

# **FAKE CURRENCY DETECTION USING MACHINE LEARNING**

*A project report submitted in partial fulfillment of the requirements for  
B.Tech. Project*

**B.Tech.**

*by*

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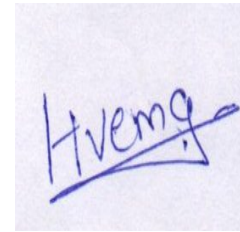
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**ABV INDIAN INSTITUTE OF INFORMATION  
TECHNOLOGY AND MANAGEMENT  
GWALIOR-474 010**

**2021**

## CANDIDATES DECLARATION

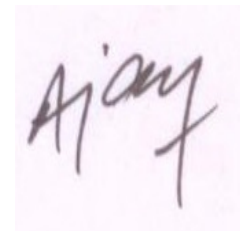
We hereby certify that the work, which is being presented in the report, entitled **FAKE CURRENCY DETECTION USING MACHINE LEARNING**, in partial fulfillment of the requirement for the award of the Degree of **Bachelor of Technology** and submitted to the institution is an authentic record of our own work carried out during the period *June 2021 to october 2021* under the supervision of **Dr. Ajay Kumar**. We also cited the reference about the text(s)/figure(s)/table(s) from where they have been taken.



Date:21 October,2021

Signatures of the Candidates

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.



Date:26 October,2021

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## ABSTRACT

The progression of color printing innovation has expanded the pace of fake money note printing and copying the notes on an extremely enormous scope. Scarcely any years back, the printing could be done in a print house, yet presently anybody can print a money note with most extreme exactness utilizing a straight forward laser printer.

Therefore the issue of phony notes rather than the veritable ones has been expanded to a great extent. India has been sadly reviled with the issues like debasement and dark cash. And fake of money notes is additionally a major issue to it. This prompts plan of a framework that distinguishes the phony money note in a less time and in a more proficient way.

The proposed framework gives a way to deal with check the Indian cash notes. Check of cash note is finished by the ideas of Machine Learning. This article depicts extraction of different provisions of Indian cash notes. Different Python libraries are utilized to extricate the elements of the note. The proposed framework has got benefits like straightforwardness and high execution speed. The outcome will foresee if the cash note is fake.

*Keywords:* fake currency, ML, data analysis, data augmentation, Indian currency, Feature extraction methods.

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# CHAPTER 1

## INTRODUCTION AND LITERATURE SURVEY

This chapter includes the details of fake currency detection and why is it so important.

### 1.1 INTRODUCTION

In Banking-area , greatest danger is phony money age. For the most part UV light is applying for verification demonstrating. Primary provisions to recognize counterfeit cash are Note esteem , ink smirch , Security thread, chronic number , Intaglio printing , watermark , Reserve bank number panel, LD mark , Topography , Micro-lettering and numbers and arrangement. In that significant elements are watermark , ink smear , security string , topography , numbers and place and microlettering. Anyway for machine based assessment, typically the accompanying strides to convey out by scientists.

- a. Pre-processing.
- b. Image Segmentation.
- c. Feature Extraction.
- d. Feature Matching or classifiers.

Individually ID performed by manual is an option exclusively for restricted amount of notes. Subsequently request an AI focused choice to perceive maybe the picture is genuine or counterfeit. Every year Bank of India experiences issue of fake cash notes or destroyed notes.

The material which are utilizing in each nation are unique. In India, cash notes are involved mash containing cotton and amber with specific colors to truly make the money takes note of that ought to be safe, intense, with quality to battle from wear and split and never to be faked without any problem. USD notes are delivered from cotton fiber paper, instead of wood fiber, which can be oftentimes applied to make famous paper.



Japanese banknotes are created from mitsumata (*Edgeworthia papyrifera* or Oriental paperbush), abaca pulp, and various filaments. Canada is exchanging their paper cash for plastic.

BSF seized counterfeit money notes of Rs. 2000 denomination with a presumptive worth of Rs 4.4 lakh from worldwide limit underneath Dhubri area of Assam last year and when BSF detailed that those notes beginning is cigarette paper.

"You will discover 16 principle components of an Indian money note, four that are imperceptible to the unaided eye. The FICN networks had illicit admittance to the material and had procured the specialty of reproducing Indian cash. All that changed get-togethers. Number cash seized by security or police powers recommend utilization of fabric," said an authority distributed at the Indo-Bangladesh line.

An assessment done by the RBI says that the measure of the phony notes in the FY 2017 has expanded by 20% and the amount stretched around 7.62 lac. The most assortment of phony notes were in the group of 500 and 2000 rupees. Specialists discovered 389 phony notes of Rs.2,000 division and a couple of heaps of fundamental sheets decrease to the estimations of money notes of Rs.2,000 and Rs.500 categories. Law requirement recuperated Rs 6.5 lakh in counterfeit cash of Rs 2,000 group from the denounced.

Fake recognition pen and finders are accessible in market, which to a great extent stresses to find the phony predicated on UV light, Watermark and Magnetic ink. In any event, when it's economical, every single store can't hold these. Furthermore, more over thing is probably going to be diverse predicated on its organization. Commonly phony appearance is doing by UV light and predicated on certain provisions manual checking. Counterfeit money location is extremely needed to find the cash approval demonstrating. To stop course of fake notes, a framework to find counterfeit notes should be made and to guarantee the financial security.(1)

## 1.2 MOTIVATION

The fundamental inspiration driving advancement of this venture was to make a framework for simple and speedy recognition of certified and phony money notes. This is a python based framework for programmed acknowledgment of safety provisions of money.

During 2010-11, the organization distinguished "4,23,539 episodes of FICN with a presumptive worth of over Rs 35 crore." The 2011-12 figures are higher. Gone are the days when a phony note could be distinguished by contact and feel: today, it has gotten practically difficult to make the qualification as forgers utilizing complex techniques and materials have prevailed with regards to duplicating practically all the security highlights.

