TU Registration No.: - 6-2-1175-53-2018
Date: - December, 2023

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LIST OF ABBREVIATIONS

CNN	Convolutional Neural Network
CSS	Cascading Style Sheets
CV	Cross-Validation
ER	Entity Diagram
HTML	Hypertext Markup Language
HOG	Histogram of Oriented Gradients
IP	Image Processing
ML	Machine Learning
OVI	Optically Variable Ink
SDK	Software Development Kit
SVM	Support Vector Machine
UI	User Interface

CHAPTER 1: INTRODUCTION

1.1. Overview

This application is designed to assist foreigners in recognizing and differentiating between Nepali currency notes. Using advanced image recognition technology, the application can quickly identify the denomination of a currency note by analyzing its image.

The Nepali currency system consists of various denominations, including the 5, 10, 20, 50, 100, 500 and 1000 rupee notes. The application can accurately detect and classify each of these notes, allowing users to effortlessly identify their value.

This application is designed to improve accessibility and independence for foreigners, ensuring they can confidently manage their finances and carry out daily transactions with ease.

1.2. Problem Statement

The problem statement for the Nepali Currency Detection Application is to address the difficulties faced by foreigners in identifying and distinguishing between Nepali currency notes. Currently, foreigners rely on assistance from others to recognize the value of their currency. This reliance can lead to a lack of independence and privacy, as well as potential risks associated with handling money.

1.3. Objectives

The objectives of this project is as follows:

- To provide an accessible and user-friendly interface that can be used foreigners to recognize and differentiate between Nepali currency notes.
- To accurately and quickly identify the denomination of Nepali currency notes using advanced image recognition technology, allowing users to manage their finances efficiently.

- To promote inclusivity and equality by providing an equal opportunity for foreigners to participate in financial transactions and activities.
- To reduce the risks associated with handling money for foreigners, by enabling them to recognize and verify the value of their currency notes independently.

1.4. Scope and Limitation

The scope of the Nepali Currency Detector App for foreigners is to provide an accessible and reliable solution for accurately recognizing and distinguishing different denominations of Nepali banknotes. The app aims to empower users in Nepal to independently handle currency transactions, thereby enhancing their financial inclusivity and independence. The app will utilize image recognition technology and audio feedback to enable users to capture images of Nepali banknotes using their smartphones' camera, and receive real-time audio feedback announcing the denomination of the banknote.

The limitations of this project are:

- The accuracy of currency detection and authentication can vary depending on factors such as image quality, lighting conditions, and variations in currency notes.
- The clear images are only detected.
- The application may not always provide 100% accurate results.
- No internet connectivity can hinder the application's functionality or accuracy.

1.5. Development Methodology

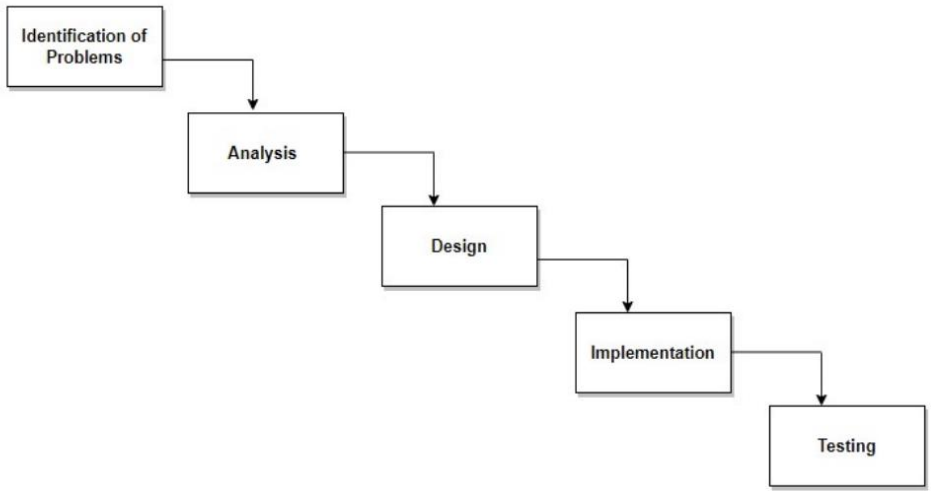

Figure 1: Development Methodology of Application

The development of the Nepali Currency Detector App followed a structured waterfall methodology, progressing through sequential phases with defined deliverables and distinct milestones. The process commenced with a comprehensive analysis and documentation phase, where exhaustive research on the requirements and functionalities essential for the app's success was conducted. Following this, the design phase ensued, translating the gathered requirements into a detailed design blueprint encompassing user interfaces, system architecture, and feature specifications. Once the design was finalized, the development phase commenced, involving the implementation of features, coding, and integration of image recognition algorithms and audio feedback systems. Subsequently, rigorous testing and quality assurance were conducted in the verification phase to ensure the app's functionality, accuracy, and accessibility. Finally, the deployment phase marked the app's release to the user base, followed by maintenance and support to address any post-deployment issues or updates.

