DARPG Hackathon 2024

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Problem Statement

Develop an AI/ML-driven Chatbot which is Ministry Specific to help the Citizens to resolve their common queries related to filing a Grievance in the CPGRAMS portal (https://pgportal.gov.in) and expedite smooth submission of grievances.

The Department of Administrative Reforms and Public Grievances

DARPG is the nodal agency of the Government of India for administrative reforms as well as redressal of public grievances relating to the states in general and those about Central Government agencies in particular.

The Department endeavors to document and disseminate successful good governance practices by way of audio-visual media and publications. It also undertakes activities in the field of international exchange and cooperation to promote public service reforms.

प्रशासनिक सुधार और लोक शिकायत विभाग
सत्यमेव जयते
DEPARTMENT OF
ADMINISTRATIVE REFORMS
& PUBLIC GRIEVANCES

Overview

1) **Processes Dataset Documents:**

- Reads text from various sources (CSV, webpages, PDF).
- Splits text into chunks for easier retrieval.

2)**Retrieves relevant documents from the provided context:**

- Uses a search engine (FAISS) and LangChain to find documents related to a user query.
- Generates informative answers.
- Uses a powerful language model (Mistral 7B) to answer queries based on retrieved documents.

3)**Provides a user interface:**

- Allows users to interact through text chat or audio input.
- Converts speech to text for accessibility.

TechStack used ~

- Python
- transformers
- langchain
- datasets
- faiss-cp
- sentence-transformers
- gradio
- speech_recognition
- pyttsx3
- PyPDF2
- pandas
- Playwrigh
- imaplib

Our Approach

We created a Multilingual User-Friendly Chatbot!

Our chatbot, **GrievBot**, takes in multilingual user queries in the form of text & audio, whichever is comfortable for the users!

These grievance-filing queries are addressed by our LLM bot by referring to the parsed authentic DARPG website content & the dataset provided by DARPG.

Our Approach

An AI-powered chatbot is being developed to help citizens easily file grievances on the CPGRAMS portal. This chatbot understands user queries, retrieves relevant information from the CPGRAMS website and past grievances, and uses this context to provide accurate guidance. It can handle common grievance categories and supports multiple languages through speech recognition. The user interface allows people to type or speak their questions, making grievance filing more accessible and user-friendly.

Data Collection/Usage

1) Collected DARPG Data from the DARPG Website.
Parsed all the URLs relevant to filing a Grievance & fed it to the LLM.
.https://www.pgportal.gov.in/”
"https://www.pgportal.gov.in/Home/Faq"
"https://www.pgportal.gov.in/Home/AboutUs"
"https://www.pgportal.gov.in/Home/ContactUs"

2) Retrieved “Subject_content_text” and “Remarks” given by DARPG.
Fed this to RAG model in order to train the LLM for accurate responses to common grievances faced by users.

Data Processing

Data collected is stored in the form of a document. The data is then broken down into vector embeddings & text chunks using LangChain and Sentence Embeddings. These chunks of text are stored in an external database which is then passed to the RAG pipeline.

The retrieval stage aims to identify the most relevant context. Usually, the retrieval is based on vector search, which calculates the semantic similarity between the query and the indexed data.
Thus, the majority of retrieval optimization techniques revolve around the embedding models.

Generation (RAG) is the process of optimizing the output of a large language model, so it references an authoritative knowledge base outside of its training data sources before generating a response.