Counterfeit picture location and its approval showing is a confounded district these days. Counterfeit cash discovery is established on norms. Picture fraud discovery have no norms. Envision in case of Fake cash discovery , researchers can focus on "state and cash note highlight" astute. In any case, in case of picture fraud, there are number explicit norms available, it should require some element extraction based assessment to find the provisions for grouping strategy if the scientist is prepared for include extraction based examination work.

### 1.3 ANACONDA

We have used the ANACONDA to implement our project. Anaconda constrictor is a distribution of the Python and R programming dialects for logical figuring (information science, AI applications, huge scope information preparing, prescient investigation, and so forth), that expects to improve on bundle the board and organization. The appropriation incorporates information science bundles reasonable for Windows, Linux, and macOS. It is created and kept up with by Anaconda, Inc., which was established by Peter Wang and Travis Oliphant in 2012. As an Anaconda, Inc. item, it is otherwise called Anaconda Distribution or Anaconda Individual Edition, while different items from the organization are Anaconda Team Edition and Anaconda Enterprise Edition, the two of which are not free.

Anaconda distribution appropriate accompanies more than 250 bundles consequently introduced, and more than 7,500 extra open-source bundles can be introduced from PyPI just as the conda bundle and virtual climate administrator. It additionally incorporates a GUI, Anaconda Navigator, as a graphical option in contrast to the order line interface (CLI).

We will be working on JUPYTER Notebook web application which comes along Anaconda editor.(2)

### 1.4 LITERATURE REVIEW

- In this project, we utilize a few administered AI calculations to fabricate models that recognize veritable and fake banknotes. We will examine these calculations to pick the best up-and-comer, and afterward attempt to additionally enhance the calculation to best model the information. Our objective with this execution is to precisely anticipate whether a money note is real or phony. This kind of examination is required, since each significant economy is overwhelmed with fake notes.

- Various papers are available that contain information on Fake currency detection. Nobody can be 100 percent certain of the manual acknowledgment thus the framework was proposed to contrast pictures of cash and the put away information and recognize whether the money is phony or certifiable. This framework utilized JUPYTER to run and play out the tasks of the framework. The component extraction measure generally centers around HSV upsides of the money where the picture is partitioned into blocks and the tasks are performed on the ROI.
- There is an overview paper that proposes a framework to improve the money discovery framework particularly in business regions like banks, shopping centers, and so forth Here some unique pre-preparing methods were referenced, for example, Radiometric adjustments and Geometric rectifications for rectifying ghastly blunders or contortions because of sensor-Earth geometric varieties and so on. Various papers were looked at and results were given dependent on the exactness rate acquired by utilizing various strategies.
- A framework was proposed to recognize counterfeit cash dependent on various highlights that can be extricated for correlation. Different techniques are utilized at various stages of histogram balance, utilizing highlight vectors to put away extricated highlights, and so forth The highlights that were utilized for cash discovery were security string, RBI miniature print also, serial number recognition.

## 1.5 OBJECTIVE

The main objective is to apply various supervised learning methods on the dataset created by data augmentation to check whether a 2000 INR note is fake or real. For this we will create a React app in which we will take image of 2000 Rs. as input from the user and then we will predict the Note if it is fake or real.

# CHAPTER 2

## System Architecture/ Methodology

To analyze any wireless ad hoc network we need a reference model. To understand the concept of ad hoc network we have considered the model which is discussed below.

### 2.1 ARCHITECTURE

We will be using various supervised learning methods to predict and train our model.

#### 2.1.1 Supervised Learning

(3)Supervised Learning, otherwise called supervised machine learning, is a subcategory of AI and machine learning. It is characterized by its utilization of marked datasets to prepare calculations that to arrange information or anticipate results precisely. As info information is taken care of into the model, it changes its loads until the model has been fitted fittingly, which happens as a component of the cross approval measure. Managed learning assists associations with settling for an assortment of true issues at scale, for example, grouping spam in a different envelope from your inbox.

Supervised learning utilizes a preparation set to help models to yield the ideal yield. This preparation dataset incorporates inputs and right yields, which permit the model to learn over the long run. The calculation estimates its exactness through the misfortune work, changing until the blunder has been adequately limited.

supervised learning can be isolated into two sorts of issues when information mining—classification and regression:

Classification utilizes a calculation to precisely allot test information into explicit classes. It perceives explicit elements inside the dataset and endeavors to make a few

inferences on how those elements ought to be marked or characterized. Normal grouping calculations are straight classifiers, support vector machines (SVM), choice trees, k-closest neighbor, and arbitrary woods, which are depicted in more detail beneath.

Regression is utilized to comprehend the connection among reliant and autonomous factors. It is ordinarily used to make projections, for example, for deals income for a given business. Direct relapse, strategic relapse, and polynomial relapse are famous relapse calculations. We have used few supervised machine learning models to build the trained models

## 2.2 Machine learning Models

After visualizing the data we will be applying some supervised machine learning models to train our data-set.

### 2.2.1 Support Vector Machine

"Support Vector Machine" (SVM) is a supervised machine learning calculation that can be utilized for both classification or regression difficulties. Nonetheless, it is for the most part utilized in classification issues. In the SVM calculation, we plot every data thing as a point in n-dimensional space (where n is various provisions you have) with the value of each component being the value of a specific coordinate. Then, at that point, we perform classification by tracking down the hyper-plane that separates the two classes quite well.

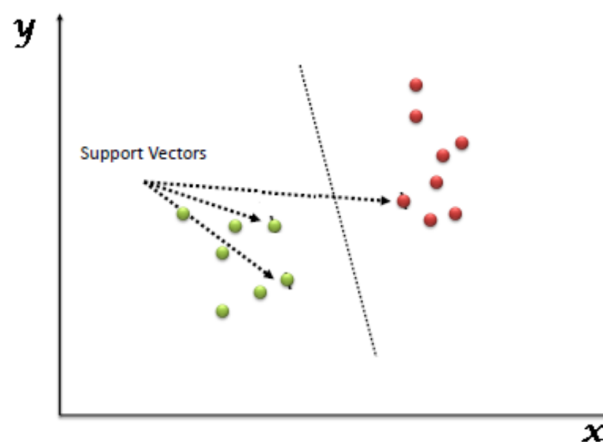


Figure 2.1: SVM.

