Final Project Report

Project ID: SWTID1720007847

Project Name: GeminiDecode: Multilingual Document Analysis

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1 Introduction

1.1 Project Overview

Features:

1. **Image Upload and Display**:
   - Users can upload images of documents in various formats (JPG, JPEG, PNG).
   - The uploaded image is displayed within the application for user verification.
2. **Document Analysis**:
   - Utilizes Google's Gemini Pro Vision API to analyze the uploaded document.
   - Generates a detailed summary of the document's content.
   - Translates the summary into English if necessary, ensuring accessibility regardless of the document's original language.
3. **Interactive Q&A**:
   - Users can ask specific questions about the document.
   - The system processes the questions in context with the uploaded document and provides detailed answers.
   - Translates answers into English, maintaining consistency in user interaction.
4. **Translation Support**:
   - Uses Google Translate API to translate non-English responses to English.
   - Ensures that users can understand the document content and responses regardless of the original language.

1.2 Project Objectives

1. **Multilingual Document Analysis:**
   Enable users to upload images of documents in various languages, ensuring that the application can process and analyze text from these documents accurately.
2. **Document Summarization:**
   Utilize the Gemini Pro Vision API to generate comprehensive summaries of uploaded documents. The summaries should be as detailed as possible, extracting key information to provide users with quick insights into the document's content.
3. **Question-Answering Capability:**
   Allow users to ask specific questions about the analyzed documents. The application should use the context of the document to provide relevant answers, enhancing the user's understanding without needing to parse through the entire document manually.

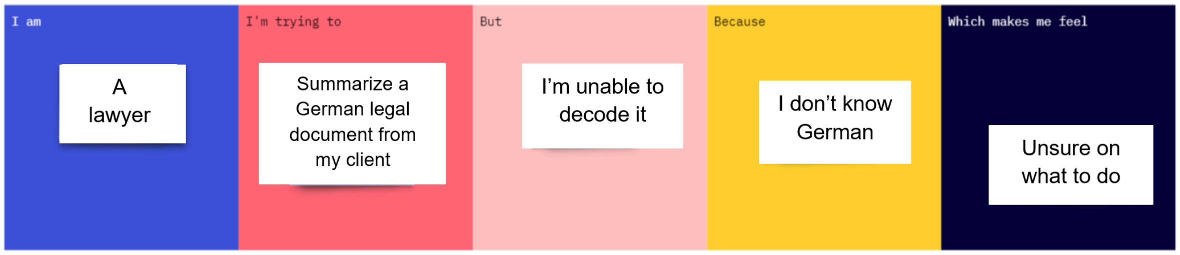
4. **Translation Support:**
   Implement functionality to translate document summaries and answers to English. This ensures that users who are not proficient in the document's original language can still benefit from the analysis provided by the application.
5. **User-Friendly Interface:**
   Design a streamlined and intuitive interface using Streamlit, providing clear instructions for document upload, analysis, question input, and result display. The interface should guide users through each step of the process seamlessly.
6. **Error Handling and Feedback:**
   Implement robust error handling mechanisms to gracefully manage scenarios where documents cannot be processed or questions cannot be answered. Provide informative feedback to users to guide them on how to proceed in such cases.
7. **Security and Privacy:**
   Ensure that sensitive information, such as API keys and user data, is handled securely and protected from unauthorized access. Adhere to best practices for data security throughout the application.

By achieving these objectives, GeminiDecode aims to empower users with the ability to efficiently analyze and extract information from documents in multiple languages, thereby enhancing productivity and knowledge acquisition across diverse contexts.

2 Project Initialization and Planning Phase

2.1 Define Problem Statements:

The document extraction process poses significant challenges for users, affecting their efficiency and overall satisfaction as there is always the matter of time consumed and the language barrier in case of international users. They will generally see issues such as inaccurate text extraction and difficulty handling diverse file formats. These challenges can be time consuming and degrades efficiency and ease of access of documents. To improve user experience, we aim to address these problems and create robust solutions through an accurate, user-friendly application that meets the requirements.