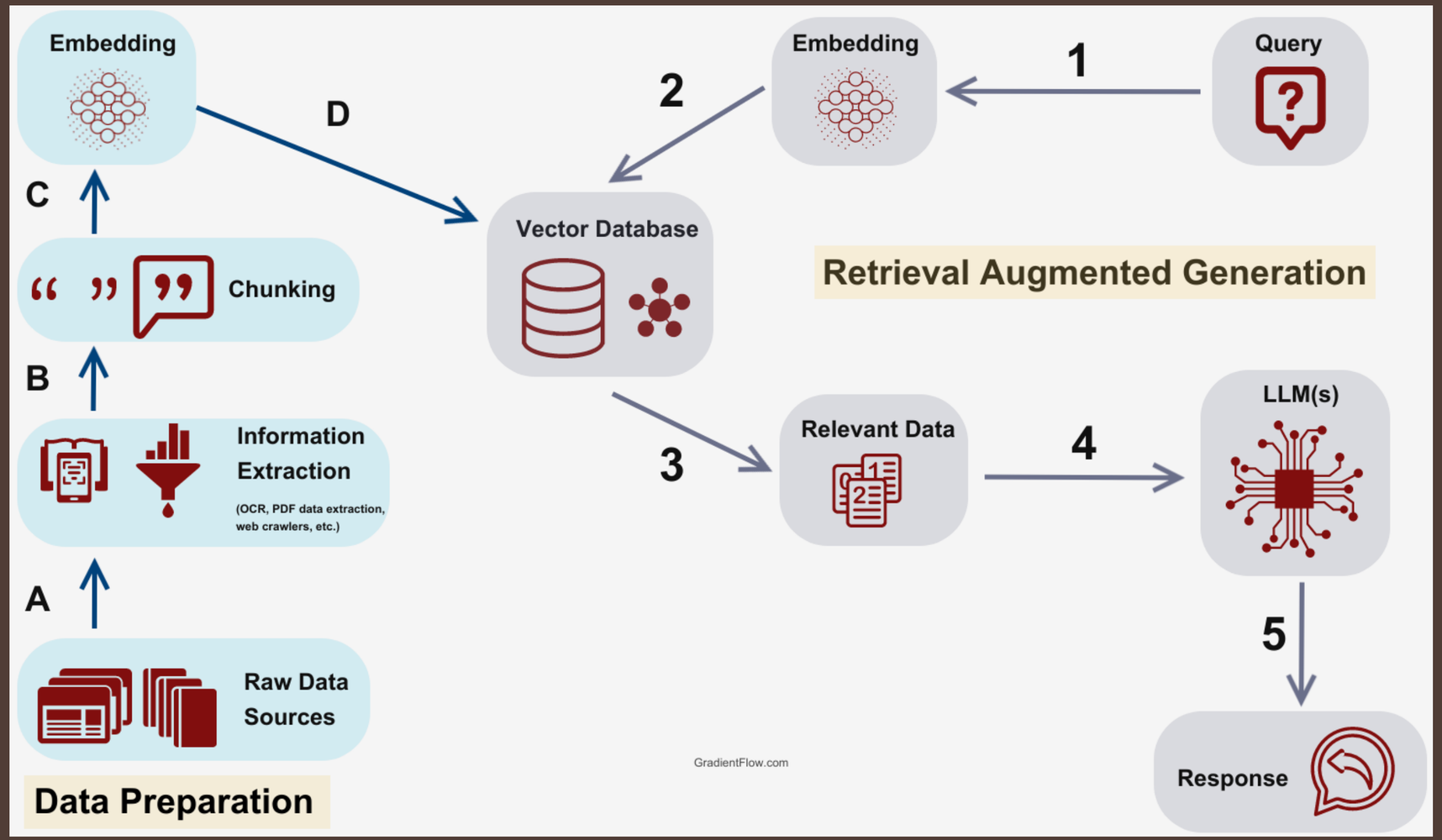
Methodology

Our GrievBot uses the concept of **Retrieval-Augmented Generation(RAG)**.

Retrieval ~ When a user asks a question, the system searches through a database of relevant information (CPGRAMS webpages, the preprocessed PDF of grievances data).
This retrieval process is powered by tools like FAISS & the LangChain framework, using sentence transformers to convert text into meaningful vector representations. The query is similarly turned into a vector and compared against the database for similarity, finding the most relevant sections of information.

Augmentation ~ The retrieved information isn't merely shown to the user. Instead, these relevant pieces of text are fed into a large language model (LLM), specifically the Mistral LLM in our case, along with the original user query as a prompt. The LLM uses this contextual information to generate a more accurate, informative, and tailored response than it could by relying on its general knowledge alone.