Support Vectors are just the directions of individual perception. The SVM classifier is

a frontier that best isolates the two classes (hyper-plane/line).

After this we select the hyper plane to separate the data points to be classified.

#### 2.2.1.1 Pros:

- It functions admirably with an unmistakable edge of partition
- It is powerful in high dimensional spaces.
- It is powerful in situations where the quantity of measurements is more noteworthy than the quantity of tests.
- It utilizes a subset of preparing focuses in the choice capacity (called support vectors), so it is likewise memory effective.

#### 2.2.1.2 Cons:

- It doesn't perform well when we have huge informational index on the grounds that the necessary preparing time is higher
- It additionally doesn't perform well indeed, when the informational index has more commotion for example target classes are covering
- SVM doesn't straightforwardly give likelihood assesses, these are determined utilizing a costly five-overlay cross-approval. It is remembered for the connected SVC strategy for Python scikit-learn library.

### 2.2.2 KNN algo

The shortened form KNN means "K-Nearest Neighbor". It is a supervised machine learning calculation. The calculation can be utilized to tackle both classification and regression issues

.

The quantity of closest neighbors to another unknown variable that must be anticipated or characterized is signified by the symbol 'K'.

The KNN calculation's point is to find the entirety of the nearest neighbors around another unknown data point to sort out what class it has a place with. It's a distance-based methodology.

It is always recommended to select a odd value for 'k'.(4)

### 2.2.2.1 Selecting 'K' value

The effect of choosing a more modest or bigger K value on the model:

- **Bigger K value:** The instance of underfitting happens when the worth of  $k$  is expanded. For this situation, the model would not be able to accurately learn on the preparation information.
- **Smaller K value:** The state of overfitting happens when the worth of  $k$  is more modest. The model will catch the entirety of the preparation information, including commotion. The model will perform inadequately for the test information in this situation.

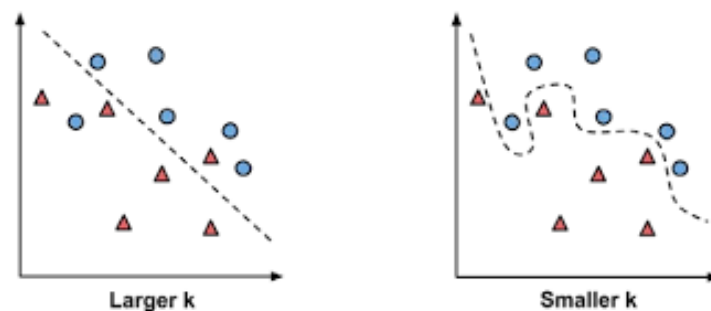


Figure 2.2: k value

### 2.2.2.2 How does it work?

- **Classification** At the point when the issue statement is of 'classification' type, KNN will in general utilize the idea of "Majority Voting". Inside the given scope of  $K$  values, the class with the most votes is picked.
- **Regression** KNN utilizes a mean/normal technique for foreseeing the value of new data. In view of the value of  $K$ , it would think about the entirety of the closest neighbors.

The calculation attempts to calculate the mean for every one of the closest neighbors' qualities until it has distinguished all the closest neighbors inside a specific scope of the  $K$  worth.

## 2.2.3 Gradient Boosting algo

A Gradient Boosting Machine or GBM consolidates the predictions from different choice trees to produce the last prediction. Remember that every one of the weak learner in an gradient boosting machine are choice trees.

However, in the event that we are utilizing a similar algorithm, how is utilizing 100 choice trees better compared to utilizing a solitary choice tree? How do distinctive decision trees catch various signs/info from the data?

Here is the trick– the nodes in each choice tree take an alternate subset of elements for choosing the best split. This implies that the individual trees aren't no different either way and subsequently they can catch various signs from the information.

Also, each new tree considers the blunders or mix-ups made by the past trees. Along these lines, each progressive choice tree is based on the blunders of the past trees. This is the way the trees in an angle boosting machine calculation are fabricated successively.

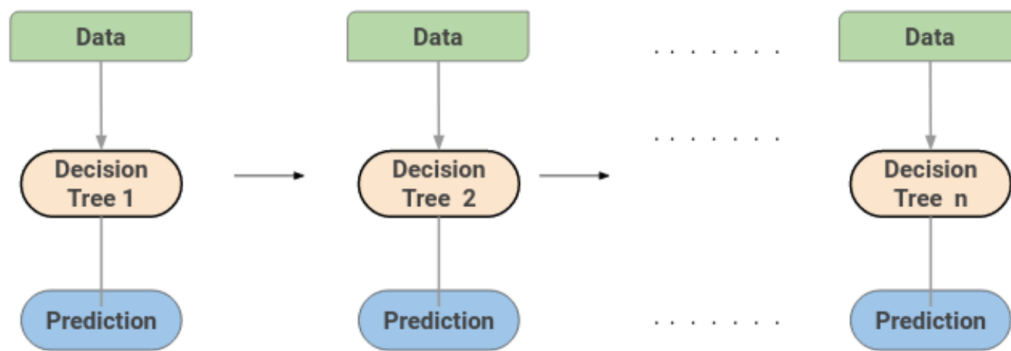


Figure 2.3: gradient boosting algo

Gradient boosting includes three components:

1. A loss function to be streamlined.
2. A weak learner to make forecasts.
3. An added substance model to add weak learners to limit the loss work.

## 2.3 Previously Completed Tasks

The data set to build the model was available on the internet in the form of extracted values of the image : the extracted values were:

- Variance
- Skewness
- Kurtosis



- Entropy
- Class (target value)

but this data was not giving proper information about the images that were used to extract data that's why i thought to develop my own dataset using images and then by applying data augmentation to it.

