TA2: Marathi Handwriting/Text Recognition using Transformer-based OCR + NLP

Steps to Follow:

1. **Capture or upload** an image of a handwritten page written in your mother tongue.
2. **Preprocess the image** to improve clarity (e.g., convert to grayscale, resize, denoise).
3. **Use OCR** to extract text from the image (e.g., Transformer based OCR with language pack for your language).
4. **Normalize** the extracted text (remove noise, unwanted characters, fix encoding issues).
5. **Tokenize** the text using an appropriate NLP tokenizer for your language.
6. **Marathi Named Entity Recognition (NER)**, Perform Named Entity Recognition on the extracted Marathi text to identify entities such as names of people, places, organizations, dates, etc.
7. **Performing NLP task**, such as:
   - Language detection
   - Translation
8. **Display the final output** in a readable format (console, notebook cell, or GUI).
9. **Sentiment Analysis:**
   Analyze the sentiment (positive, negative, or neutral) of the text extracted through OCR to understand the emotional tone of the content.
10. **Summarization** of the extracted text

Step 0: Install & Import Required Libraries

```
# Install All Required Python Libraries

!pip install gdown
!pip install indic-nlp-library
!pip install pytesseract
!pip install opencv-python-headless
!pip install googletrans==4.0.0-rc1
!pip install deep-translator
!pip install langdetect

# Update and Install All Required Libraries and Tools

!sudo apt-get update
!sudo apt-get upgrade
!sudo apt-get install -y tesseract-ocr
!sudo apt-get install -y tesseract-ocr-mar
!git clone https://github.com/anoopkunchukuttan/indic_nlp_resources.git
```

```
Requirement already satisfied: gdown in /usr/local/lib/python3.11/dist-packages (5.2.0)
Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.11/dist-packages (from gdown) (4.13.3)
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-packages (from gdown) (3.18.0)
Requirement already satisfied: requests[socks] in /usr/local/lib/python3.11/dist-packages (from gdown) (2.32.3)
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages (from gdown) (4.67.1)
Requirement already satisfied: soupsieve>1.2 in /usr/local/lib/python3.11/dist-packages (from beautifulsoup4->gdown) (2.6)
Requirement already satisfied: typing-extensions>=4.0.0 in /usr/local/lib/python3.11/dist-packages (from beautifulsoup4->gdown) (4.13.1)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests[socks]->gdown) (3.4.1)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests[socks]->gdown) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests[socks]->gdown) (2.3.0)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests[socks]->gdown) (2025.1.31)
Requirement already satisfied: PySocks!=1.5.7,>=1.5.6 in /usr/local/lib/python3.11/dist-packages (from requests[socks]->gdown) (1.7.1)
Collecting indic-nlp-library
  Downloading indic_nlp_library-0.92-py3-none-any.whl.metadata (5.7 kB)
Collecting sphinx-argparse (from indic-nlp-library)
  Downloading sphinx_argparse-0.5.2-py3-none-any.whl.metadata (3.7 kB)
Collecting sphinx-rtd-theme (from indic-nlp-library)
  Downloading sphinx_rtd_theme-3.0.2-py2.py3-none-any.whl.metadata (4.4 kB)
Collecting morfessor (from indic-nlp-library)
  Downloading Morfessor-2.0.6-py3-none-any.whl.metadata (628 bytes)
Requirement already satisfied: pandas in /usr/local/lib/python3.11/dist-packages (from indic-nlp-library) (2.2.2)
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (from indic-nlp-library) (2.0.2)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-packages (from pandas->indic-nlp-library) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas->indic-nlp-library) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas->indic-nlp-library) (2025.2)
Collecting sphinx>=5.1.0 (from sphinx-argparse->indic-nlp-library)
  Downloading sphinx-8.2.3-py3-none-any.whl.metadata (7.0 kB)
Collecting docutils>=0.19 (from sphinx-argparse->indic-nlp-library)
  Downloading docutils-0.21.2-py3-none-any.whl.metadata (2.8 kB)
Collecting sphinxcontrib-jquery<5,>=4 (from sphinx-rtd-theme->indic-nlp-library)
  Downloading sphinxcontrib_jquery-4.1-py2.py3-none-any.whl.metadata (2.6 kB)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.8.2->pandas->indic-nlp-library) (1.17.0)
Collecting sphinxcontrib-applehelp>=1.0.7 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading sphinxcontrib_applehelp-2.0.0-py3-none-any.whl.metadata (2.3 kB)
Collecting sphinxcontrib-devhelp>=1.0.6 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading sphinxcontrib_devhelp-2.0.0-py3-none-any.whl.metadata (2.3 kB)
Collecting sphinxcontrib-htmlhelp>=2.0.6 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading sphinxcontrib_htmlhelp-2.1.0-py3-none-any.whl.metadata (2.3 kB)
Collecting sphinxcontrib-jsmath>=1.0.1 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading sphinxcontrib_jsmath-1.0.1-py2.py3-none-any.whl.metadata (1.4 kB)
Collecting sphinxcontrib-qthelp>=1.0.6 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading sphinxcontrib_qthelp-2.0.0-py3-none-any.whl.metadata (2.3 kB)
Collecting sphinxcontrib-serializinghtml>=1.1.9 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading sphinxcontrib_serializinghtml-2.0.0-py3-none-any.whl.metadata (2.4 kB)
Requirement already satisfied: Jinja2>=3.1 in /usr/local/lib/python3.11/dist-packages (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library) (3.1.6)
Requirement already satisfied: Pygments>=2.17 in /usr/local/lib/python3.11/dist-packages (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library) (2.19.1)
Collecting snowballstemmer>=2.2 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading snowballstemmer-2.2.0-py2.py3-none-any.whl.metadata (6.5 kB)
Collecting babel>=2.13 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading babel-2.17.0-py3-none-any.whl.metadata (2.0 kB)
Collecting alabaster>=0.7.14 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading alabaster-1.0.0-py3-none-any.whl.metadata (2.8 kB)
Collecting imagesize>=1.3 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading imagesize-1.4.1-py2.py3-none-any.whl.metadata (1.5 kB)
Requirement already satisfied: requests>=2.30.0 in /usr/local/lib/python3.11/dist-packages (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library) (2.32.3)
Collecting roman-numerals-py>=1.0.0 (from sphinx>=5.1.0->sphinx-argparse->indic-nlp-library)
  Downloading roman_numerals_py-3.1.0-py3-none-any.whl.metadata (3.6 kB)
```

```
# Import All Required Libraries

import gdown
from google.colab import files
from PIL import Image
import numpy as np
import cv2
import torch
import pytesseract
import re
import pandas as pd
import matplotlib.pyplot as plt
from deep_translator import GoogleTranslator
from indicnlp.tokenize.indic_tokenize import trivial_tokenize
from langdetect import detect

!huggingface-cli clear-cache

from huggingface_hub import login
login()
```