RAG~


Embedding
D
Embedding
2
1
Query
C
Vector Database
Chunking
Retrieval Augmented Generation
B
Information Extraction
(OCR, PDF data extraction, web crawlers, etc.)
3
Relevant Data
4
LLM(s)
A
5
Raw Data Sources
GradientFlow.com
Response
Data Preparation

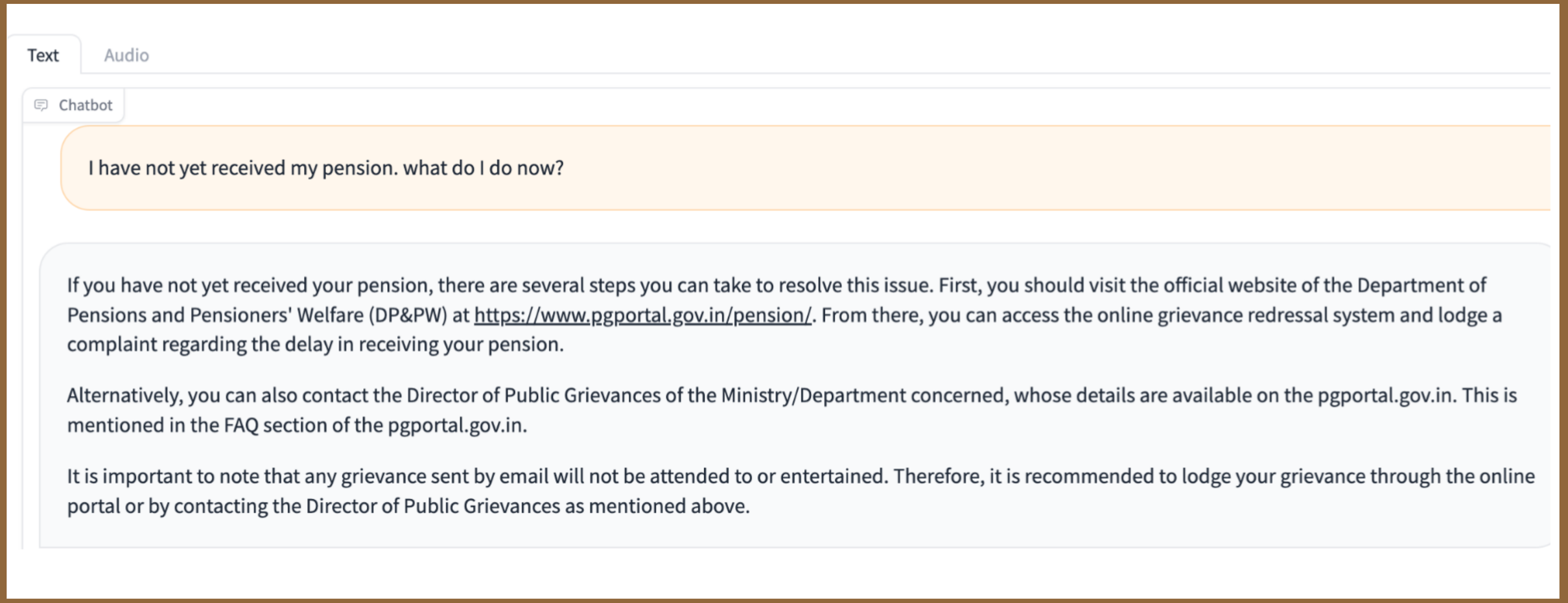
Working~

Let us see how our GrievBot performs!