### **2.3.1 New 2000 Rs. note data-set**

At first, there were 3 smart-phone camera pictures every one of a genuine new 2000 rupee note and the copy of a 2000 rupee note (to reenact counterfeit notes) which was destroyed following tapping the pictures. The pictures were taken by holding the note and its copy against light. This is a necessity as we need all the security highlights in a genuine money note uncovered, which include highlights like the watermark of Mahatma Gandhi and the transparent register. In each picture, the money note covered roughly the whole edge of the picture. This gave us an aggregate of 6 introductory pictures in the informational index.

### **2.3.2 Data Augmentation**

Data augmentation is a methodology that empowers experts to fundamentally expand the variety of information accessible for preparing models, without really gathering new information. Data augmentation strategies, for example, editing, cushioning, and flat flipping are usually used to prepare huge neural organizations.

We at that point apply accompanying three kinds of changes for every unique picture in both the data-sets to expand them.

#### **2.3.2.1 Grayscale Conversion**

The algorithm that our program utilizes is grayscale calculation, which changes a picture from the RGB to the grayscale area. The explanation that we play out this interaction is that it is hard to do our tasks in every one of the shading space freely, and changing pictures over to grayscale and working with light power as opposed to colors improves on our concern. Furthermore, by utilizing grayscale pictures rather than shading pictures, we can save some memory.(5)

#### **2.3.2.2 Image Translation**

Translated each picture with a step of 5 pixels along both axis along every one of the 4 headings. The reach for interpretation was - 30 pixels to +30 pixels. The first picture

moves withing the edge and dark pixels make up for the shortfall made consequently.

#### **2.3.2.3 Image Rotation**

Turned each picture in the angle scope of - 10 to +10 degrees with a stage equivalent to 0.5 degree. The axis for revolution goes through the focal point of the picture and dark pixels make up for the shortfall made by revolution.

#### **2.3.2.4 Perspective Translation**

Applied perspective changes on each picture to zoom in the scope of 100-130% and zoom out in the scope of 100-70%. This additional a sum of 60 pictures for each picture in the data-set.

**After performing these 4 operation on our images we will get data of around 1600 images.**

# CHAPTER 3

## Tasks Completed

After creating the data-set we visualized the data-set by using below listed methods.

### 3.1 Matplotlib

(6)Matplotlib is a Python 2D plotting library which produces distribution quality figures in an assortment of printed copy designs and intuitive conditions across stages. Matplotlib can be utilized in Python scripts, the Python and IPython shells, the Jupyter note pad, web application workers, and four graphical UI tool compartments.

#### 3.1.1 Histograms plot

A histogram is a plot of the recurrence dispersion of numeric exhibit by parting it to little approach estimated receptacles.

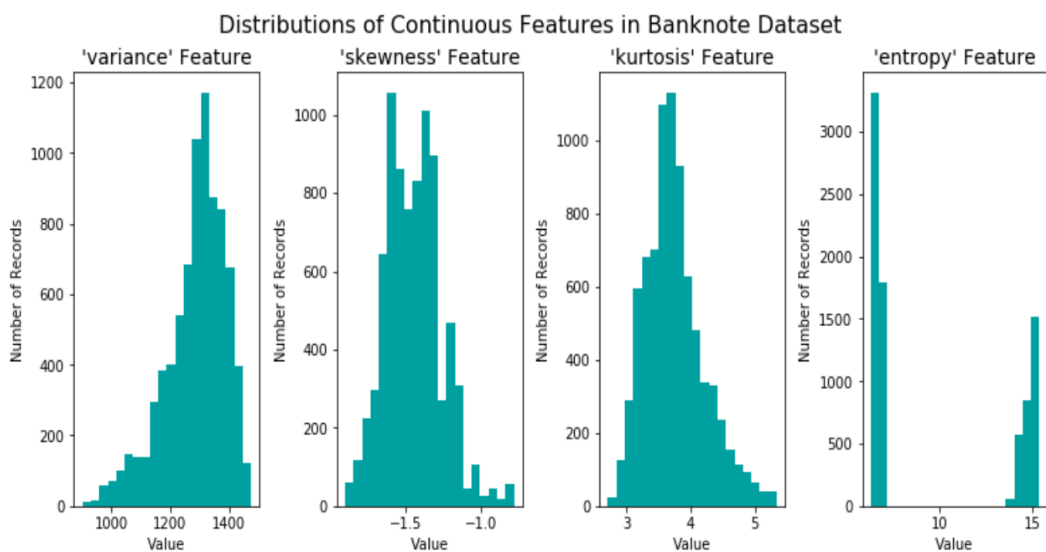


Figure 3.1: Distribution chart for model

### 3.1.2 Scatter plot

Scatter plots are helpful for showing the connection between two factors. Any connection between factors or exceptions in the information can be handily spotted utilizing scatter plots.