Step 1: Upload Image

```
# Option for the user to try dynamic upload quickly
user_choice = input("Would you like to skip static image and upload a dynamic image? (y/n) [default: n]: ").strip().lower()

if user_choice == 'y':
    print("Proceeding with dynamic image upload...")
    # Dynamic Image Uploads
    uploaded = files.upload()  # Upload image from user
    filename = list(uploaded.keys())[0]  # Get the name of the uploaded file

    # Open image with PIL
    img_pil = Image.open(filename)
    img_pil.show()

else:
    # Static Image Uploads
    file_id = '1z526YFcKb2g8HftFLPhH9Gg25I-jNtHh'  # Extract the file ID from the shared link
    url = f'https://drive.google.com/uc?export=download&id={file_id}'

    try:
        # Try downloading the static image using gdown
        gdown.download(url, 'marathi.gif', quiet=False)

        # Open the image with PIL
        img_pil = Image.open('marathi.gif')
        img_pil.show()

    except Exception as e:
        # If static image download fails, handle with dynamic image upload
        print(f"Static image download failed with error: {e}")
        print("Proceeding with dynamic image upload...")

        # Dynamic Image Uploads
        uploaded = files.upload()  # Upload image from user
        filename = list(uploaded.keys())[0]  # Get the name of the uploaded file

        # Open image with PIL
        img_pil = Image.open(filename)
        img_pil.show()
```

```
Would you like to skip static image and upload a dynamic image? (y/n) [default: n]: n
Downloading...
From: https://drive.google.com/uc?export=download&id=1z526YFcKb2g8HftFLPhH9Gg25I-jNtHh
To: /content/marathi.gif
100%|████████| 7.23k/7.23k [00:00<00:00, 14.4MB/s]
```