1.6. Report Organization

The report is organized into five chapters.

Chapter 1: Includes description about Nepali currency detector app, problem statements, objectives, scopes and limitations.

Chapter 2: Consists of literature review about previous work done in related field.

Chapter 3: Comprises of requirement analysis. The requirement analysis further consists of functional and non-functional requirements. This section talks about the research done about Nepali currency detector app, and the functional and non-functional requirements of this project. This chapter includes the algorithm that is used for this project.

Chapter 4: Consists of system design which includes system architecture, Event diagram, Use case diagram. This section includes diagrams that help to elaborate on the overall 3 design of the system proposed in this project.

Chapter 5: Includes conclusion. This section includes a conclusion to this paper.

CHAPTER 2: BACKGROUND STUDY AND LITERATURE REVIEW

2.1. Background Study

The use of technology has significantly impacted the lives of foreigners, enhancing their access to information, communication, and daily activities. In the realm of financial management, the identification and differentiation of banknotes pose a particular challenge for foreigners. In Nepal, where the Nepali Rupee is the official currency, the tactile similarities among banknote denominations further compound this challenge.

The software detects currency by extracting existing features of banknotes such as micro-printing, optically variable ink (OVI), water-mark, iridescent ink, security thread, Contour Analysis, Face Recognition, Canny Edge & Hough transformation algorithm. This paper also focuses on the pros and cons of implementation details that may degrade the performance of image processing based paper currency authentication systems [1]. The process of identification is done by comparing the original images of money that will be tested with reference of original currency paper image that has been extracted and capture its characteristics and with the help of canny operator to make edge detection where the previously existing image has to be pre-processing, including extraction characteristics [2] [3].

2.2. Literature Review

Recognition of the currency using computer vision

It presents an android application that can be used to recognize the currency notes. The user has to switch on the application after switching on the application camera will be opened and it will be asking the user to put a currency note in front of the camera. When the user will be putting the currency note in front of the camera the app will be taking the images of the note and that image will be sent to the CNN model in the backend [4].

Indian Currency Detection using Image Recognition Technique

The main purpose behind this study is to recognize Indian paper currency with this hybrid approach which is portable and making an application used on the go. In this study, the Indian currency note features will be extracted and will be stored in MAT files and then these stored features will be matched with the input paper currency to recognize whether it is genuine or duplicate. With this system, easy to recognize the currency note anywhere, anytime. MATLAB is used for image processing toolbox. The image processing is a way to improve the pictorial information of the image for the sake of machine or hardware perception. The currency notes will be recognized with the combination of both local binary patterns and principal component analysis. The LBP is significant progress in texture analysis and used for matching purpose. PCA is used for training purpose. Euclidian distance algorithm will be used for combining the metrics which has simple measure computations. Currency recognition has big challenges like watermark recognition, currency note resolution, dirty notes etc [5].

CHAPTER 3: SYSTEM ANALYSIS

3.1. Requirement Analysis

The requirement analysis of this project is discussed below:

i. Functional Requirement

The functional requirements of this project are:

- The app should have the ability to detect images of Nepali banknotes.
- The app should feature a user-friendly interface optimized for foreigners, including high contrast.

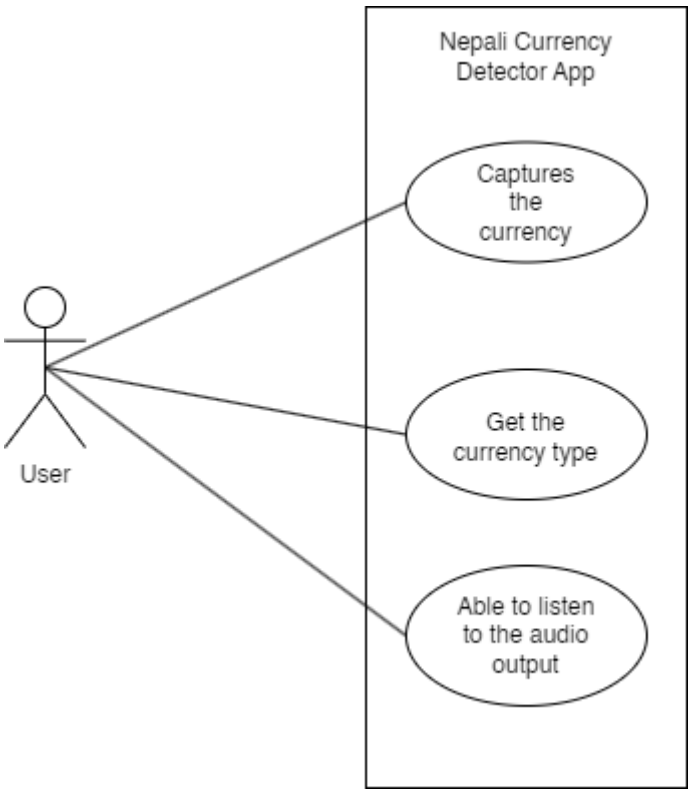

Figure 2: Use case diagram

ii. Non-Functional Requirement

The non-functional requirements of this project are:

- The connection must be reliable.
- The app should be accessible to all the foreigners as well as locals.

3.2. Feasibility Analysis

i. Technical Feasibility

The development of the application requires advanced image recognition technology and machine learning algorithms, which are available and accessible for developers. Additionally, there are several programming languages and software development kits (SDKs) that can be used to develop the application.

The project is technically feasible as it can be built using the existing available technologies. The tools and modules needed to build the system are open source, freely available and are easy to use. Python, as programming language, and Flask, as programming framework, have been chosen.

ii. Operational Feasibility

The application can be designed to be user-friendly, with simple and design that can be easily used by foreigners.

With the availability of Internet and browser in the machine, any user can easily operate the application for automatically solving the uploaded maze image. The application neither requires any special hardware besides computer system nor does it have dependency on any proprietary software for functionality. Hence, the project is operationally feasible.

iii. Economic Feasibility

The cost of developing the application will depend on several factors, such as the complexity of the algorithm, the features, and the platform used. However, with careful planning and budgeting, the development cost can be kept within reasonable limits.

iv. Schedule Feasibility

The schedule feasibility is the time estimation that take to execute the project and set deadlines.

Activities	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Project Planning and Research						
Research on Nepali currency						
Research on Algorithms						
Working of Image Processing						
Create Dataset						
Activities	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Create Dataset						
Application Development						
Testing						
Documentation						
Review and Final Report						

Figure 3: Gantt Chart

3.3. Process Model

a) Event Diagram

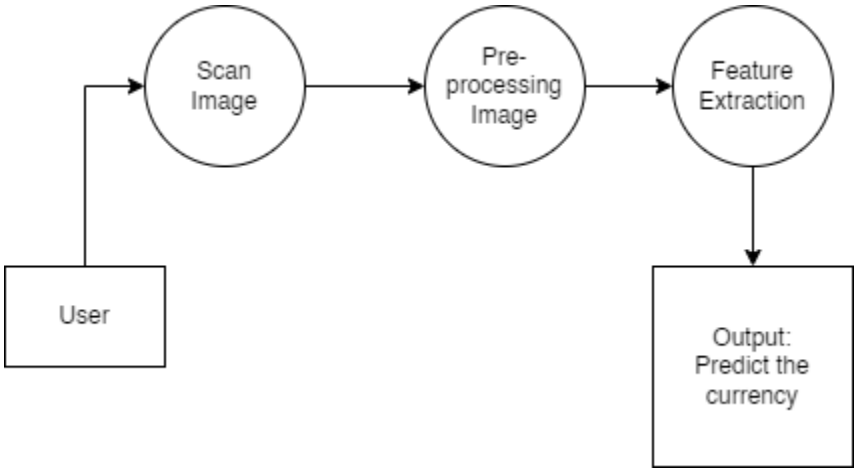

Figure 4: Event diagram of the system

The Figure 3 explains the events that happens in the system. In this system, the user scans a valid image. Then preprocesses the image and feature extraction is carried out. The extracted features are then passed into predict function to predict the denomination of the currency.

b) Sequential Diagram

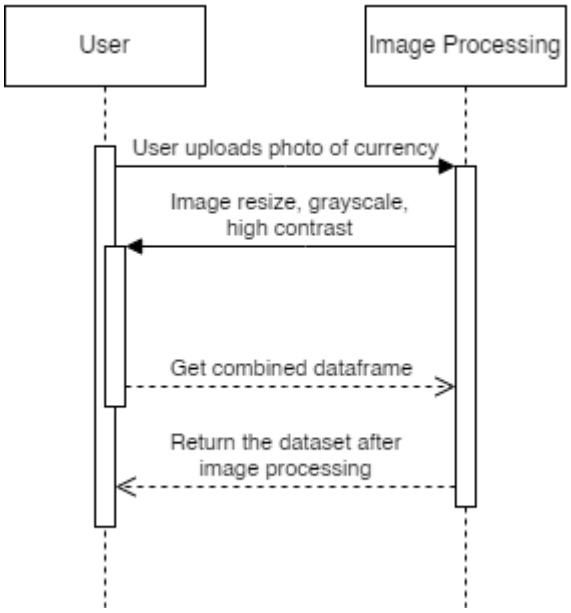

Figure 5: Sequence diagram of the system (Image Processing)

The process modeling is shown with the help of sequence diagram. The sequence diagram describes what happens in the system. As shown in Figure 4, first user uploads the image to the server. Here, at first the user uploads the image into the system. The received image then undergoes various image processing techniques that includes image resize, image gray-scale, image high contrast, and feature extraction.