I am

A lawyer

I'm trying to

Summarize a German legal document from my client

But

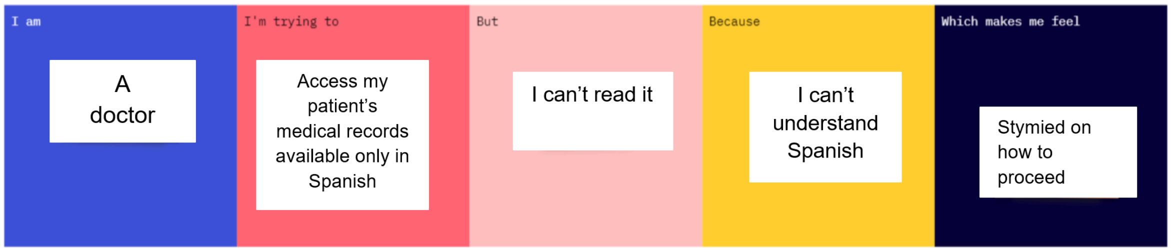
I'm unable to decode it

Because

I don't know German

Which makes me feel

Unsure on what to do


I am

A doctor

I'm trying to

Access my patient's medical records available only in Spanish

But

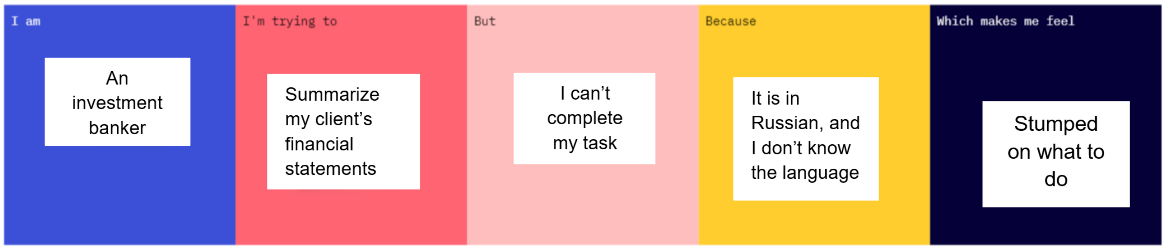
I can't read it

Because

I can't understand Spanish

Which makes me feel

Stymied on how to proceed


I am

An investment banker

I'm trying to

Summarize my client's financial statements

But

I can't complete my task

Because

It is in Russian, and I don't know the language

Which makes me feel

Stumped on what to do

Problem Statement (PS)	**I am (Customer)**	**I am trying to**	**But**	**Because**	**Which makes me feel**
PS-1	A lawyer	Summarize a German legal	I am unable to	I do not know	Unsure on what to do
PS-2	A doctor	Access my patient's medical	I cannot read it	I cannot	Stymied on how to
PS-3	An	Summarize my client's	I cannot	It is in Russian,	Stumped on what to do

2.2 Project Proposal (Proposed Solution) report

The proposal report aims to improve document extraction by using machine learning and natural language processing algorithms with the Gemini Pro model. It increases efficiency of operations by saving time on translation and summarization. Key features include a generative AI model and answering queries made by the user.

Project Overview	
Objective	The primary objective is to transform document extraction by using machine learning and natural language processing algorithms with the Gemini Pro model.

Scope	The project aims to enhance operational efficiency in the legal sector, financial institutions and the healthcare industry by automating information extraction from important documents in different languages.
Problem Statement	
Description	Addressing the need to automate document extraction in industries that work internationally with different languages, thus saving time and improving efficiency.
Impact	Solving these issues will result in improved operational efficiency and enhancement in information extraction, contributing to customer satisfaction and organizational success.
Proposed Solution	
Approach	Employing a generative AI model that uses machine learning and natural languages processing techniques to create a multilingual extraction system.
Key Features	-Implementation of Gemini Pro for document extraction -Q&A for users to ask more questions about the uploaded document

Resource Requirements

Resource Type	**Description**	**Specification/Allocation**
Hardware		
Computing Resources	CPU/GPU specifications, number of cores	Eight core processor
Memory	RAM specifications	8 GB

Storage	Disk space for data, models, and logs	1 TB SSD
Software		
Frameworks	Python frameworks	Streamlit
Libraries	Additional libraries	google-generativeai, python-dotenv, langchain, PyPDF2, chromadb, faiss-cpu,translator
Development Environment	IDE	Visual Studio Code
Data		
Data	Source, size, format	Ten documents from various government databases

2.3 Initial Project Planning

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create a product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Priority	Team Members	Sprint Start Date	Sprint End Date (Planned)
Sprint-1	Requirements Specification	USN-1	Create a requirements.txt file to list the required libraries	Low	Sundar	6/7/24	6/7/24

Sprint-1	Requirements Specification	USN-2	Install the required libraries	High	Sundar	6/7/24	6/7/24
Sprint-1	Initialization of Google API Key	USN-3	Generate the Google API key	Medium	Kapilesh	6/7/24	6/7/24
Sprint-1	Initialization of Google API Key	USN-4	Initialize Google API key	High	Kapilesh	6/7/24	6/7/24
Sprint-2	Interfacing With Pre trained Model	USN-5	Load the Gemini Pro API	High	Nia	7/7/24	7/7/24
Sprint-2	Interfacing With Pretrained	USN-6	Implement a function to get Gemini's responses	High	Nia	7/7/24	7/7/24
Sprint-2	Interfacing With Pre trained Model	USN-7	Implement a function to read the image and set the image format for Gemini Pro model input	High	Tharaka	7/7/24	7/7/24
Sprint-3	Interfacing With Pre trained Model	USN-8	Implement a function for the user to ask a question about the image uploaded	Medium	Tharaka	8/7/24	8/7/24
Sprint-3	Interfacing With Pre trained Model	USN-9	Write a prompt for the Gemini model	Medium	Kapilesh	8/7/24	8/7/24
Sprint-4	Model Deployment	USN-10	Integrate with the web framework	Medium	Tharaka, Nia	9/7/24	9/7/24
Sprint-4	Model Deployment	USN-11	Host the application	High	Kapilesh, Sundar	9/7/24	9/7/24
Sprint-5	Project Files	USN-12	Prepare the project documents	High	Tharaka, Nia	11/7/24	16/7/24

Sprint-6	Project Demo	USN-13	Prepare the project demo	High	Tharaka	18/7/24	18/7/24

3 Data Collection and Preprocessing Phase

We collected images of documents in various languages which do and do not make use of the English alphabets. The documents were screenshots of medical invoices, government certificates and financial statements written in various languages like French, Spanish, Malay, Tamil, Malayalam, German, Russian, Thai etc.