Step 2: Preprocess Image

```
# Convert PIL to OpenCV format
img_cv = cv2.cvtColor(np.array(img_pil), cv2.COLOR_RGB2BGR)

# Preprocess image
gray = cv2.cvtColor(img_cv, cv2.COLOR_BGR2GRAY)
blurred = cv2.GaussianBlur(gray, (3, 3), 0)
_, thresh = cv2.threshold(blurred, 0, 255, cv2.THRESH_BINARY + cv2.THRESH_OTSU)

#Show the preprocessed image
plt.imshow(thresh, cmap='gray')
plt.title("Preprocessed Image")
plt.axis('off')
plt.show()
```

Step 3: Transformer based OCR Extraction

TrOCR

```
from transformers import TrOCRProcessor, VisionEncoderDecoderModel

# Load the pre-trained TrOCR model and processor
processor = TrOCRProcessor.from_pretrained("microsoft/trocr-base-handwritten")
model = VisionEncoderDecoderModel.from_pretrained("microsoft/trocr-base-handwritten")
model.eval()  # inference mode only

# Optional: use GPU if available
device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
```

```
model.to(device)

# Step 1: Load or convert the image
# If using OpenCV image (NumPy array), convert to PIL
if isinstance(img_pil, np.ndarray):
    img_pil_ = Image.fromarray(img_pil)

# Step 2: Preprocess (resize and RGB)
img_pil_ = img_pil.convert("RGB")
img_pil_ = img_pil_.resize((384, 384))

# Step 3: Feature extraction
pixel_values = processor(images=img_pil_, return_tensors="pt").pixel_values.to(device)

# Step 4: Generate text from image
with torch.no_grad():
    generated_ids = model.generate(pixel_values)
    generated_text = processor.batch_decode(generated_ids, skip_special_tokens=True)[0]

print("\n📌 OCR Text with TrOCR:\n", generated_text)
```

```
/usr/local/lib/python3.11/dist-packages/huggingface_hub/utils/_auth.py:94: UserWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings tab (https://huggingface.co/settings/tokens), set it as secret in your Google Colab and restart your session.
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access public models or datasets.
  warnings.warn(
preprocessor_config.json: 100%  224/224 [00:00<00:00, 29.2kB/s]
Using a slow image processor as `use_fast` is unset and a slow processor was saved with this model. `use_fast=True` will be the default behavior in v4.52, even if the model was saved with a slow processor. This will result in minor differences in outputs. You'll still be able to use a slow processor with `use_fast=False`.
tokenizer_config.json: 100%  1.12k/1.12k [00:00<00:00, 157kB/s]
vocab.json: 100%  899k/899k [00:00<00:00, 4.60MB/s]
merges.txt: 100%  456k/456k [00:00<00:00, 31.8MB/s]
special_tokens_map.json: 100%  772/772 [00:00<00:00, 113kB/s]
config.json: 100%  4.17k/4.17k [00:00<00:00, 636kB/s]
model.safetensors: 100%  1.33G/1.33G [00:08<00:00, 151MB/s]
Config of the encoder: <class 'transformers.models.vit.modeling_vit.ViTModel'> is overwritten by shared encoder config: ViTConfig {
  "attention_probs_dropout_prob": 0.0,
  "encoder_stride": 16,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.0,
  "hidden_size": 768,
  "image_size": 384,
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "layer_norm_eps": 1e-12,
  "model_type": "vit",
  "num_attention_heads": 12,
  "num_channels": 3,
  "num_hidden_layers": 12,
  "patch_size": 16,
  "pooler_act": "tanh",
  "pooler_output_size": 768,
  "qkv_bias": false,
  "torch_dtype": "float32",
  "transformers_version": "4.51.1"
}

Config of the decoder: <class 'transformers.models.trocr.modeling_trocr.TrOCRForCausalLM'> is overwritten by shared decoder config: TrOCRConfig {
  "activation_dropout": 0.0,
  "activation_function": "gelu",
  "add_cross_attention": true,
  "attention_dropout": 0.0,
  "bos_token_id": 0,
  "classifier_dropout": 0.0,
  "cross_attention_hidden_size": 768,
  "d_model": 1024,
  "decoder_attention_heads": 16,
  "decoder_ffn_dim": 4096,
  "decoder_layerdrop": 0.0,
  "decoder_layers": 12,
  "decoder_start_token_id": 2,
  "dropout": 0.1,
  "eos_token_id": 2,
  "init_std": 0.02,
  "is_decoder": true,
  "layernorm_embedding": true,
  "max_position_embeddings": 512,
  "model_type": "trocr",
  "pad_token_id": 1,
  "scale_embedding": false,
  "use_cache": false,
  "use_learned_position_embeddings": true,
  "vocab_size": 50265
}

You should probably TRAIN this model on a down-stream task to be able to use it for predictions and inference.
config.json: 100%  728/728 [00:00<00:00, 26.4kB/s]
model.safetensors: 100%  950M/950M [00:06<00:00, 154MB/s]
tokenizer_config.json: 100%  1.30k/1.30k [00:00<00:00, 185kB/s]
vocab.txt: 100%  3.16M/3.16M [00:00<00:00, 31.5MB/s]
tokenizer.json: 100%  6.41M/6.41M [00:00<00:00, 7.56MB/s]
special_tokens_map.json: 100%  695/695 [00:00<00:00, 101kB/s]
Device set to use cpu

📜 OCR Text:
 १७ व्या शतकात जेव्हा छत्रपती शिवाजी महाराजांनी कोकण, मावळ आणि देश हे प्रांत एकज जोडून मोगल आणि ब्रिपीशांना आव्हान देणा या स्वराज्याची स्थापना केली तेव्हा ख या अर्थने महाराष्थराचा जन्म झाला. ९६७४ साली शिवाजी महाराजांच्या राज्याभिषेकाने सुवर्णयुगाची नांदी झाली. त्यांच्या राजबटीच्या प्रत्येक दिवसाने शिवनेरी होनाला (राज्याभिषेकाच्या वेळी पाडलेली सोन्याची नाणीप झळाळी आणली. मराठयांनी स्वराजाच्या उग्जल परंपरेचे रक्षण केले आणि दोन तृतियांश भारत आपल्या ताब्यात आणला. नंतर पेशव्यांच्या काळात स्वराज्याला उत्तरती कळा लागली आणि शेबपी त्याचा अस्त झाला.


🔍 MahaBERT Inference:
 [{'label': 'LABEL_0', 'score': 0.969126284122467}]
```