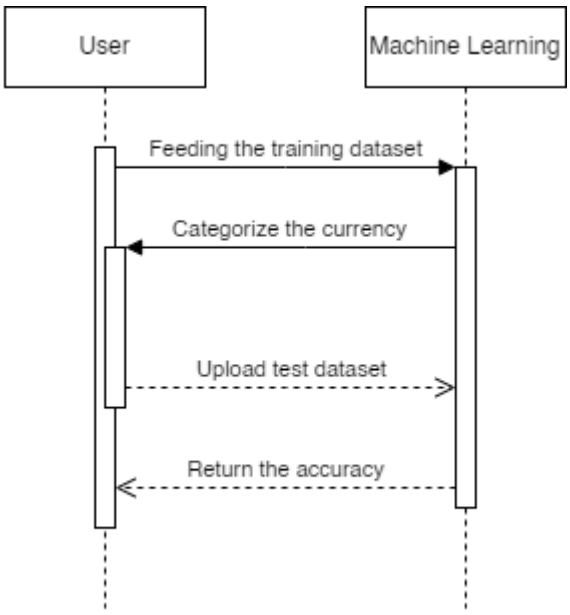

Figure 6: Sequence diagram of the system (Machine Learning)

After an image completes its processing, the machine learning algorithm is applied to the features extracted from the image. This part where extracted features are fit into the trained model, and then the system recognizes the denomination.

3.4. Data Preparation

3.4.1 Data Collection

Manual data collection was performed. The collected data sets consist of Final training dataset consists of around 100 currency note for each of the 7 denominations.

These images were used to train the system using Support Vector Machine and Support Vector Classifier algorithms. There are total of 673 image datasets used for this system, of which 70% are used for training purpose, whereas remaining 30% are used for testing purpose.

Some of the sample images used in this experiments are as shown below.

Figure 7: Sample of Nepalese paper currency notes

3.4.2 Pipeline for image feature extraction and preprocessing

A pipeline for image feature extraction and preprocessing using three transformers: RGB2GrayTransformer, HogTransformer, and StandardScaler.

RGB2GrayTransformer:

This transformer converts the input RGB image into grayscale. Grayscale images have a single channel instead of three channels (red, green, and blue) present in RGB images. Converting to grayscale simplifies the subsequent processing steps and reduces computational complexity.

HogTransformer:

HogTransformer stands for Histogram of Oriented Gradients. It calculates the Histogram of Oriented Gradients features for an image. The parameters specified in the code snippet configure how these features are computed.

"pixels_per_cell=(14, 14)" defines the size of the cells within which the gradients are computed. In this case, each cell has a size of 14x14 pixels.

"cells_per_block=(2, 2)" specifies the number of cells that form a block. A block consists of multiple cells, and this parameter defines the size of the block.

"orientations=9" determines the number of orientation bins used to construct the histograms. It divides the gradient orientations into nine bins.

"block_norm='L2-Hys'" defines the block normalization technique used. L2-Hys normalization is a commonly used technique that normalizes the block's histogram of gradients.

HOG features capture local patterns of gradients in an image, which can be useful for object detection and recognition tasks.

StandardScaler:

The StandardScaler is used for data normalization. It scales the input data by subtracting the mean and dividing by the standard deviation. This step ensures that all features have zero mean and unit variance, making them more comparable and preventing certain features from dominating others during subsequent analysis or modeling.

By using this pipeline, the input RGB image is first converted to grayscale, then transformed into HOG features, and finally standardized using the StandardScaler. These transformed and preprocessed features can be used as input for further machine learning tasks, such as classification or regression.

3.4.3 GridSearchCV

A GridSearchCV performs a grid search for hyperparameter tuning in the HOG pipeline, selecting the best estimator and saving it for later use. GridSearchCV is a function from scikit-learn used for hyperparameter tuning by exhaustively searching through a predefined parameter grid.

By performing the grid search, evaluating different combinations of hyperparameters, and selecting the best model based on the defined evaluation metric, the code facilitates finding the optimal configuration for the HOG pipeline and saves the best model for future use.