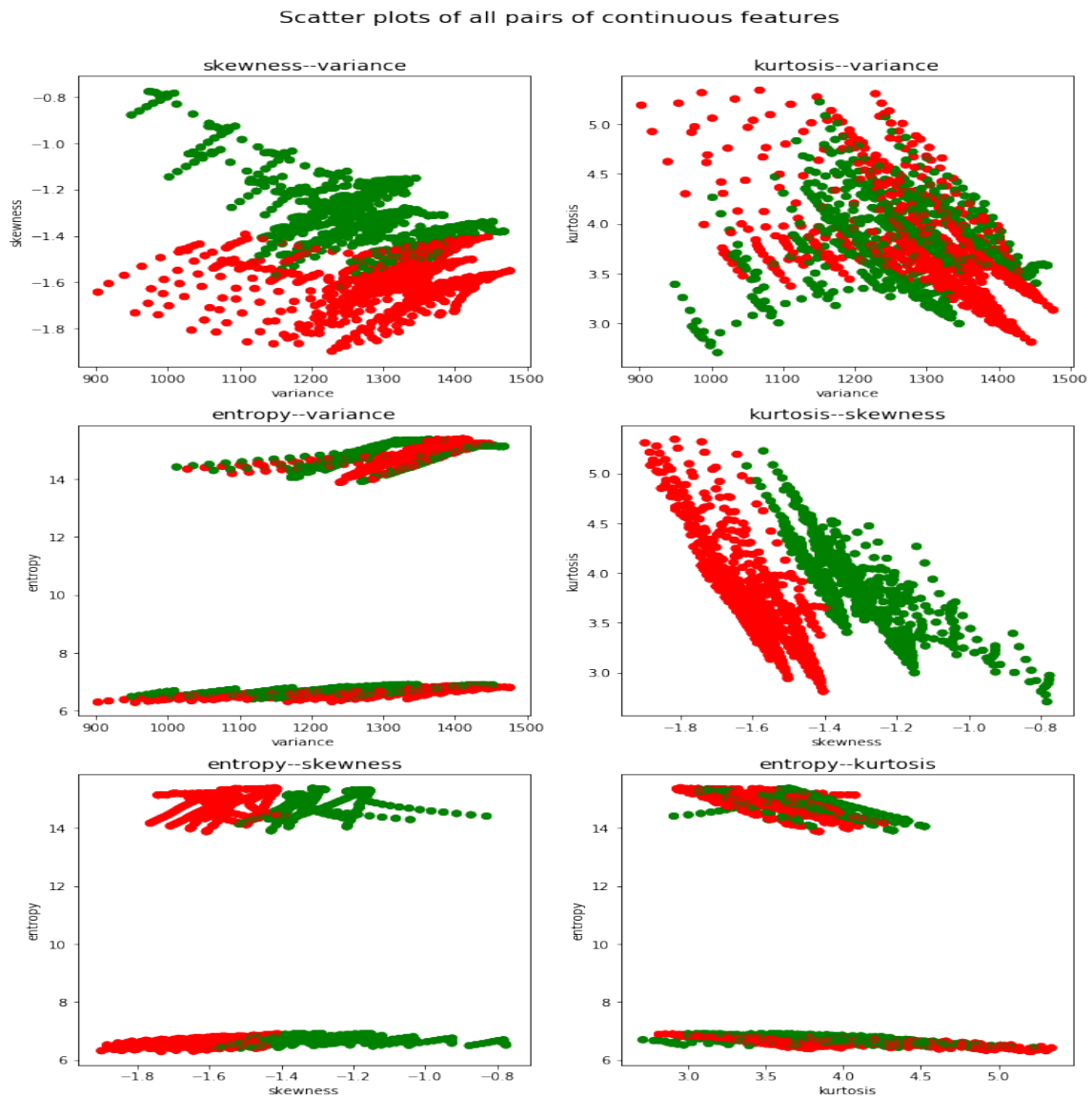


Figure 3.2: Scatter plots for model

## 3.2 MinMaxScaler

For each value in a feature, MinMaxScaler deducts the base worth in the component and afterward isolates by the reach. The reach is the contrast between the first greatest and unique least.

MinMaxScaler preserves the state of the original distribution. It doesn't seriously

change the data installed in the first information.

Note that MinMaxScaler doesn't diminish the significance of outliers.

### 3.3 Splitting Dataset

After these steps we splitted the dataset in Training set and Testing set in 6:4 ratio respectively. After splitting we got 4859 rows in our training set and 3240 rows in our testing set.

### 3.4 Applying Models On the Dataset

After splitting data we have applied Gradient boosting, Support Vector Machine and K neighbours classifiers and checked which one of these works better with our dataset.

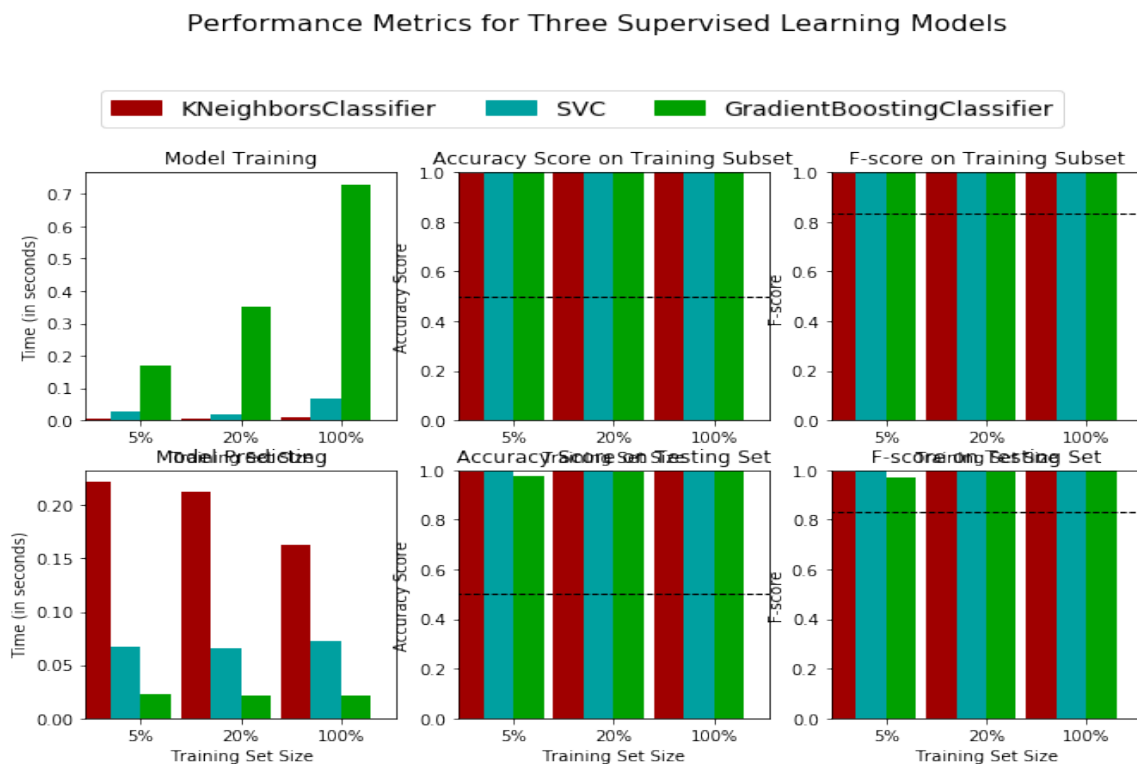


Figure 3.3: Performance Metrics for model

Since our dataset was made using few images of 2000 Rs. note by data augmentation that's why these models are giving such high accuracies. We have used KNN classifier for our model.