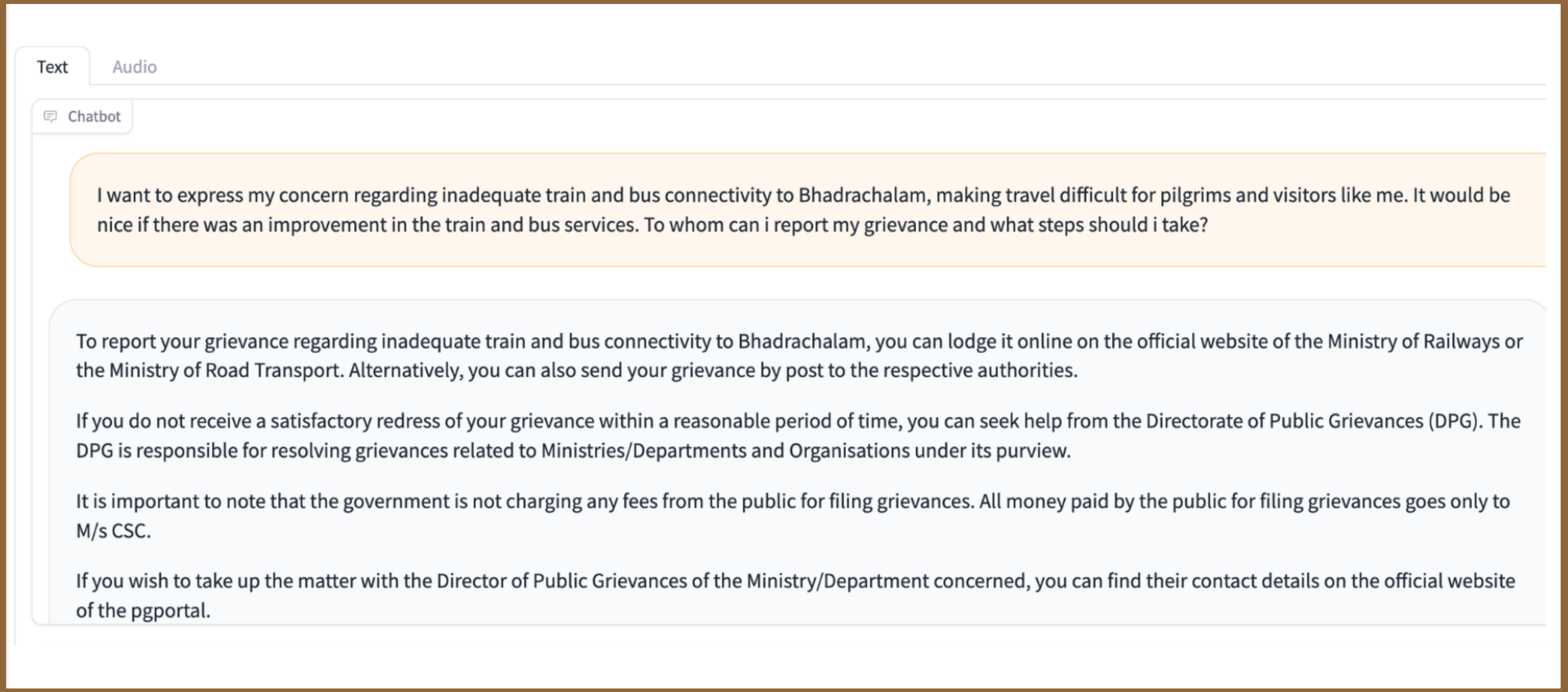
User-Interface for our GrievBot:

The user enters the query in the textbox and the output from the LLM is generated by the bot.

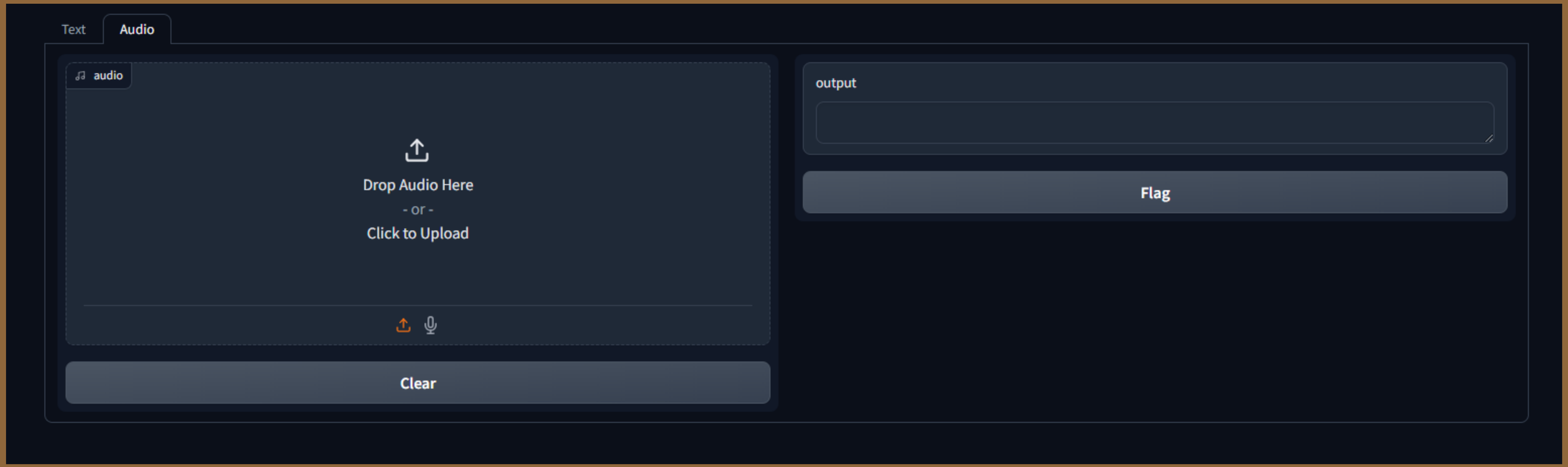
Demo:


Text
Audio
Chatbot
I have not yet received my pension. what do I do now?
If you have not yet received your pension, there are several steps you can take to resolve this issue. First, you should visit the official website of the Department of Pensions and Pensioners' Welfare (DP&PW) at https://www.pgportal.gov.in/pension/. From there, you can access the online grievance redressal system and lodge a complaint regarding the delay in receiving your pension.
Alternatively, you can also contact the Director of Public Grievances of the Ministry/Department concerned, whose details are available on the pgportal.gov.in. This is mentioned in the FAQ section of the pgportal.gov.in.
It is important to note that any grievance sent by email will not be attended to or entertained. Therefore, it is recommended to lodge your grievance through the online portal or by contacting the Director of Public Grievances as mentioned above.

Demo:

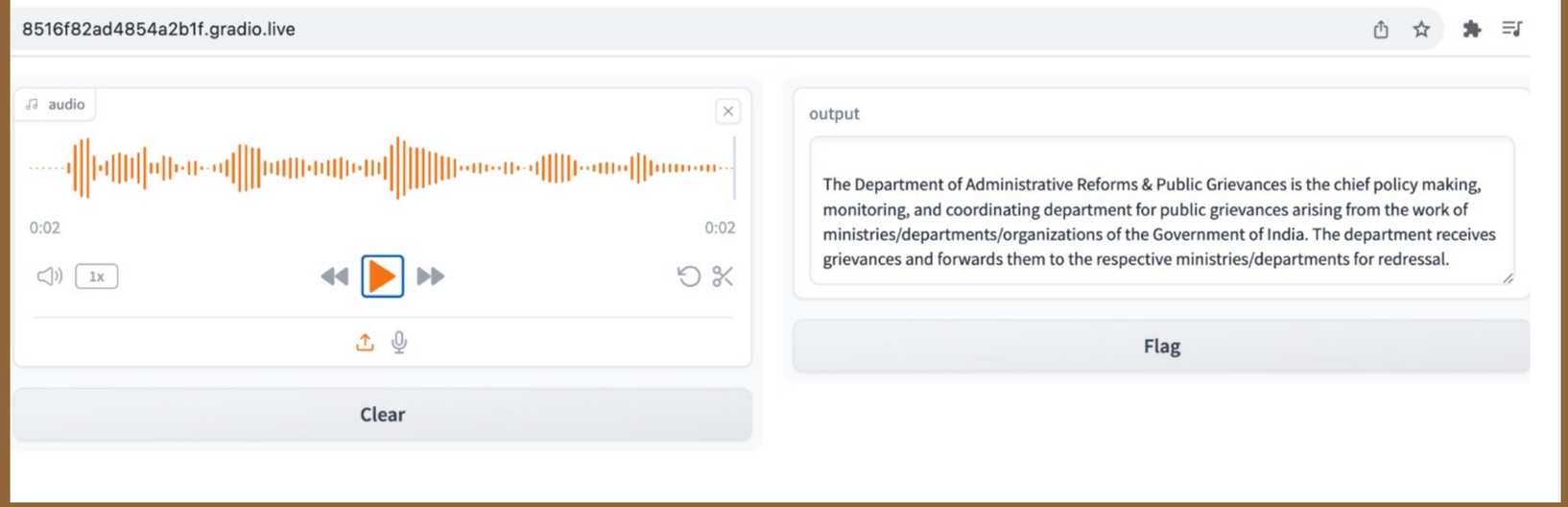

Text
Audio
Chatbot
I want to express my concern regarding inadequate train and bus connectivity to Bhadrachalam, making travel difficult for pilgrims and visitors like me. It would be nice if there was an improvement in the train and bus services. To whom can i report my grievance and what steps should i take?