4 Model Development Phase

The model used in this project is Gemini Pro Vision. This model requires no pre-training on the user side. We only need to get the API key and configure it in our model after which we can use the model in our program.

5 Model Optimization and Tuning Phase

The Gemini Pro Vision does not have be optimized or fine tuned by us for this project. We only need to feed in a clear and concise input text which describe the functions of the model in our situation and also supply the appropriate prompt which will enable the model to execute the task we need it to do.

6 Results

1. **Effective Multilingual Document Analysis**:

   - **Accurate Text Extraction**: Successfully extracted text from document images in multiple languages using Google's Gemini Pro Vision API.
   - **Comprehensive Summaries**: Provided detailed and contextually relevant summaries of the extracted text, aiding in quick understanding of the document content.

2. **Seamless Translation**:

   - **Reliable Translation**: Translated non-English content into English with a high degree of accuracy using Google Translate API, ensuring accessibility for users regardless of the document's original language.
   - **User-Friendly Translations**: Maintained the readability and coherence of translated content, making it easy for users to understand the document summaries and responses.

3. **Interactive Q&A Functionality**:

   - **Context-Aware Responses**: Enabled users to ask specific questions about the document and receive detailed, relevant answers, maintaining context with the uploaded document image.
   - **Enhanced User Engagement**: Provided an interactive experience that allowed users to delve deeper into the document content, improving their understanding and knowledge.

4. **User-Friendly Interface**:

   - **Intuitive Design**: Delivered an easy-to-use interface through Streamlit, allowing users to upload images, view summaries, and interact with the system seamlessly.
   - **Visual Feedback**: Displayed uploaded images and provided clear visual feedback, enhancing user confidence and satisfaction with the analysis process.

5. **Increased Productivity**:

   - **Time Savings**: Significantly reduced the time required to understand and analyze documents, especially those in foreign languages, by providing quick and accurate summaries.

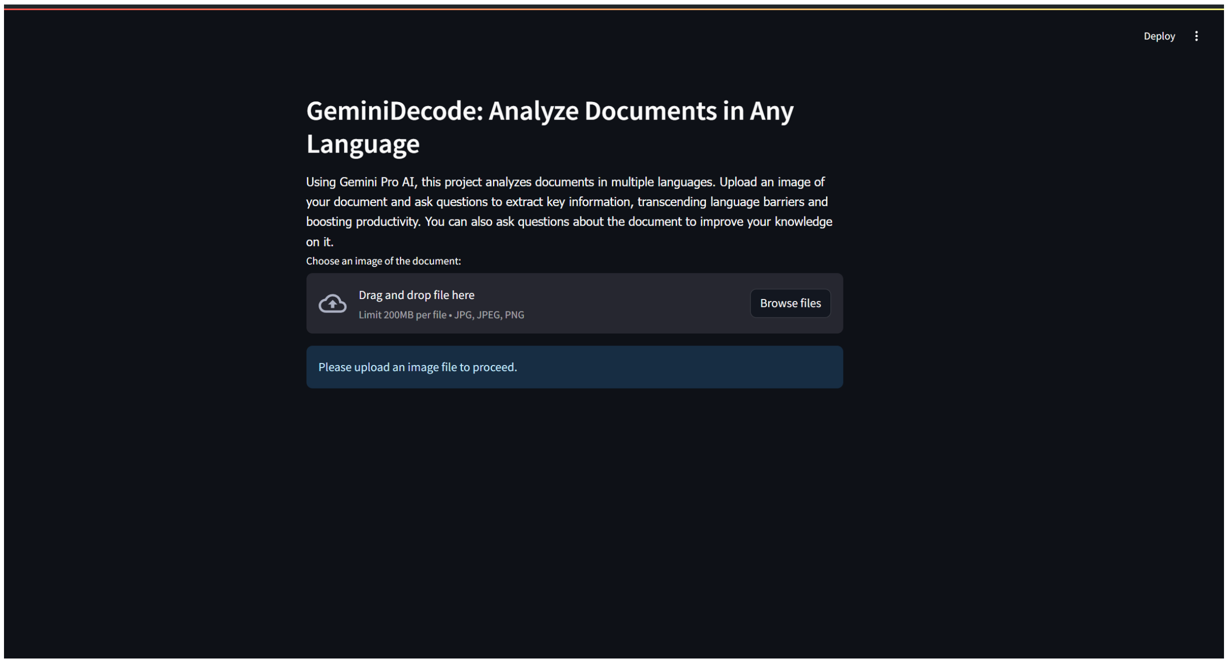
- **Enhanced Efficiency**: Enabled users to focus on key information and insights from documents without the need for manual reading and translation, boosting overall productivity.