CHAPTER 4: IMPLEMENTATION AND TESTING

4.1. Implementation

4.1.1. Tools Used

Client Side:

1. HTML is used to display content in the browser.
2. CSS is used to properly align the HTML content.
3. Bootstrap CSS framework is used for beautifying the HTML elements to improve the user experience.

Server Side:

1. Django, a python web framework is used to implement the core program logic.
2. Flask web framework is used for dynamic webpage generation and to display the predicted result in the browser as well as to handle page requests for image upload.
3. SciKit-Learn is used to implement the classification.
4. Android Studio is used for mobile application.

4.1.2. Implementation Details of Modules

The algorithm used in this project is:

SVM

SVM is used for the classification and to distinguish between different classes of currency notes. To train an SVM model, a labeled dataset of Nepali currency notes is required. This dataset should include images of different denominations and potentially include both authentic and counterfeit examples. Each image should be associated with the corresponding class or label.

Support Vector Machines (SVM) is a powerful supervised machine learning algorithm used for classification and regression tasks. It works by finding an optimal hyperplane that separates data

points into different classes. The key idea behind SVM is to maximize the margin between the classes, allowing for better generalization and improved performance on unseen data.

Support Vector Machines have proven to be effective in various domains, including image recognition, text classification, bioinformatics, and finance. SVM's ability to handle both linear and non-linear classification problems, its robustness against outliers, and its generalization capabilities make it a popular and widely used machine learning algorithm.

4.2. Testing

During testing, 30% images of Nepali notes from the datasets were used. For the testing purpose following 4 approaches were developed. Testing was conducted using four test cases:

Test Case 1: Training the model

Test Case 2: Uploading test image to the server

Test Case 3: Prediction result displaying in the web interface

4.2.1. Training the model

To train the model, following is done.

i. Train the available datasets.
ii. The feature extraction, resizing is done.
iii. The trained data are stored in a pickle file.

4.2.2. Uploading test image to the UI

In this test approach, following test case is generated.

Table 1: Uploading test image to the UI

Image Upload to the server
Precondition: Currency image is available in the local storage.
Assumption: The image is not corrupted and is in standard extension like (png, jpg)
Test steps 1. Navigate to the index page 2. Choose image 3. Click upload button
Expected result: Image should be saved in the storage.

4.2.3. Capturing and uploading test image to the UI

In this test approach, following test case is generated.

Table 2: Capturing and uploading test image to the UI

Image Capture and Upload to the server
Precondition: Currency image is captured from the camera.
Assumption: The currency is detected.
Test steps 1. Navigate to the index page 2. Capture image 3. Click upload button
Expected result: Image should be saved in the storage.

4.2.4. Prediction result displaying in the web interface

In this test approach, following test case is generated.

Table 3: Prediction result displaying in the web interface

Result display in UI interface
Precondition: Uploading of currency image to UI is executed successfully.
Assumption: The system is working without any error and user has uploaded a currency note's image.
Test steps 1. Click 2. Choose image 3. Click upload button
Expected result: Predicted denomination number is displayed in the web interface.

CHAPTER 5: CONCLUSION AND FUTURE RECOMMENDATION

5.1. Lesson Learnt

The expected outcomes of the Nepali Currency Detection Application are as follows:

- Improved Accessibility: The application will improve accessibility for foreigners, enabling them to manage their finances independently and with greater privacy.

- Increased Independence: The application will promote independence for foreigners, allowing them to confidently participate in financial transactions and activities.

- Enhanced Safety: The application will reduce the risks associated with handling money for foreigners, by enabling them to recognize and verify the value of their currency notes independently.

- Inclusive Participation: The application will promote inclusivity and equality by providing an equal opportunity for foreigners to participate in financial transactions and activities.

Overall, the Nepali Currency Detection Application is expected to improve the quality of life for foreigners, by enabling greater independence and participation in economic activities, and promoting inclusivity and equality.

5.2. Conclusion

In conclusion, the development of the Nepali Currency Detection Application has the potential to significantly improve the quality of life for foreigners in Nepal. By leveraging advanced image recognition technology and machine learning algorithms, the application will enable

accurate and efficient recognition of Nepali currency notes, promoting independence, safety, and efficient financial management.

5.3. Future Recommendation

The future recommendations of this project are:

- Extend recognition capabilities to encompass newer currency designs or denominations.
- Offer multi-language support to cater to a broader user base.
- Develop offline capabilities to ensure usability in areas with limited connectivity.
- Strengthen security measures to safeguard user data and privacy.

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[3] B. H. U. G. Ankush Roy, "Machine-assisted authentication of paper currency: an experiment on Indian banknote”".