To report your grievance regarding inadequate train and bus connectivity to Bhadrachalam, you can lodge it online on the official website of the Ministry of Railways or the Ministry of Road Transport. Alternatively, you can also send your grievance by post to the respective authorities.
If you do not receive a satisfactory redress of your grievance within a reasonable period of time, you can seek help from the Directorate of Public Grievances (DPG). The DPG is responsible for resolving grievances related to Ministries/Departments and Organisations under its purview.
It is important to note that the government is not charging any fees from the public for filing grievances. All money paid by the public for filing grievances goes only to M/s CSC.
If you wish to take up the matter with the Director of Public Grievances of the Ministry/Department concerned, you can find their contact details on the official website of the pgportal.

The bot also takes in Voice Queries & generates respective outputs with the help of Mistral 7B LLM

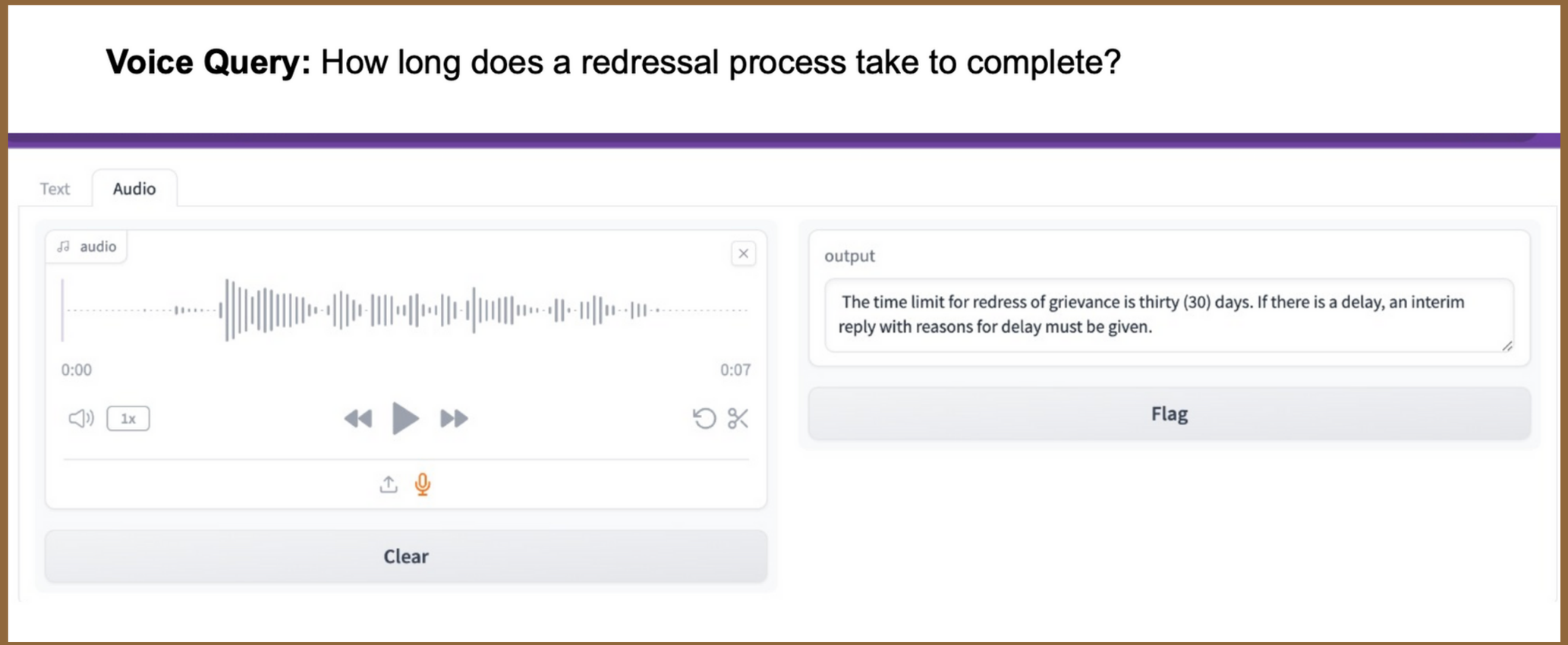


Demo:

Voice Query: Which is the Department incharge for Grievances?