Key Metrics

1. **High Accuracy in Text Extraction and Translation**:
   - Achieved high accuracy in text extraction from document images, ensuring minimal errors and high-quality content.
   - Maintained a high level of translation accuracy, effectively conveying the meaning and context of the original text.
2. **User Engagement and Interaction**:
   - High engagement levels with the Q&A functionality, with users asking detailed questions and receiving relevant answers.
   - Positive user interaction and feedback indicating satisfaction with the document analysis and translation capabilities.
3. **Efficiency and Productivity Gains**:
   - Significant reduction in the time and effort required to understand and analyze multilingual documents.
   - Increased efficiency in handling and processing documents, leading to improved productivity for users.

6.1 Output Screenshots

Initial interface



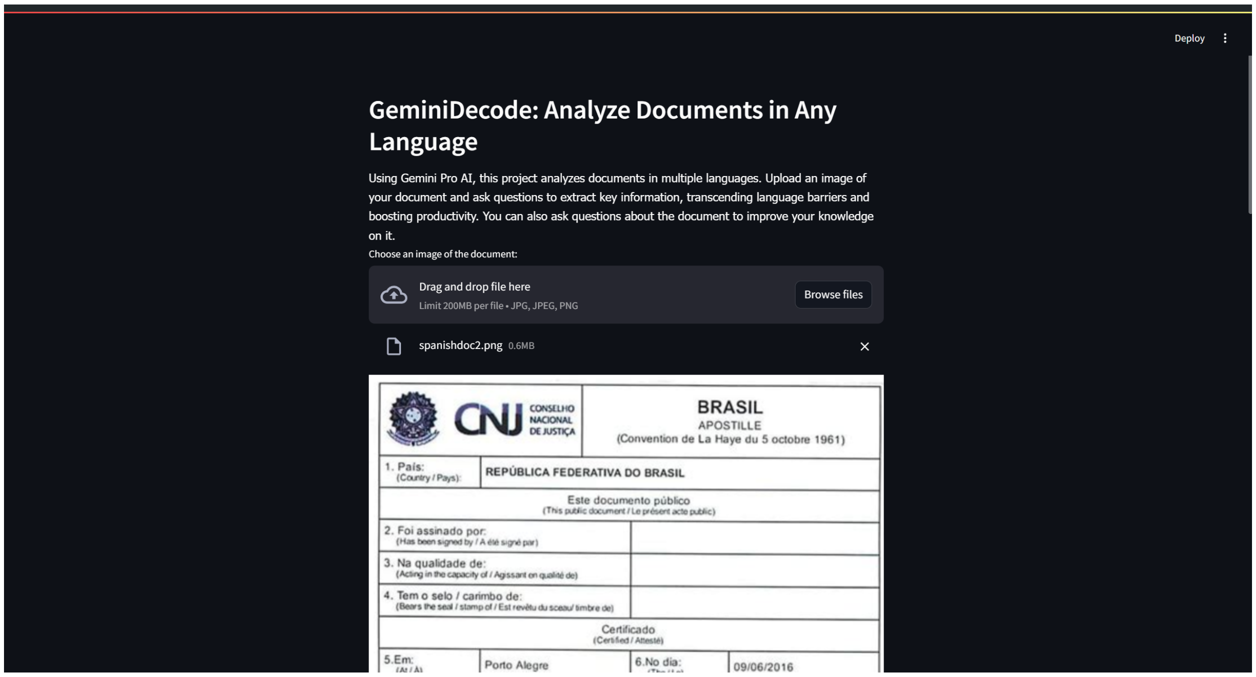
GeminiDecode: Analyze Documents in Any Language

Using Gemini Pro AI, this project analyzes documents in multiple languages. Upload an image of your document and ask questions to extract key information, transcending language barriers and boosting productivity. You can also ask questions about the document to improve your knowledge on it.

Choose an image of the document:

Please upload an image file to proceed.