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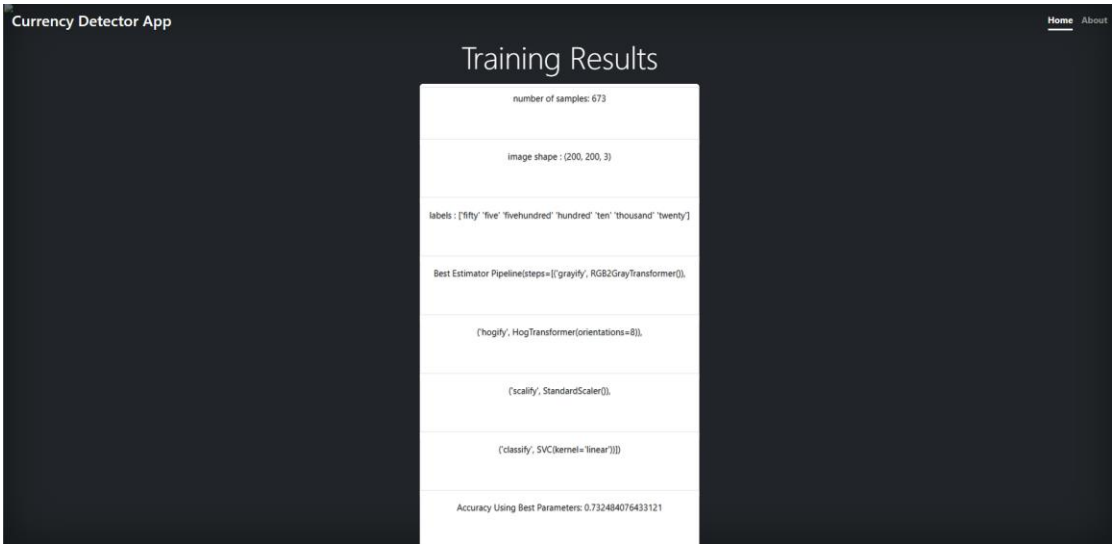
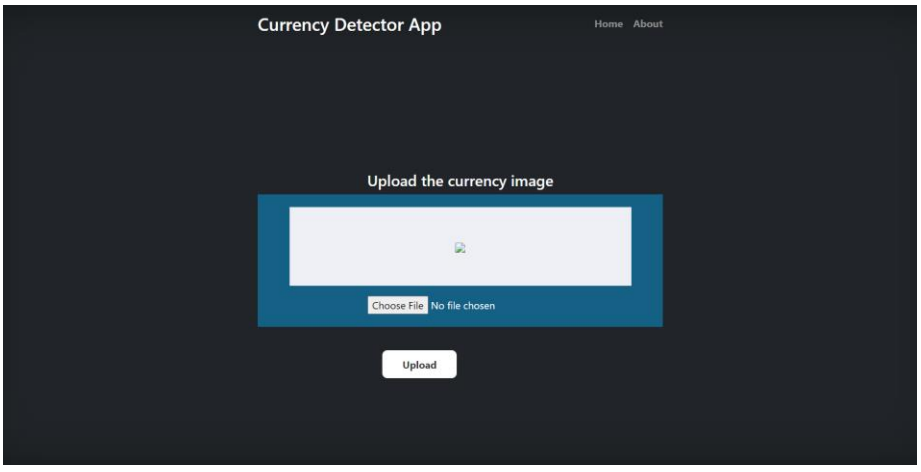
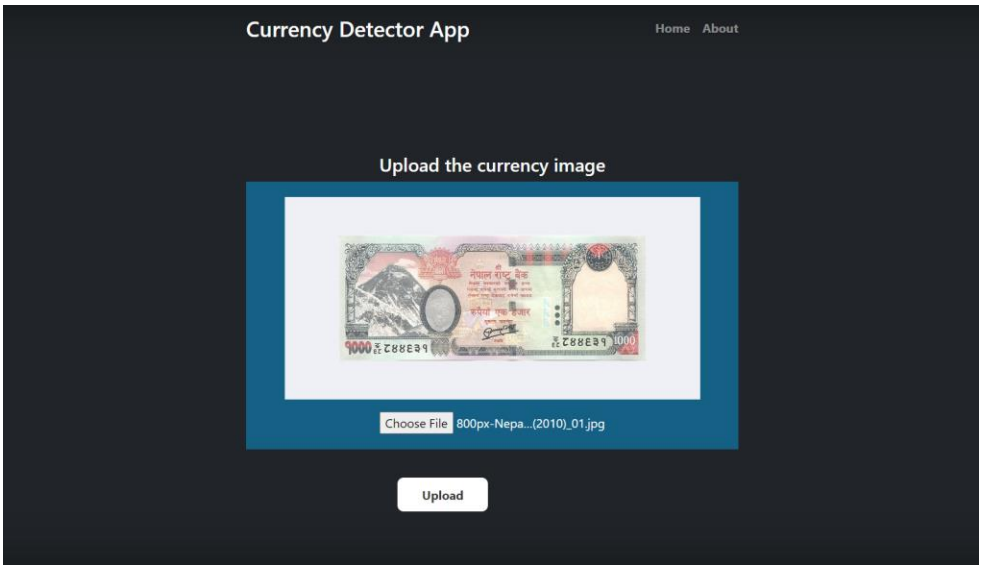
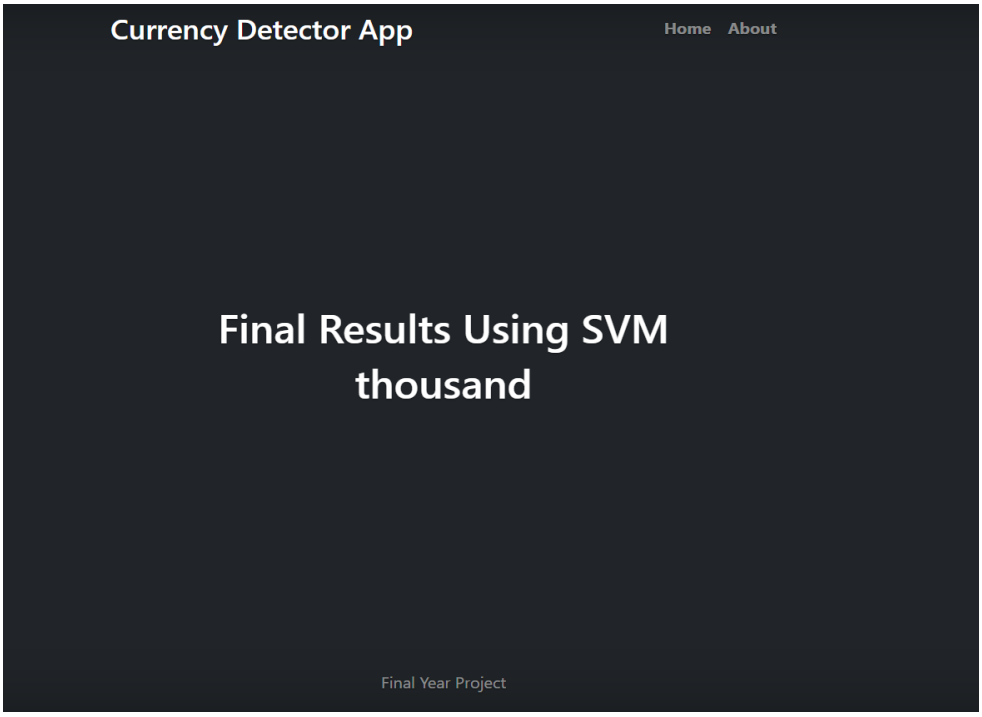
APPENDIX

