USPTO Technical Drawing Search Engine

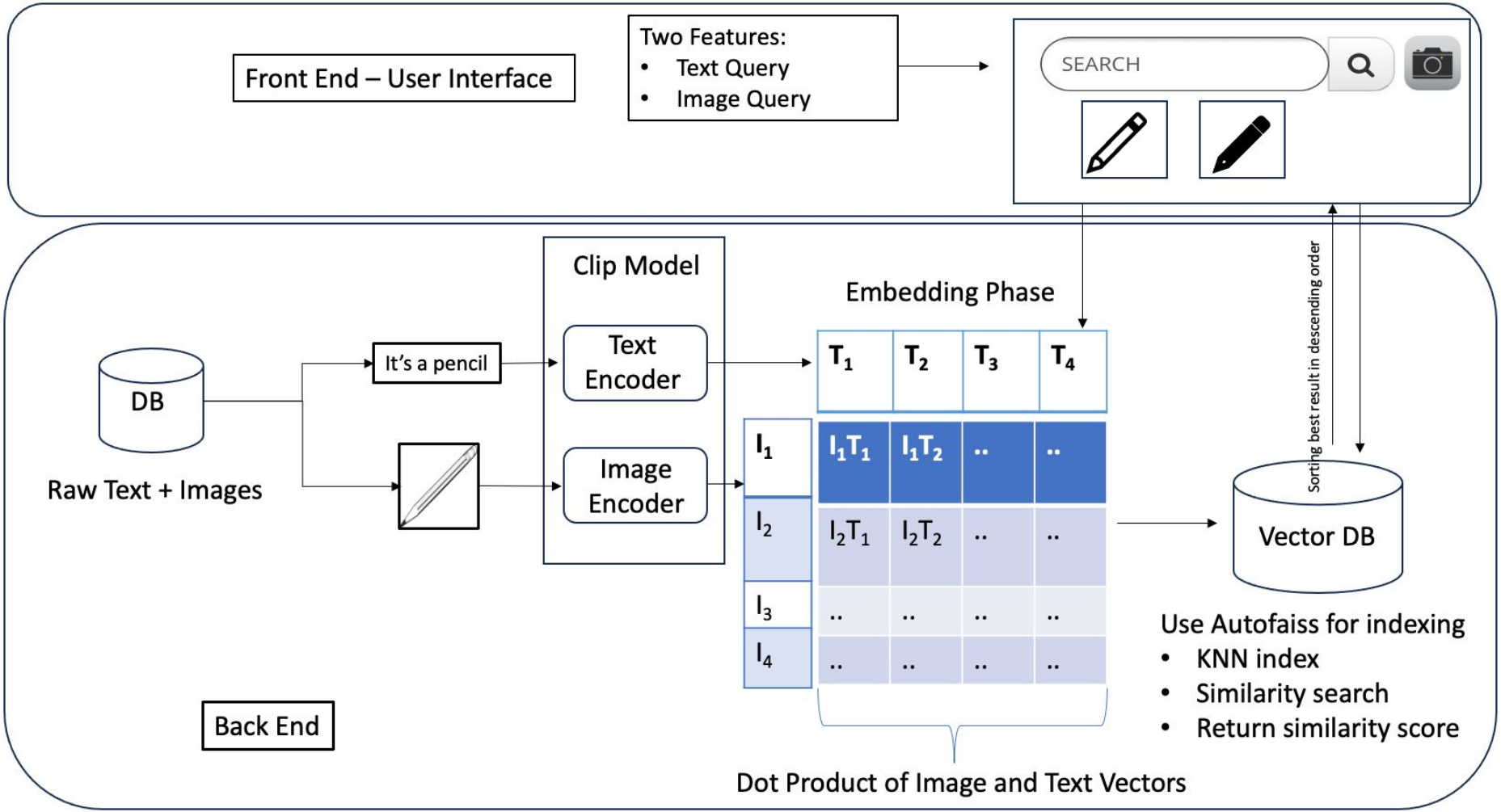
Muntabir Choudhury
Ph.D. Student
Department of Computer Science
Old Dominion University