Image uploaded and shown to the user



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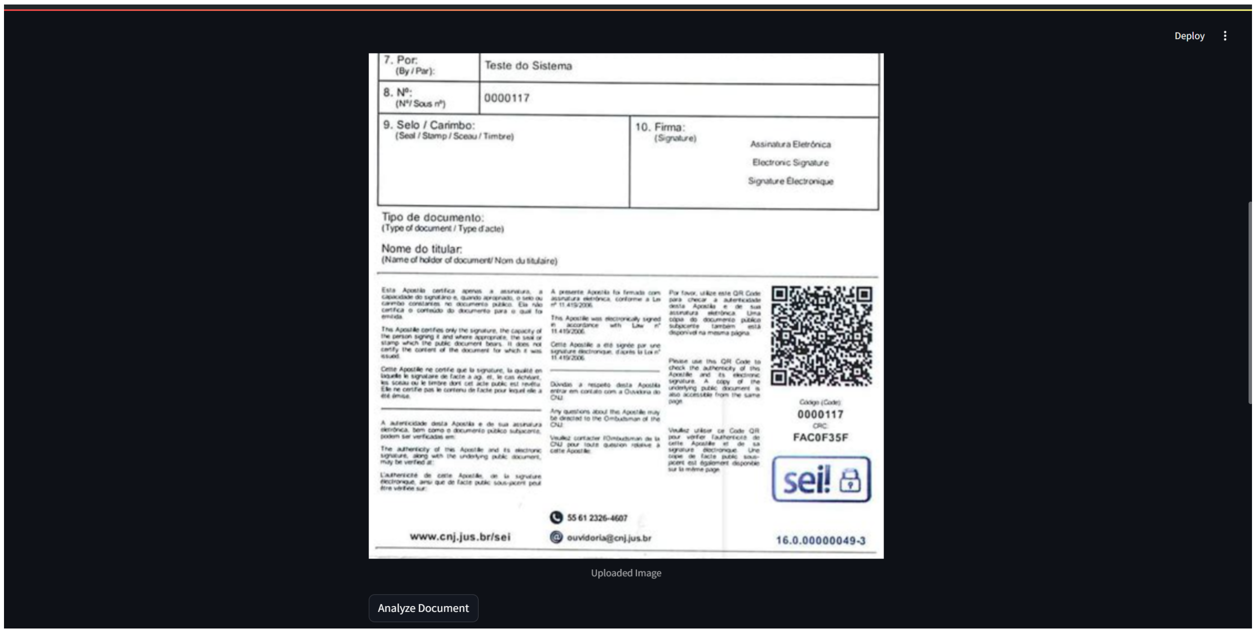
Using Gemini Pro AI, this project analyzes documents in multiple languages. Upload an image of your document and ask questions to extract key information, transcending language barriers and boosting productivity. You can also ask questions about the document to improve your knowledge on it.

Choose an image of the document:

CONSELHO NACIONAL DE JUSTIÇA

BRASIL
APOSTILLE
(Convention de La Haye du 5 octobre 1961)

1. País: (Country / Pays):	REPÚBLICA FEDERATIVA DO BRASIL		
Este documento público (This public document / Le présent acte public)			
2. Foi assinado por: (Has been signed by / A été signé par)			
3. Na qualidade de: (Acting in the capacity of / Agissant en qualité de)			
4. Tem o selo / carimbo de: (Bears the seal / stamp of / Est revêtu du sceau/ timbre de)			
Certificado (Certified / Attesté)			
5.Em:	Porto Alegre	6.No dia:	09/06/2016



7. Por: (By / Par):	Teste do Sistema
8. Nº: (Nº/ Sous nº)	0000117
9. Selo / Carimbo: (Seal / Stamp / Sceau / Timbre)	10. Firma: (Signature) Assinatura Eletrônica Electronic Signature Signature Électronique

Tipo de documento:
(Type of document / Type d'acte)

Nome do titular:
(Name of holder of document/ Nom du titulaire)

Esta Apostila certifica apenas a assinatura, a capacidade do signatário e, quando apropriado, o selo ou carimbo constantes no documento público. Ela não certifica o conteúdo do documento para o qual foi emitida.

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Cette Apostille ne certifie que la signature, la qualité en laquelle le signataire de l'acte a agi, et, le cas échéant, les sceau ou le timbre dont cet acte public est revêtu. Elle ne certifie pas le contenu de l'acte pour lequel elle a été émise.

A autenticidade desta Apostila e de sua assinatura eletrônica, bem como o documento público subjacente, podem ser verificadas em:

The authenticity of this Apostille and its electronic signature, along with the underlying public document, may be verified at:

L'authenticité de cette Apostille, de la signature électronique, ainsi que de l'acte public sous-jacent peut être vérifiée sur:

A presente Apostila foi firmada com assinatura eletrônica, conforme a Lei nº 11.419/2006.

This Apostille was electronically signed in accordance with Law nº 11.419/2006.

Cette Apostille a été signée par une signature électronique, d'après la Loi nº 11.419/2006.

Dúvidas a respeito desta Apostila entrar em contato com a Ouvidoria do CNJ.

Any questions about the Apostille may be directed to the Ombudsman of the CNJ.

Veuillez contacter l'Ombudsman de la CNJ pour toute question relative à cette Apostille.

Por favor, utilize este QR Code para checar a autenticidade desta Apostila e de sua assinatura eletrônica. Uma cópia do documento público subjacente também está disponível na mesma página.

Please use this QR Code to check the authenticity of this Apostille and its electronic signature. A copy of the underlying public document is also accessible from the same page.

Veuillez utiliser ce Code QR pour vérifier l'authenticité de cette Apostille et de sa signature électronique. Une copie de l'acte public sous-jacent est également disponible sur la même page.