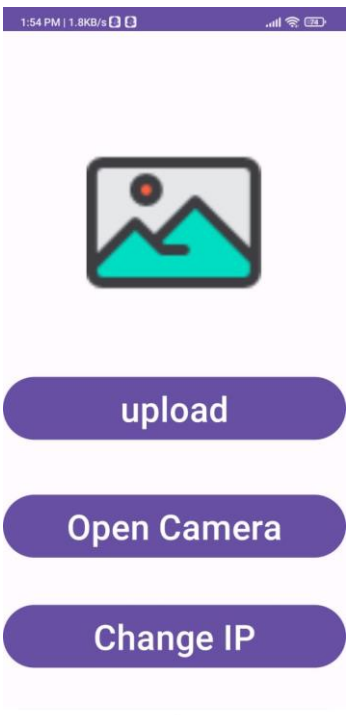

Currency Detector App
Home
About
Currency Detector App using Image Processing and Machine Learning
Train Model
Start Analysis
Final Year Project


Currency Detector App
Home
About
Training Results
number of samples: 673
image shape : (200, 200, 3)
labels : ['fifty' 'five' 'fivehundred' 'hundred' 'ten' 'thousand' 'twenty']
Best Estimator Pipeline(steps=[('grayify', RGB2GrayTransformer()),
('hogify', HogTransformer(orientations=8)),
('scalify', StandardScaler()),
('classify', SVC(kernel='linear'))])
Accuracy Using Best Parameters: 0.732484076433121