Abhi964/MahaPhrase_mahaBERTv2_Finetuning

```
# Use pytesseract for raw text
ocr_text = pytesseract.image_to_string(thresh, lang="mar")

# Run through l3cube-pune/marathi-bert-v2 for context-aware prediction
from transformers import pipeline
ocr_model = pipeline("text-classification", model="Abhi964/MahaPhrase_mahaBERTv2_Finetuning", tokenizer="Abhi964/MahaPhrase_mahaBERTv2_Finetuning")
ocr_result = ocr_model(ocr_text)

print("\n📜 OCR Text:\n", ocr_text)
print("\n🔍 MahaBERT Inference:\n", ocr_result)
```

```
You should probably TRAIN this model on a down-stream task to be able to use it for predictions and inference.
config.json: 100%  728/728 [00:00<00:00, 26.4kB/s]
model.safetensors: 100%  950M/950M [00:06<00:00, 154MB/s]
tokenizer_config.json: 100%  1.30k/1.30k [00:00<00:00, 185kB/s]
vocab.txt: 100%  3.16M/3.16M [00:00<00:00, 31.5MB/s]
tokenizer.json: 100%  6.41M/6.41M [00:00<00:00, 7.56MB/s]
special_tokens_map.json: 100%  695/695 [00:00<00:00, 101kB/s]
Device set to use cpu

📜 OCR Text:
 १७ व्या शतकात जेव्हा छत्रपती शिवाजी महाराजांनी कोकण, मावळ आणि देश हे प्रांत एकज जोडून मोगल आणि ब्रिपीशांना आव्हान देणा या स्वराज्याची स्थापना केली तेव्हा ख या अर्थने महाराष्थराचा जन्म झाला. ९६७४ साली शिवाजी महाराजांच्या राज्याभिषेकाने सुवर्णयुगाची नांदी झाली. त्यांच्या राजबटीच्या प्रत्येक दिवसाने शिवनेरी होनाला (राज्याभिषेकाच्या वेळी पाडलेली सोन्याची नाणीप झळाळी आणली. मराठयांनी स्वराजाच्या उग्जल परंपरेचे रक्षण केले आणि दोन तृतियांश भारत आपल्या ताब्यात आणला. नंतर पेशव्यांच्या काळात स्वराज्याला उत्तरती कळा लागली आणि शेबपी त्याचा अस्त झाला.


🔍 MahaBERT Inference:
 [{'label': 'LABEL_0', 'score': 0.969126284122467}]
```