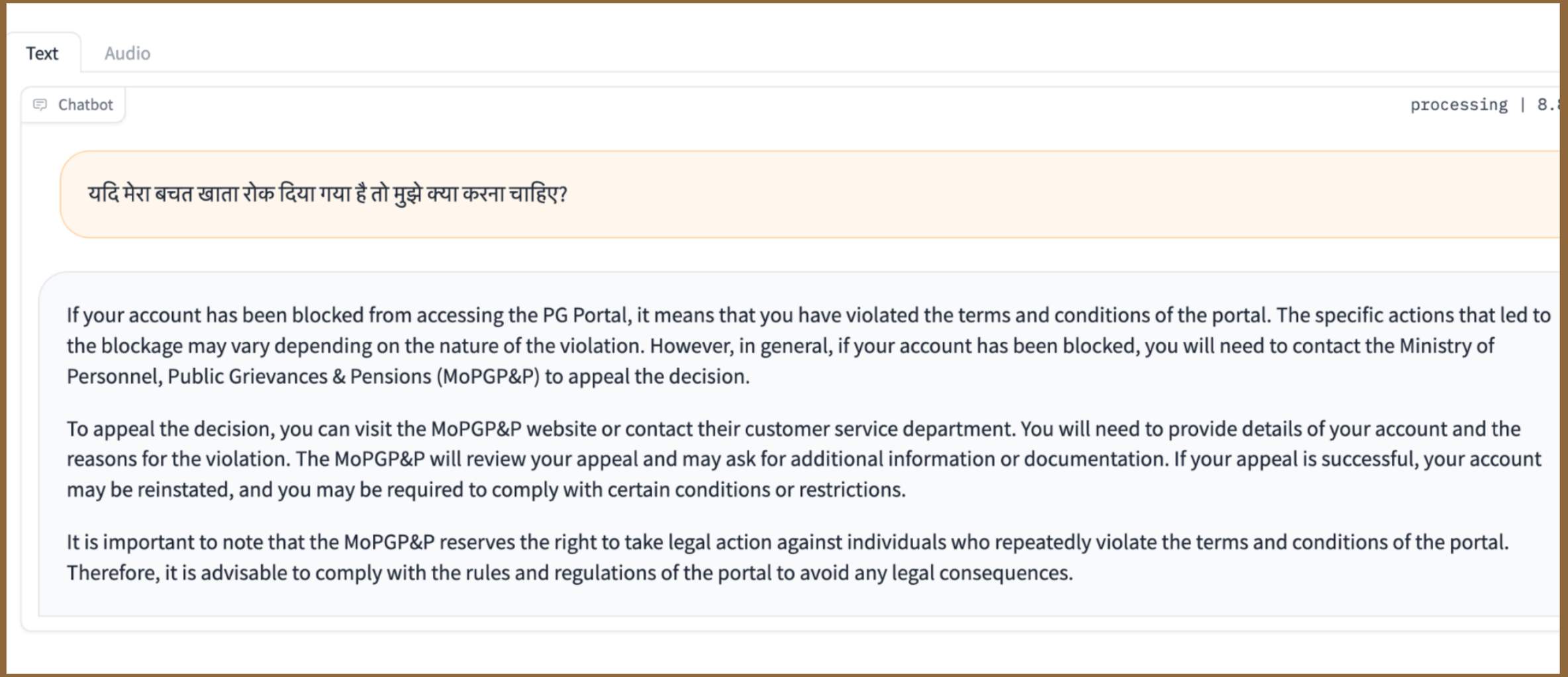


Demo:


Voice Query: How long does a redressal process take to complete?
Text
Audio
audio
0:00
0:07
1x
Clear
output
The time limit for redress of grievance is thirty (30) days. If there is a delay, an interim reply with reasons for delay must be given.
Flag