Código (Code):
0000117
CRC:
FAC0F35F

www.cnj.jus.br/sei

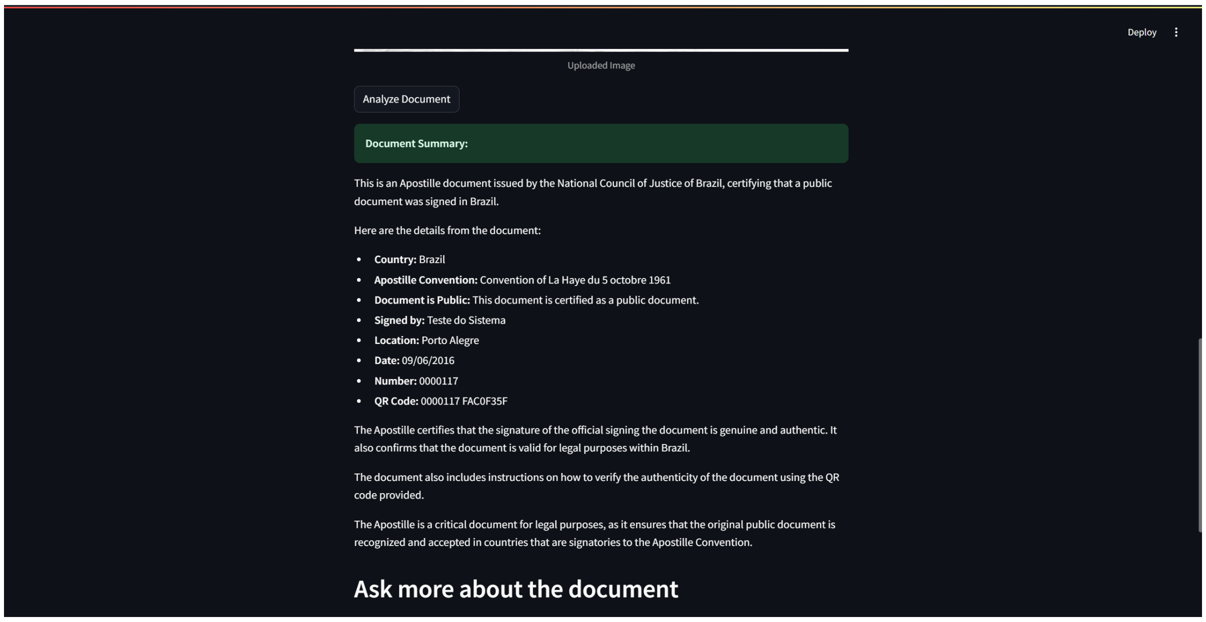
55 61 2326-4607

ouvidoria@cnj.jus.br

16.0.00000049-3

Uploaded Image

Document summary given



Uploaded Image

Document Summary:

This is an Apostille document issued by the National Council of Justice of Brazil, certifying that a public document was signed in Brazil.

Here are the details from the document:

- **Country:** Brazil
- **Apostille Convention:** Convention of La Haye du 5 octobre 1961
- **Document is Public:** This document is certified as a public document.
- **Signed by:** Teste do Sistema
- **Location:** Porto Alegre
- **Date:** 09/06/2016
- **Number:** 0000117
- **QR Code:** 0000117 FAC0F35F

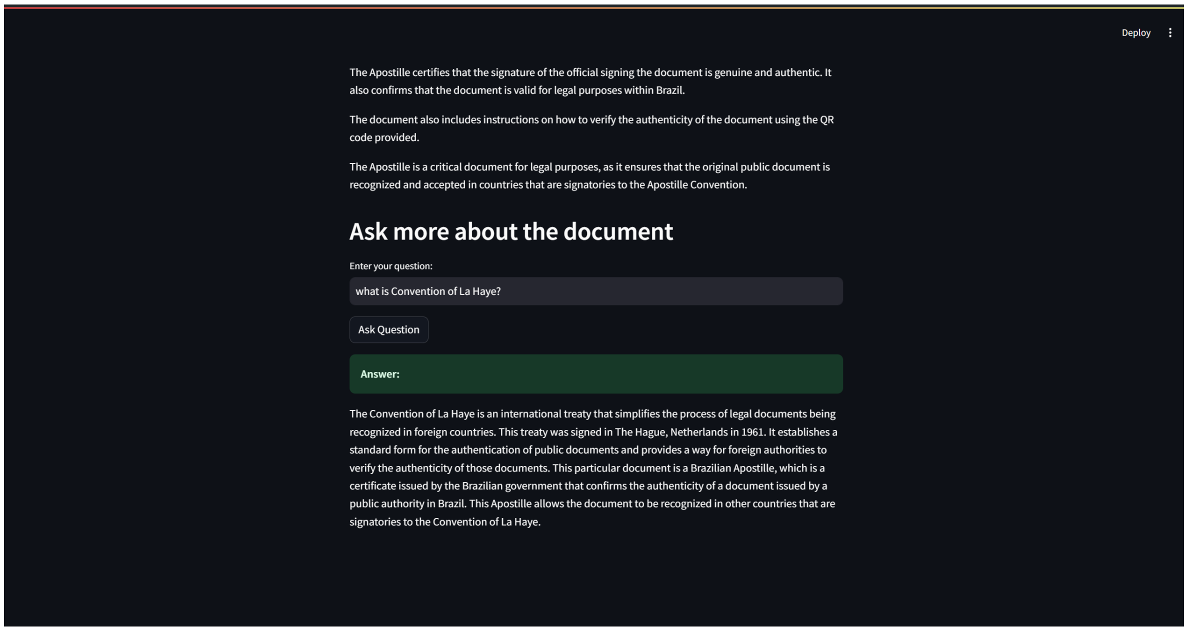
The Apostille certifies that the signature of the official signing the document is genuine and authentic. It also confirms that the document is valid for legal purposes within Brazil.