Step 4: Normalize Text

```
# Normalize the OCR output
normalized_text = re.sub(r'[^\u0900-\u097F\s]', '', ocr_text)
normalized_text = re.sub(r'\s+', ' ', normalized_text).strip()
print("\nNormalized Marathi Text:\n", normalized_text)
```

```
Normalized Marathi Text:
 १७ व्या शतकात जेव्हा छत्रपती शिवाजी महाराजांनी कोकण मावळ आणि देश हे प्रांत एकज जोडून मोगल आणि ब्रिपीशांना आव्हान देणा या स्वराज्याची स्थापना केली तेव्हा ख या अर्थने महाराष्थराचा जन्म झाला ९६७४ साली शिवाजी महाराजांच्या राज्याभिषेकाने सुवर्णयुगाची नांदी झाली त्यांच्या राजबटीच्या प्रत्येक दिवसाने शिवनेरी होनाला राज्याभिषेकाच्या वेळी पाडलेली सोन्याची नाणीप झळाळी आणली मराठयांनी स्वराजाच्या उग्जल परंपरेचे रक्षण केले आणि दोन तृतियांश भारत आपल्या ताब्यात आणला नंतर पेशव्यांच्या काळात स्व
```

Step 5: Tokenization

```
# Tokenization

# Simple whitespace tokenizer
tokens_simple = normalized_text.split()
print("\nTokenized Words (Simple Split):\n", tokens_simple)

# Advanced Indic NLP tokenizer
tokens_advanced = trivial_tokenize(normalized_text, lang='mar')
print("\nTokenized Words (Indic NLP):\n", tokens_advanced)

tokens = tokens_advanced
```

```
Tokenized Words (Simple Split):
 ['१७', 'व्या', 'शतकात', 'जेव्हा', 'छत्रपती', 'शिवाजी', 'महाराजांनी', 'कोकण', 'मावळ', 'आणि', 'देश', 'हे', 'प्रांत', 'एकज', 'जोडून', 'मोगल', 'आणि', 'ब्रिपीशांना', 'आव्हान', 'देणा', 'या', 'स्वराज्याची', 'स्थापना', 'केली', 'तेव्हा', 'ख', 'या', 'अर्थने', 'महाराष्थराचा', 'जन्म', 'झाला', '९६७४', 'साली', 'शिवाजी', 'महाराजांच्या', 'राज्याभिषेकाने', 'सुवर्णयुगाची', 'नांदी', 'झाली', 'त्यांच्या', 'राजबटीच्या', 'प्रत्येक', 'दिवसाने', 'शिवनेरी', 'होनाला', 'राज्याभिषे

Tokenized Words (Indic NLP):
 ['१७', 'व्या', 'शतकात', 'जेव्हा', 'छत्रपती', 'शिवाजी', 'महाराजांनी', 'कोकण', 'मावळ', 'आणि', 'देश', 'हे', 'प्रांत', 'एकज', 'जोडून', 'मोगल', 'आणि', 'ब्रिपीशांना', 'आव्हान', 'देणा', 'या', 'स्वराज्याची', 'स्थापना', 'केली', 'तेव्हा', 'ख', 'या', 'अर्थने', 'महाराष्थराचा', 'जन्म', 'झाला', '९६७४', 'साली', 'शिवाजी', 'महाराजांच्या', 'राज्याभिषेकाने', 'सुवर्णयुगाची', 'नांदी', 'झाली', 'त्यांच्या', 'राजबटीच्या', 'प्रत्येक', 'दिवसाने', 'शिवनेरी', 'होनाला', 'राज्याभिषे
```