## 3.5 Pickle file

After applying model on our data set we have saved the whole model into a pickle file so that we don't have to train model again and again when we deploy it on the web.

## 3.6 Deploying Project on Heroku using Flask

### 3.6.1 What is Heroku?

Heroku is a cloud service stage whose popularity has filled lately. Heroku is so natural to utilize that it's a top decision for some, improvement projects.

With an uncommon spotlight on supporting client centered applications, it empowers basic application advancement and sending. Since the Heroku stage oversees equipment and workers, organizations that utilization Heroku can zero in on idealizing their applications. Furthermore, not the foundation that upholds them.

### 3.6.2 What is Flask?

Flask is a miniature web structure written in Python. It is delegated as a microframework on the grounds that it doesn't need specific tools or libraries. It has no data base abstraction layer, structure approval, or whatever other segments where prior outsider libraries give normal capacities. Nonetheless, Flask upholds augmentations that can add application includes as though they were executed in Flask itself. Extensions exist for object-social mappers, structure approval, transfer dealing with, different open verification advancements and a few normal system related devices.

Additional time goes towards guaranteeing that clients get the best encounters as could really be expected.

Flask is a web application system written in Python. Flask depends on the Werkzeug WSGI tool stash and Jinja2 layout engine. Both are Pocco projects. This article spins around how to send a flask application on Heroku. **Necessary things to deploy model:**

1. Python
2. PIP
3. Heroku CLI
4. git

### 3.6.3 Flask REST Api

REST represents REpresentational State Transfer and is an engineering style utilized in present day web development. It characterizes a set of rules/imperatives for a web application to send and get information.

There are two ways of creating a REST API in Flask:

1. Using Flask without any external libraries
2. Using flask restful library

**(7) We have created a Flask api which uses our pickle file of ML model. In this api whenever we create a POST request to this server with image data it puts the image data in the model and then throws an output depicting whether the image is real 2000 Rs. note or fake in the form of JSON object.**

### 3.6.4 REACT APP

React.js is the most well known front-end JavaScript library for building Web applications. React.js or Reactjs or essentially React are various ways of addressing React.js.

React is a JavaScript library made for building quick and intuitive UIs for web and versatile applications. It is an open-source, part based, front-end library capable just for the application's view layer. In Model View Controller (MVC) engineering, the view layer is liable for how the application looks and feels. React was made by Jordan Walke, a computer programmer at Facebook.

(8)

**For the better experience we have built a React app which takes an image as input and sends it to the flask api we have built in POST request and takes back the response sent by Flask Api and displays it.**

After all these steps we have deployed our React app and Flask api on Heroku using heroku cli to the domain <https://currency-detection.herokuapp.com/>

### 3.7 Flow chart depicting model stages

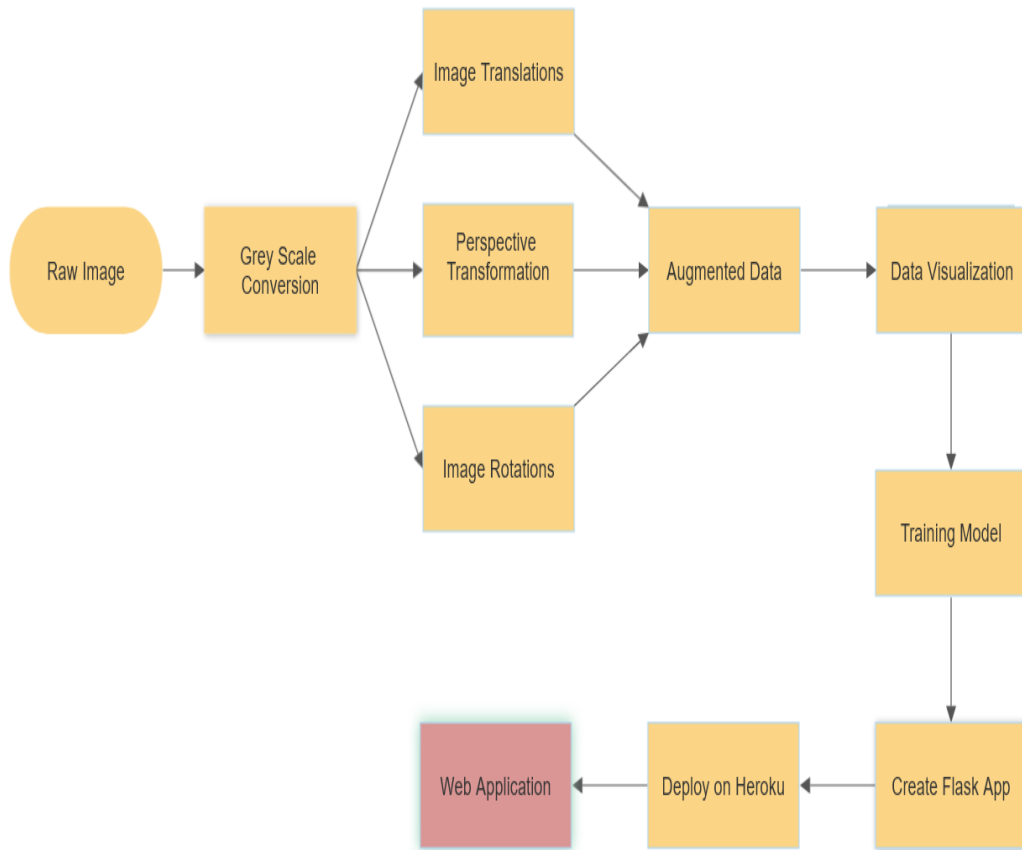


Figure 3.4: Flow chart for model



# CHAPTER 4

## Results and Future Implementations

We will go to this domain <https://currency-detection.herokuapp.com/> to test our web app.