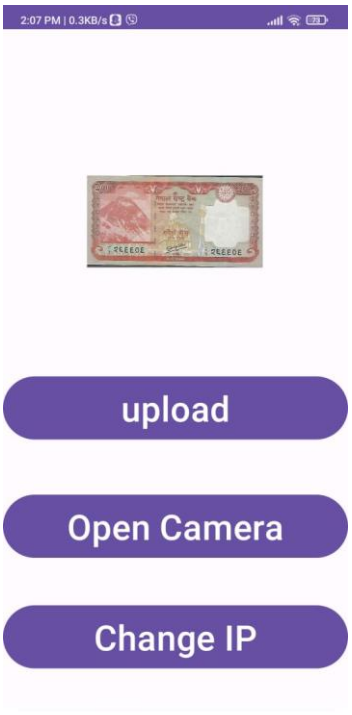

Currency Detector App
Home
About
Upload the currency image
Choose File
No file chosen
Upload

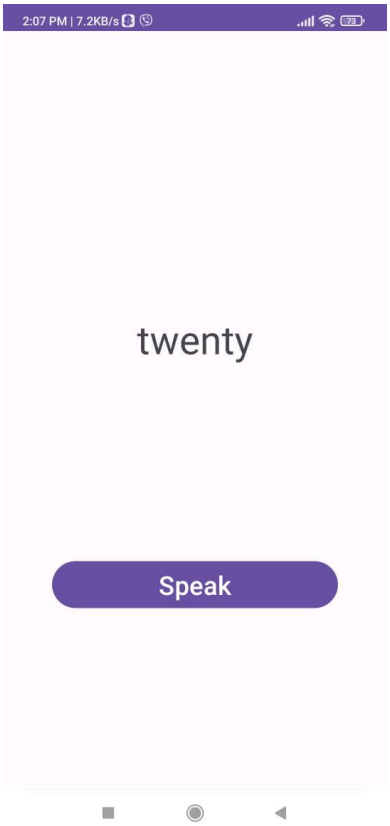

Currency Detector App
Home About
Upload the currency image
Choose File
800px-Nepa...(2010)_01.jpg
Upload

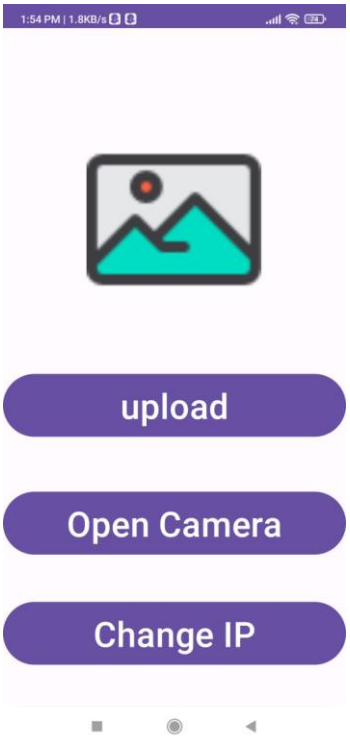

Currency Detector App
Home About
Final Results Using SVM
thousand
Final Year Project


upload
Open Camera
Change IP

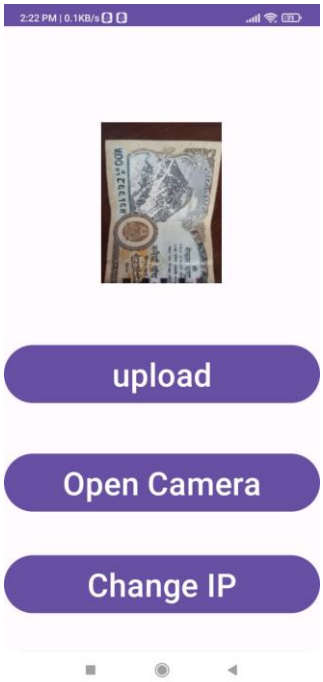

Welcome, enter the server IP to get started
192.168.21.128
SAVE

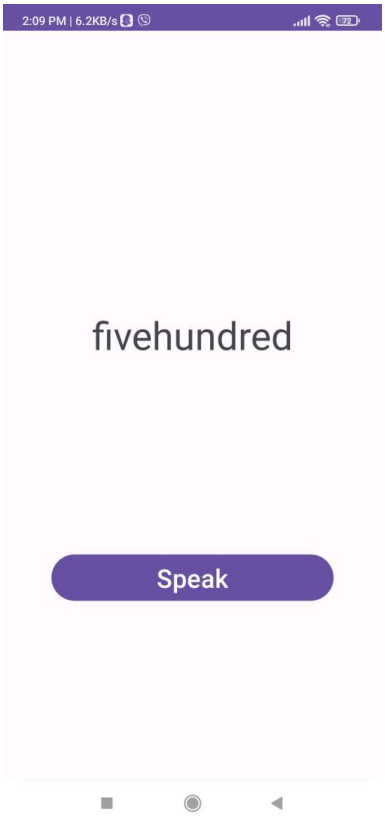

upload
Open Camera
Change IP


twenty
Speak


upload
Open Camera
Change IP


Photo


upload
Open Camera
Change IP


fivehundred
Speak