Step 6: Name Entity Recogination

```
# NER Marathi

# Use a pipeline as a high-level helper
from transformers import pipeline
pipe = pipeline("token-classification", model="l3cube-pune/marathi-mixed-ner-iob")

ner_results = pipe(normalized_text)
print("\nNER Results:\n", ner_results)
```

```
config.json: 100%  1.23k/1.23k [00:00<00:00, 178kB/s]
pytorch_model.bin: 100%  948M/948M [00:06<00:00, 156MB/s]
model.safetensors: 100%  948M/948M [00:09<00:00, 144MB/s]
tokenizer_config.json: 100%  535/535 [00:00<00:00, 79.3kB/s]
vocab.txt: 100%  3.16M/3.16M [00:00<00:00, 38.0MB/s]
tokenizer.json: 100%  6.41M/6.41M [00:00<00:00, 34.6MB/s]
special_tokens_map.json: 100%  125/125 [00:00<00:00, 15.3kB/s]
Device set to use cpu

NER Results:
 [{'entity': 'B-NEM', 'score': np.float32(0.9490036), 'index': 1, 'word': '१७', 'start': 0, 'end': 2}, {'entity': 'B-NED', 'score': np.float32(0.9949727), 'index': 5, 'word': 'छत्रपती', 'start': 21, 'end': 28}, {'entity': 'B-NEP', 'score': np.float32(0.99822646), 'index': 6, 'word': 'शिवाजी', 'start': 29, 'end': 35}, {'entity': 'B-NED', 'score': np.float32(0.70473385), 'index': 7, 'word': 'महार
```

Step 7: Language Detection and Translation

Language Detection

```
# Detect language
detected_language_code = detect(normalized_text)

# Map language code to full name (optional, for readability)
language_map = {
    'mr': 'Marathi',
    'en': 'English',
    # Add more mappings as needed
}
detected_language = language_map.get(detected_language_code, detected_language_code)

# Print result
print(f"Detected language: {detected_language}")
```

```
Detected language: Marathi
```

Translation

```
# Convert Marathi numbers to English numbers in text and tokens
devanagari_to_english_digits = {
    '०': '0', '१': '1', '२': '2', '३': '3', '४': '4',
    '५': '5', '६': '6', '७': '7', '८': '8', '९': '9'
}

def convert_devanagari_numbers(text):
    return re.sub(r'[\u0966-\u096F]+', lambda m: ''.join(devanagari_to_english_digits.get(ch, ch) for ch in m.group()), text)
```

```
# Translate full text
normalized_with_english_digits = convert_devanagari_numbers(normalized_text)
translation_text = GoogleTranslator(source='mr', target='en').translate(normalized_with_english_digits)
print("\nEnglish Translated Text:\n", translation_text)
```

```
English Translated Text:
 In the 17th century, when Chhatrapati Shivaji Maharaj established the Konkan Maval and the country to challenge the Mughals and the British, Maharashtra was born in 9674 Shivaji Maharaj's coronation of the golden age. Protecting the tradition and two -thirds of India were taken into custody, after the Peshwa's time, Swarajya was responding and Sheeppi was dissolved.
```

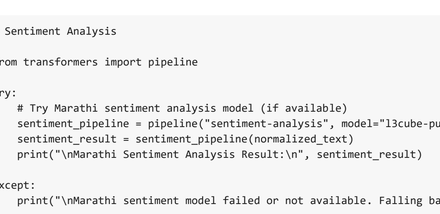
```
# Translate individual tokens
translated_tokens = []
for token in tokens:
    if re.fullmatch(r'[\u0966-\u096F]+', token):
```

```
        translated_tokens.append(convert_devanagari_numbers(token))
    else:
        try:
            translated = GoogleTranslator(source='mr', target='en').translate(token)
            translated_tokens.append(translated)
        except:
            translated_tokens.append(token)

print("\nTranslated Tokens:\n", translated_tokens)
```

```
Translated Tokens:
 ['17', 'Th', 'Centuries', 'When', 'Chhatrapati', 'Shivaji', 'By the Maharaja', 'Konkan', 'Maval', 'And', 'Country', 'This', 'Province', 'Unity', 'By connecting', 'Mughal', 'And', 'To the brippens', 'Challenge', 'Conjunction', 'These', 'State', 'Establishment', 'Kelly', 'When', 'B', 'These', 'In a sense', 'Maharashtra', 'Birth', 'Became', '9674', 'Sill', 'Shivaji', 'To the Maharaja', 'Coronat
```