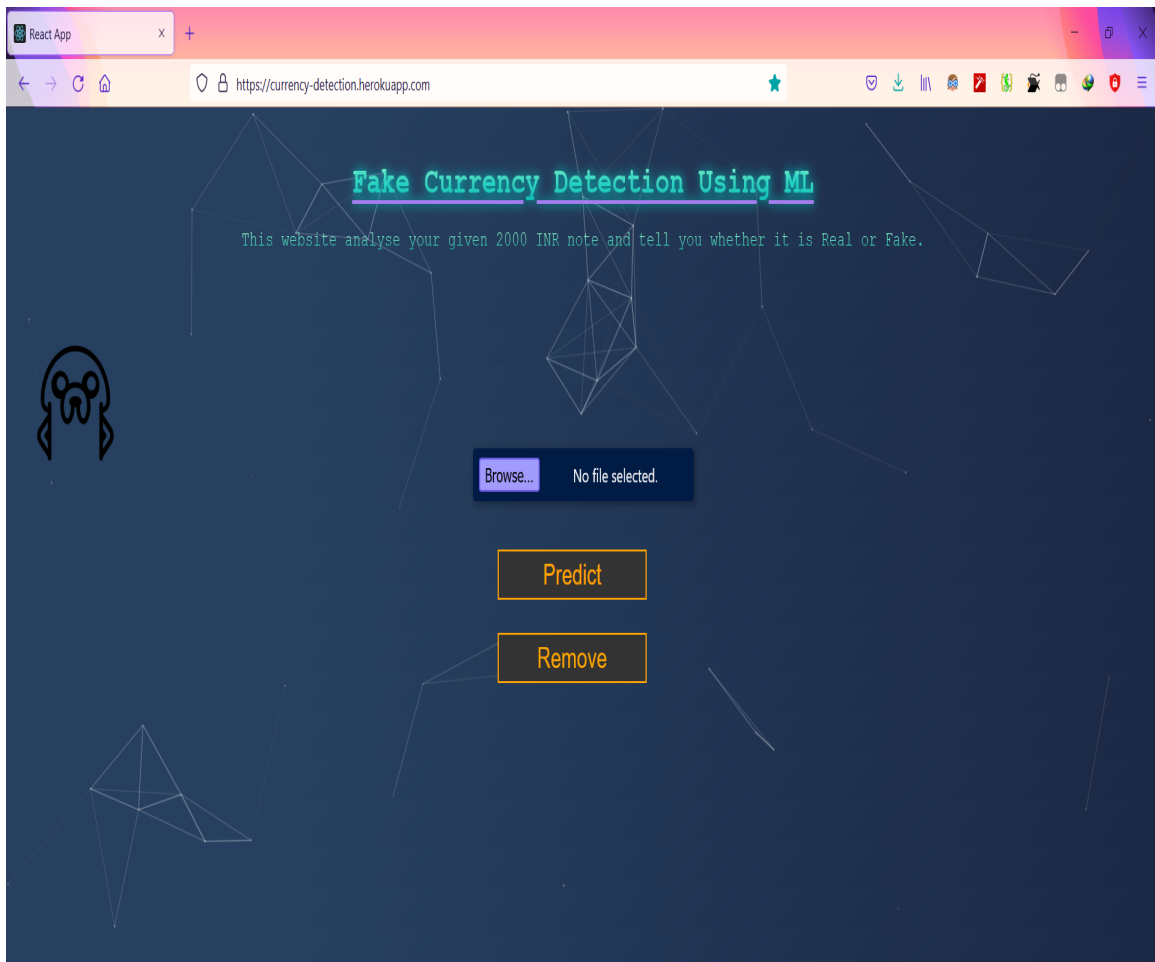


Figure 4.1: Intro page

This is how our web app looks. There is a image selector in the middle. We will upload our image of 2000 Rs. note in that selector and check it.