The document also includes instructions on how to verify the authenticity of the document using the QR code provided.

The Apostille is a critical document for legal purposes, as it ensures that the original public document is recognized and accepted in countries that are signatories to the Apostille Convention.

Ask more about the document

Model answers questions asked by the user



The Apostille certifies that the signature of the official signing the document is genuine and authentic. It also confirms that the document is valid for legal purposes within Brazil.

The document also includes instructions on how to verify the authenticity of the document using the QR code provided.

The Apostille is a critical document for legal purposes, as it ensures that the original public document is recognized and accepted in countries that are signatories to the Apostille Convention.

Ask more about the document

Enter your question:

what is Convention of La Haye?

Answer:

The Convention of La Haye is an international treaty that simplifies the process of legal documents being recognized in foreign countries. This treaty was signed in The Hague, Netherlands in 1961. It establishes a standard form for the authentication of public documents and provides a way for foreign authorities to verify the authenticity of those documents. This particular document is a Brazilian Apostille, which is a certificate issued by the Brazilian government that confirms the authenticity of a document issued by a public authority in Brazil. This Apostille allows the document to be recognized in other countries that are signatories to the Convention of La Haye.

7 Advantages and Disadvantages

While GeminiDecode offers significant advantages in terms of multilingual document analysis, ease of use, and productivity enhancement, it also comes with certain limitations related to dependency on external APIs, translation accuracy, image quality requirements, privacy concerns, and the need for an internet connection. Users should weigh these advantages and disadvantages based on their specific needs and use cases.

Advantages	**Disadvantages**
Multilingual Support	Dependency on API Services
User-Friendly Interface	Translation Accuracy
Advanced AI Integration	Image Quality Requirements
Translation Capabilities	Privacy and Security Concerns
Productivity Enhancement	Limited Offline Functionality

8 Conclusion

GeminiDecode: Multilingual Document Analysis is a powerful and innovative tool designed to break down language barriers and enhance productivity in document analysis. By leveraging advanced AI technologies such as Google's Gemini Pro Vision API and the Google Translate API, GeminiDecode enables users to upload document images, extract detailed summaries, translate content, and interactively ask questions to gain deeper insights.

The project offers numerous advantages, including broad multilingual support, an intuitive user interface, accurate and context-aware analysis, and robust translation capabilities. These features make it an invaluable resource for international business, academic research, legal document review, and personal productivity.

However, it is essential to acknowledge the limitations associated with dependency on external APIs, translation accuracy, image quality requirements, privacy concerns, and the need for a stable internet connection. Addressing these challenges will be crucial for the continued improvement and broader adoption of GeminiDecode.

Overall, GeminiDecode represents a significant step forward in the field of document analysis, providing users with a comprehensive and user-friendly solution to understand and interpret documents in various languages. With further enhancements and refinements, it has the potential to become an indispensable tool for anyone dealing with multilingual documents, helping to foster global communication and collaboration.

9 Future Scope of GeminiDecode: Multilingual Document Analysis

- **Broader Language Support**:
  - **Expanding Language Database**: Increase the number of languages supported by both the analysis and translation features, including less common and regional languages.
  - **Dialect and Regional Variations**: Enhance the ability to understand and accurately translate dialects and regional language variations.
- **Enhanced AI Models**:
  - **Improved Analysis Accuracy**: Integrate more advanced AI models to enhance the depth and precision of document analysis, including better OCR (Optical Character

Recognition) capabilities for text extraction. The model used for text extraction can also be upgraded as the Gemini Pro Vision model has been deprecated as of July 12, 2024.

- **Specialized Domain Models**: Develop models tailored to specific domains such as legal, medical, and technical documents to provide more contextually accurate summaries and answers.

 User Interface Improvements:

- **Enhanced Usability**: Refine the user interface to provide a more seamless and intuitive experience, including better navigation and user guidance.
- **Customizable Interface**: Allow users to customize the interface to suit their needs better, such as adjusting the layout or adding specific functionalities.

 Offline Functionality:

- **Local Processing**: Develop capabilities for offline document analysis and translation to cater to users with limited or no internet access, potentially through downloadable language models.
- **Edge Computing**: Utilize edge computing technologies to perform certain analyses locally on the user's device, reducing dependency on continuous internet connectivity.

 Security and Privacy Enhancements:

- **Data Encryption**: Implement end-to-end encryption for all data transmissions to ensure the privacy and security of sensitive documents.
- **Local Data Storage Options**: Provide options for local data storage and processing to address privacy concerns, especially for confidential or sensitive documents.

 Integration with Other Platforms:

- **Cloud Storage Integration**: Integrate with popular cloud storage services such as Google Drive, Dropbox, and OneDrive to facilitate easy document upload and management.
- **Collaboration Tools**: Enable integration with collaboration tools like Slack, Microsoft Teams, and Asana to streamline workflow and document sharing.