Step 8: Final Output

```
# Display the image
plt.imshow(img_pil)
plt.axis('off')
plt.title("Uploaded Image")
plt.show()

# Final Output
print("\nFinal Output Summary:\n")
print("Original Marathi OCR Text:\n", normalized_text) # OCR Marathi Text
print("\nMarathi to English Translation:\n", translation_text) # English Translated Text
print("\nTokens in Marathi:\n", tokens) # Marathi Tokens
print("\nTranslated Tokens in English:\n", translated_tokens) # English Tokens
```




```
Final Output Summary:

Original Marathi OCR Text:
 १७ व्या शतकात जेव्हा छत्रपती शिवाजी महाराजांनी कोकण मावळ आणि देश हे प्रांत एकज जोडून मोगल आणि ब्रिपीशांना आव्हान देणा या स्वराज्याची स्थापना केली तेव्हा ख या अर्थने महाराष्यराचा जन्म झाला ९६७४ साली शिवाजी महाराजांच्या राज्याभिषेकाने सुवर्णयुगाची नांदी झाली त्यांच्या राजबटीच्या प्रत्येक दिवसाने शिवनेरी होनाला राज्याभिषेकाच्या वेळी पाडलेली सोन्याची नाणीप झळाळी आणली मराठयांनी स्वराजाच्या उग्जल परंपरेचे रक्षण केले आणि दोन तृतियांश भारत आपल्या ताब्यात आणला नंतर पेशव्यांच्या काळात स्वः

Marathi to English Translation:
 In the 17th century, when Chhatrapati Shivaji Maharaj established the Konkan Maval and the country to challenge the Mughals and the British, Maharashtra was born in 9674 Shivaji Maharaj's coronation of the golden age. Protecting the tradition and two -thirds of India were taken into custody, after the Peshwa's time, Swarajya was responding and Sheeppi was dissolved.

Tokens in Marathi:
 ['१७', 'व्या', 'शतकात', 'जेव्हा', 'छत्रपती', 'शिवाजी', 'महाराजांनी', 'कोकण', 'मावळ', 'आणि', 'देश', 'हे', 'प्रांत', 'एकज', 'जोडून', 'मोगल', 'आणि', 'ब्रिपीशांना', 'आव्हान', 'देणा', 'या', 'स्वराज्याची', 'स्थापना', 'केली', 'तेव्हा', 'ख', 'या', 'अर्थने', 'महाराष्यराचा', 'जन्म', 'झाला', '९६७४', 'साली', 'शिवाजी', 'महाराजांच्या', 'राज्याभिषेकाने', 'सुवर्णयुगाची', 'नांदी', 'झाली', 'त्यांच्या', 'राजबटीच्या', 'प्रत्येक', 'दिवसाने', 'शिवनेरी', 'होनाला', 'राज्याभिषे
Translated Tokens in English:
 ['17', 'Th', 'Centuries', 'When', 'Chhatrapati', 'Shivaji', 'By the Maharaja', 'Konkan', 'Maval', 'And', 'Country', 'This', 'Province', 'Unity', 'By connecting', 'Mughal', 'And', 'To the brippens', 'Challenge', 'Conjunction', 'These', 'State', 'Establishment', 'Kelly', 'When', 'B', 'These', 'In a sense', 'Maharashtra', 'Birth', 'Became', '9674', 'Sill', 'Shivaji', 'To the Maharaja', 'Coronat
```

```
# Show tokens in tabular format
df = pd.DataFrame({'Marathi': tokens, 'English': translated_tokens})
df
```

	Marathi	English
0	१७	17
1	व्या	Th
2	शतकात	Centuries
3	जेव्हा	When
4	छत्रपती	Chhatrapati
...	...	...
72	आणि	And
73	शेबपी	Shabby
74	त्याचा	Its
75	अस्त	Weed
76	झाला	Became