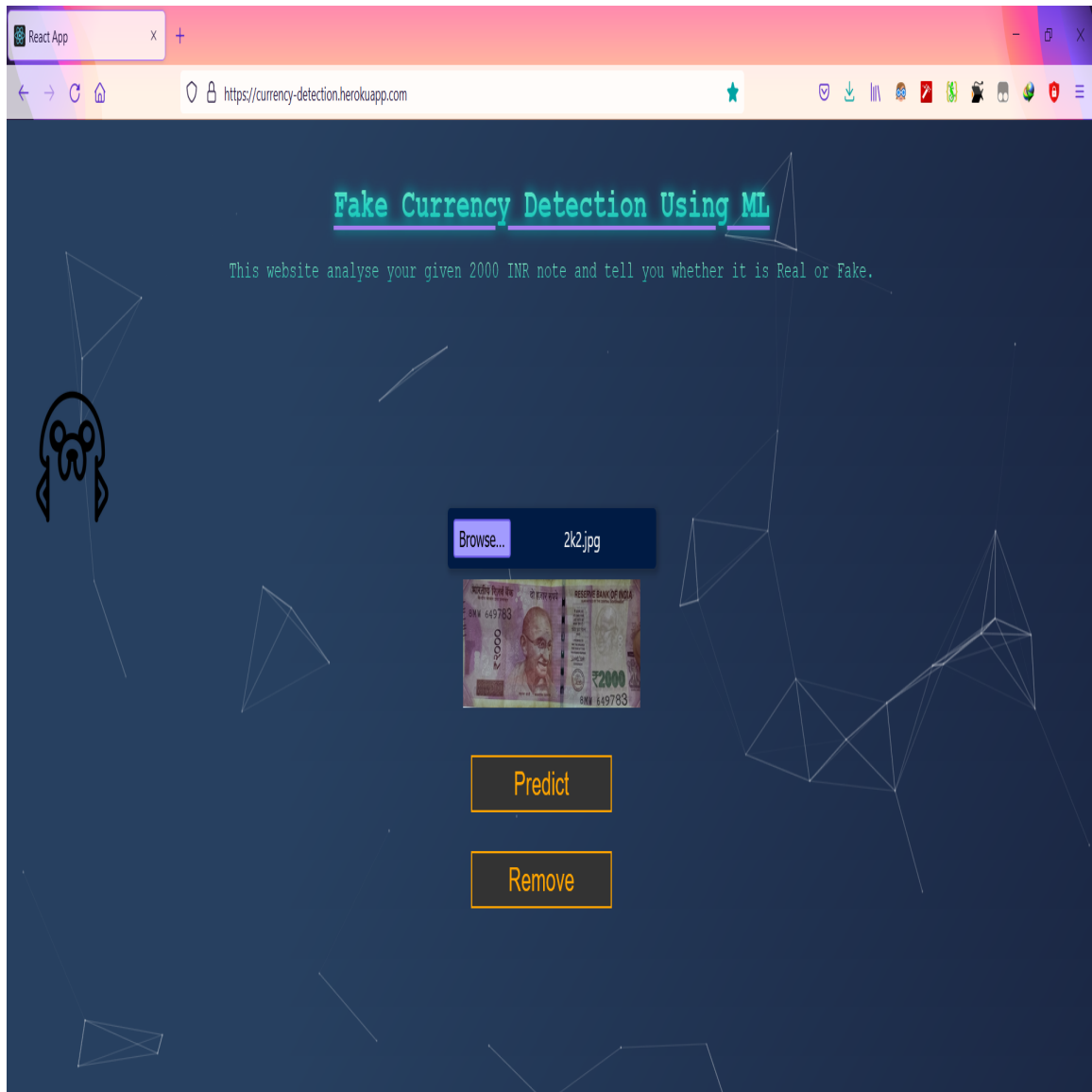


Figure 4.2: Image selected

We have selected an image of real 2000 Rs. note clicked through my phone in front of light.



Figure 4.3: displayed result for real note

On pressing *Predict* button we can see the result displayed there depicting that the *Note is Real* which is true.

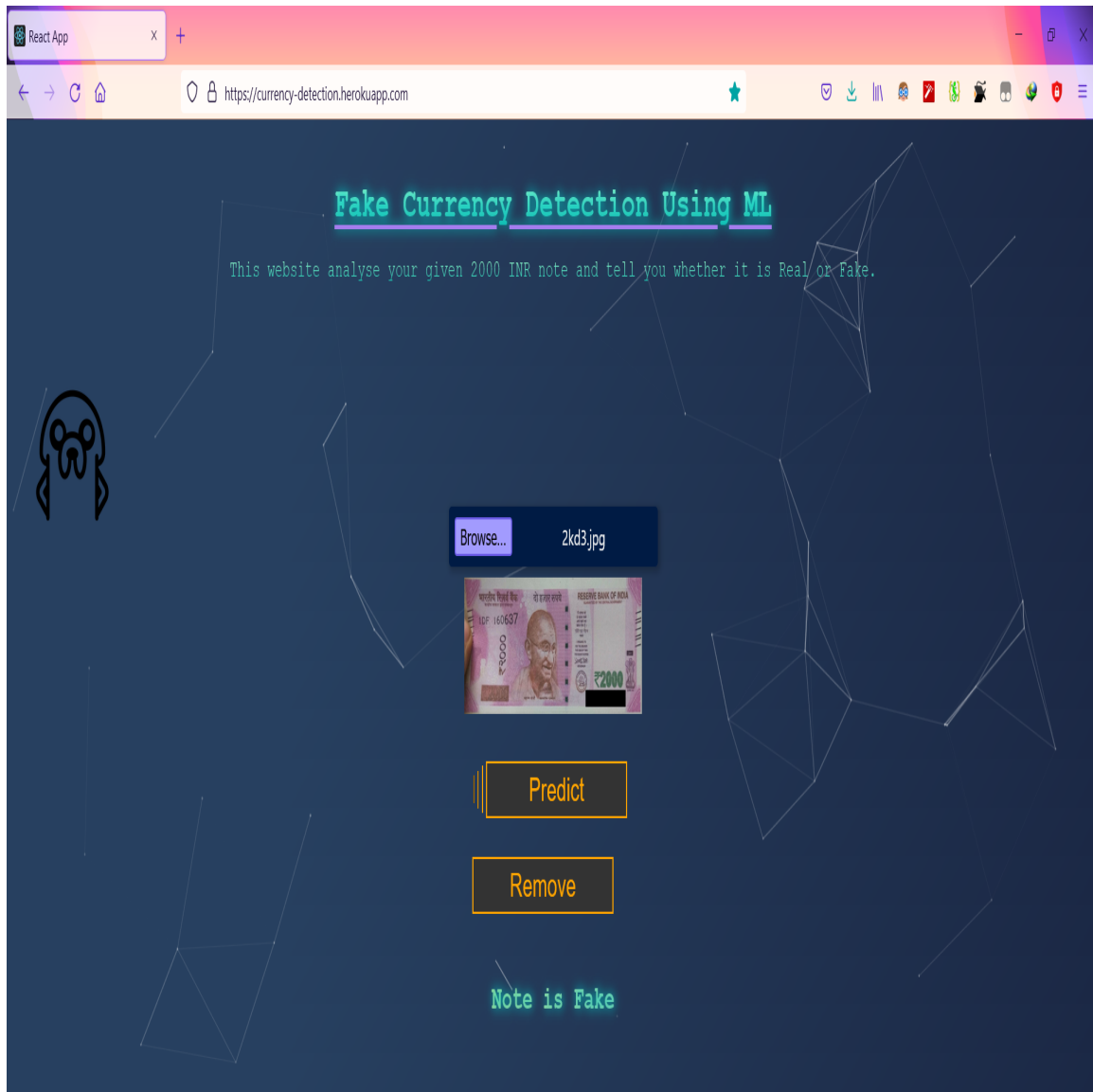


Figure 4.4: displayed result for fake note

This time we have tested with a fake image of 2000 Rs. note and it depicts that the *Note is Fake*

## 4.1 Future Implementations

As of now we have deployed our model for 2000Rs. note only due to unavailability of data. But in future we may consider applying dataset of other Indian rupees note or even foreign currency too. We can train our model on different datasets of different currency notes and then we may give options in our web app to users in which he can select the type of note he wants to check.

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