 Advanced Q&A Capabilities:

- **Contextual Learning**: Implement machine learning algorithms that learn from user interactions to provide increasingly accurate and contextually relevant answers.
- **Multi-turn Conversations**: Develop multi-turn conversational capabilities, allowing users to have more natural and interactive dialogues with the system about the document.

 Mobile Application Development:

- **Cross-Platform Support**: Create mobile applications for iOS and Android to allow users to analyze and interact with documents on the go.
- **Camera Integration**: Utilize mobile device cameras for instant document capture and

analysis, enhancing convenience and usability.

 Feedback and Improvement Mechanisms:

- **User Feedback Integration**: Incorporate user feedback mechanisms to continuously improve the system based on real-world usage and suggestions.
- **Performance Monitoring**: Implement monitoring tools to track performance and accuracy, enabling ongoing optimization and enhancement.

 Educational and Training Modules:

- **Tutorials and Guides**: Develop comprehensive tutorials, guides, and training modules to help users understand and make the most of the tool's features.
- **Interactive Demos**: Provide interactive demos and examples to showcase the tool's capabilities and use cases.

10 Appendix

10.1 Source Code

```
from dotenv import load_dotenv

load_dotenv()                                # Load all the environment variables

import streamlit as st

import os

import google.generativeai as genai

from PIL import Image

from googletrans import Translator


genai.configure(api_key=os.getenv("GOOGLE_API_KEY"))          # Configure Gemini Pro
Vision API


## Function to load Google Gemini Pro Vision API and get response
```

```
def get_gemini_response(input_text, image, prompt):
    try:
        model = genai.GenerativeModel('gemini-pro-vision')

        if image.mode != 'RGB':                    # Ensure image is in the correct format
            image = image.convert('RGB')

        response = model.generate_content([input_text, image, prompt])

        # Extract text from response
        if response.candidates and response.candidates[0].content and
response.candidates[0].content.parts:
            print(response)
            return response.candidates[0].content.parts[0].text         # actual summary part
        else:
            st.warning("No valid text found in the response.")
            return None
    except Exception as e:
        st.error(f"An error occurred while processing the request: {e}")
        return None

## Function to handle image upload and processing
def input_image_setup():
    uploaded_file = st.file_uploader("Choose an image of the document:", type=["jpg", "jpeg",
"png"])
    image = None
    if uploaded_file is not None:
        image = Image.open(uploaded_file)
        st.image(image, caption="Uploaded Image", use_column_width=True)
    else:
        st.info("Please upload an image file to proceed.")
    return image

## Function to translate text to English (this is for some specific cases where the model
displays the result
## in the language of the document, we observed this in case of mainly Hindi documents)
def translate_to_english(text):
    translator = Translator()
    translation = translator.translate(text, dest='en')
    return translation.text

## Function to summarize the document
def summarize_document():
    if st.session_state.image:
        prompt = "Analyze the uploaded document and provide a summary as detailed as possible."
        response = get_gemini_response(prompt, st.session_state.image, prompt)
        if response:
            translated_response = translate_to_english(response)
            st.session_state.analysis_result = translated_response
        else:
            st.warning("Could not extract relevant information from the document.")
```

```
## Function to ask questions about the document
def ask_question():
    user_question = st.text_input("Enter your question:")
    if st.button("Ask Question"):
        if user_question:
            detailed_response = get_gemini_response(user_question, st.session_state.image, user_question)    #the session will be the same so it maintains context for the image
            if detailed_response:
                translated_response = translate_to_english(detailed_response)
                st.success("**Answer:**")
                st.write(translated_response)
            else:
                st.warning("Could not extract relevant information for the question.")
        else:
            st.warning("Please enter a question.")

## Main function for Streamlit app
def main():
    # Initialize Streamlit app
    st.set_page_config(page_title="GeminiDecode: Multilingual Document Analysis")
    st.header("GeminiDecode: Analyze Documents in Any Language")

    # Text description
    text = """
    Using Gemini Pro AI, this project analyzes documents in multiple languages.
    Upload an image of your document and ask questions to extract key information,
    transcending language barriers and boosting productivity. You can also ask questions
    about the document to improve your knowledge on it.
    """

    styled_text = f"<span style='font-family:tahoma;'>{text}</span>"
    st.markdown(styled_text, unsafe_allow_html=True)

    # Initialize session state for image and analysis results
    if "image" not in st.session_state:
        st.session_state.image = None
    if "analysis_result" not in st.session_state:
        st.session_state.analysis_result = None
    # User input for image and question
    image = input_image_setup()
    if image:
        st.session_state.image = image

    if st.session_state.image and st.button("Analyze Document"):
        summarize_document()

    # Display analysis result if available
    if st.session_state.analysis_result:
        st.success("**Document Summary:**")
        st.write(st.session_state.analysis_result)

        # Add section for user to ask additional questions
```

```
        st.header("Ask more about the document")
        ask_question()

if __name__ == "__main__":
    main()
```

10.2 GitHub & Project Demo Link

GitHub link

https://github.com/Tharaka410/geminidecode/blob/main/app.py

Project Demo Link

https://drive.google.com/file/d/1ESnBWs4YnkRBgFA8KvuNptjdr21rRhZg