77 rows × 2 columns

Step 9: Sentiment Analysis

```
# Sentiment Analysis

from transformers import pipeline

try:
    # Try Marathi sentiment analysis model (if available)
    sentiment_pipeline = pipeline("sentiment-analysis", model="l3cube-pune/MarathiSentiment")
    sentiment_result = sentiment_pipeline(normalized_text)
    print("\nMarathi Sentiment Analysis Result:\n", sentiment_result)

except:
    print("\nMarathi sentiment model failed or not available. Falling back to English sentiment analysis.")

    try:
        # Fallback: Use English-translated text and English sentiment model
        en_sentiment_pipeline = pipeline("sentiment-analysis")
        sentiment_result = en_sentiment_pipeline(translation_text)
        print("\nEnglish Sentiment Analysis Result:\n", sentiment_result)

    except Exception as e:
        print("\nSentiment analysis failed due to:", str(e))
```

```
config.json: 100% 981/981 [00:00<00:00, 127kB/s]
model.safetensors: 100% 134M/134M [00:00<00:00, 158MB/s]
tokenizer_config.json: 100% 442/442 [00:00<00:00, 43.0kB/s]
spiece.model: 100% 5.65M/5.65M [00:00<00:00, 132MB/s]
special_tokens_map.json: 100% 244/244 [00:00<00:00, 34.7kB/s]
Device set to use cpu

Marathi Sentiment Analysis Result:
 [{'label': 'Neutral', 'score': 0.983304500579834}]
```

Step 10: Summarize the Marathi and English text

```
# Summarization using transformers pipeline
summarizer_mar = pipeline("summarization", model="Existance/mT5_multilingual_XLSum-marathi-summarization")
summarizer_en = pipeline("summarization", model="Falconsai/text_summarization")

try:
    marathi_summary = summarizer_mar(normalized_text, max_length=130, min_length=30, do_sample=False)
    print("\nMarathi Text Summary:\n", marathi_summary[0]["summary_text"])
except Exception as e:
    print(f"\nError summarizing Marathi text: {e}")

try:
    english_summary = summarizer_en(translation_text, max_length=130, min_length=30, do_sample=False)
    print("\nEnglish Text Summary:\n", english_summary[0]["summary_text"])
except Exception as e:
    print(f"\nError summarizing English text: {e}")
```

```
config.json: 100% 908/908 [00:00<00:00, 110kB/s]
pytorch_model.bin: 100% 2.33G/2.33G [00:14<00:00, 159MB/s]
model.safetensors: 100% 2.33G/2.33G [01:12<00:00, 29.4MB/s]
generation_config.json: 100% 234/234 [00:00<00:00, 29.1kB/s]
tokenizer_config.json: 100% 285/285 [00:00<00:00, 36.3kB/s]
spiece.model: 100% 4.31M/4.31M [00:00<00:00, 125MB/s]
tokenizer.json: 100% 16.3M/16.3M [00:00<00:00, 156MB/s]
special_tokens_map.json: 100% 74.0/74.0 [00:00<00:00, 9.77kB/s]
Device set to use cpu
config.json: 100% 1.49k/1.49k [00:00<00:00, 177kB/s]
model.safetensors: 100% 242M/242M [00:01<00:00, 154MB/s]
generation_config.json: 100% 112/112 [00:00<00:00, 14.6kB/s]
tokenizer_config.json: 100% 2.32k/2.32k [00:00<00:00, 256kB/s]
spiece.model: 100% 792k/792k [00:00<00:00, 59.9MB/s]
tokenizer.json: 100% 2.42M/2.42M [00:00<00:00, 37.6MB/s]
special_tokens_map.json: 100% 2.20k/2.20k [00:00<00:00, 291kB/s]
Device set to use cpu
Your max_length is set to 130, but your input_length is only 105. Since this is a summarization task, where outputs shorter than the input are typically wanted, you might consider decreasing max_length manually, e.g. summarizer('...', max_length=52)

Marathi Text Summary:
 मराठयांनी स्वराजाच्या उग्जल परंपरेचे रक्षण केले आणि दोन तृतियांश भारत आपल्या ताब्यात आणला नंतर पेशव्यांच्या काळात स्वराज्याला उत्तरती कळा लागली आता शेबपी त्याचा अस्त झाला
```