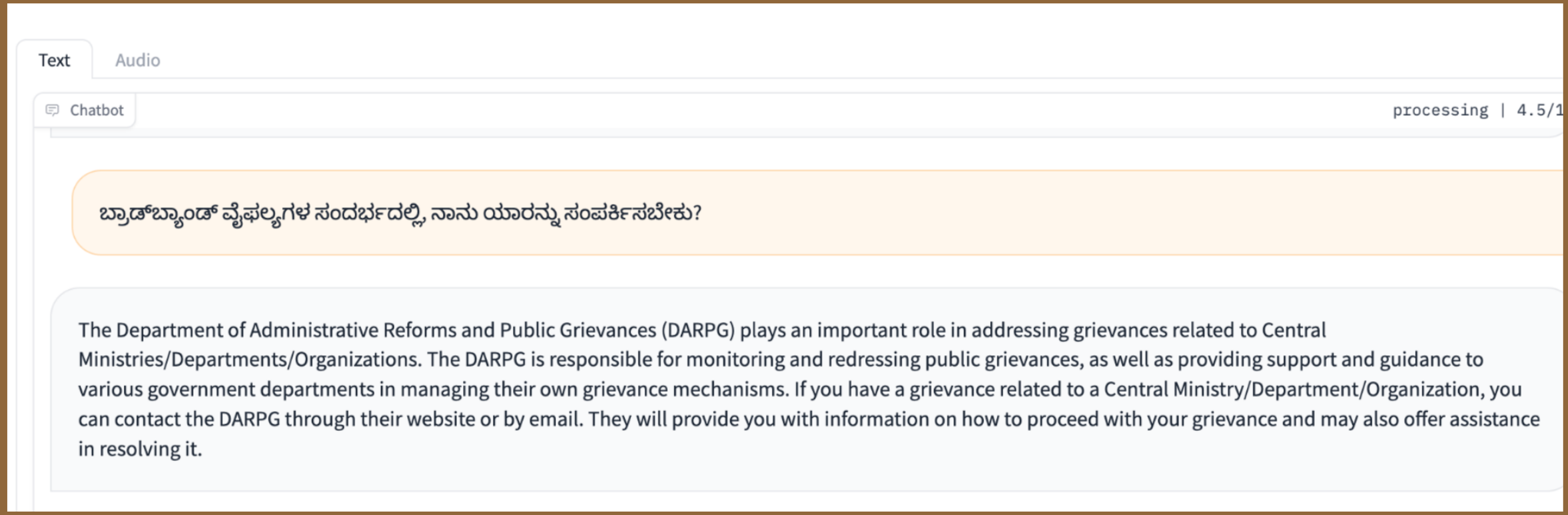
Multilingual Query Support~

Hindi:



Multilingual Query Support~

Kannada:



How to run the code?

Open the Colab notebook:
Click on the provided Colab link:https://colab.research.google.com/drive/1rqGhwY70m8bFeN7dDDFEK_I_5-K9Wg2R?usp=sharing
Switch to T4 GPU runtime:
Navigate to the Runtime menu at the top of the Colab page.

- Select Change runtime type.
- Under Hardware accelerator, choose GPU.
- Under GPU type, if available, select Tesla T4.
- Click Save.

Run the code:

Follow any additional instructions or comments within the notebook.
Execute code cells sequentially by clicking the Play button (triangle icon) or hitting Shift + Enter.

Note:

Large language models (LLMs) typically require powerful GPUs due to their vast number of parameters.
This can be expensive and impractical for many users who lack access to such resources.
To address this limitation, we employed a technique called quantization using Qlora and Peft. This process reduces the number of bits used to represent the model's parameters, effectively shrinking its memory footprint. Consequently, we could successfully train and run the LLM on the free tier GPUs available on Google Colab

Significance

Improved User Experience:
Citizens can get quick and accurate answers to their common queries for the grievance filing process.

Data Insights:
The chatbot can answer common issues faced by citizens, which helps the Ministry to identify trends and areas for improvement in their grievance handling processes.

Efficient Multilingual Grievance Handling:
The chatbot can assist citizens in understanding the filing process, required documents, and other relevant information for a smoother and more efficient grievance submission.

24/7 Availability:
Unlike human support, the chatbot is available 24/7 to assist citizens, ensuring that they can get help whenever required.

Cost-Effective:
Using AI/ML-driven chatbots can reduce the need for human resources dedicated to answering common queries, saving costs for the Ministry.

Our Team

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THANK YOU!