Introduction

- I am from **Dhaka, Bangladesh**
- **Bachelor of Science** in Computer Engineering
  - Graduated from **Elizabethtown College**, PA, USA – 2018
  - On Campus Jobs: (a) Grader (b) Database Assistant (c) International Leadership Assistant
  - Summer Research – Data Analytics
- Worked with **Resource 9 Group** – a New York based start-up
  - Application Performance Engineer (Specialized on **AppDynamics**)
  - Contractor – **John Deere**
- Joined **Old Dominion University** as a Ph.D. student in Fall 2019.
  - Advisor: Dr. Jian Wu
  - Our research lab is known as **LAMP-SYS** (Lab for Applied Machine Learning and Natural Language Processing and Systems)
  - We are also collaborating with **WSDL lab** (Web Science and Digital Libraries, ODU)
  - Two Summer Internships:
    - **Research Intern – Los Alamos National Laboratory,** New Mexico – 2020
    - **Machine Learning Intern** – **Bihrle Applied Research Inc**, VA – 2021

Building Search Engine

- Dataset: **DeepPatent3** – contains 50,000 technical drawings
- We have two tasks –
  - Front End – is a user interface (UI) that will connect to the database
    - Mostly focusing on the design aspects of the website
    - Connect to database so that it can return search results
    - Features: a **search bar** which will allow users to query through text and image
      - Example: LAION-5B Search Demo
    - We plan to use **Django** – a python framework to build the UI
  - Back End – focuses on the server-side application which you can not see in the UI
    - We will use Deep Learning based model (OpenAI's Clip Model) to embed text and image into vectors
    - Store these vectors in the database (vector database)
      - Autofaiss to create a KNN index for retrieval
      - Returns a best score using a similarity search algorithm (e.g., cosine similarity)
      - Sorting the score in **descending order** to return the result of the user's query


Front End – User Interface
Two Features:
• Text Query
• Image Query
SEARCH
Back End
Clip Model
Embedding Phase
DB
Raw Text + Images
It's a pencil
Text Encoder
Image Encoder
T1 T2 T3 T4
I1 I1T1 I1T2 .. ..
I2 I2T1 I2T2 .. ..
I3 .. ..
I4 .. ..
Dot Product of Image and Text Vectors
Sorting best result in descending order
Vector DB
Use Autofaiss for indexing
• KNN index
• Similarity search
• Return similarity score

Tools / Technologies and Frameworks

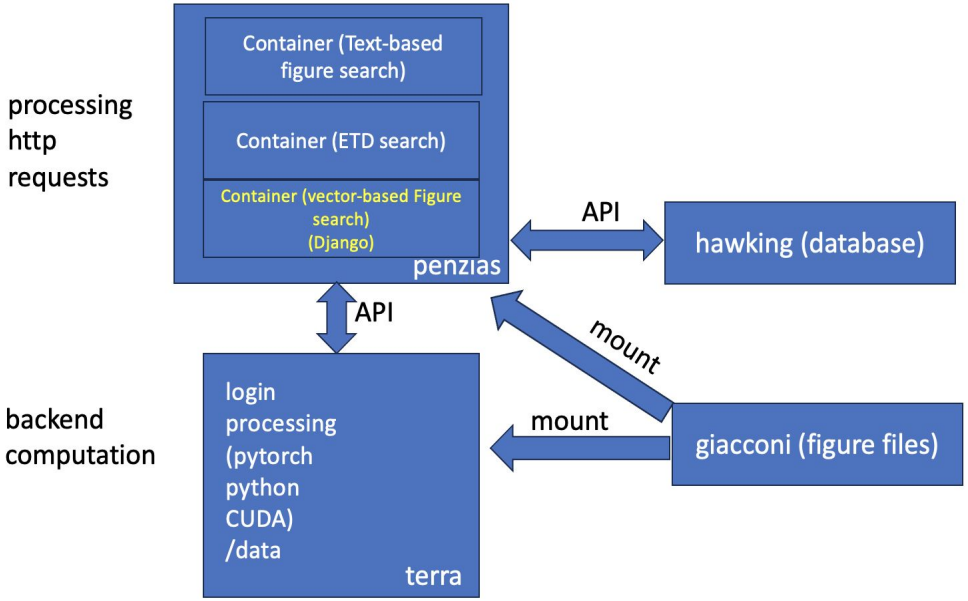
- Version Control and Code Sharing: GitHub
- AI model: Clip model (pre-trained model for embeddings)
- Indexing tools: Autofaiss
- Framework: Django for front end
- HPC Cluster: Wahab Cluster
  - Jupyter Notebook
- Database: ES, MySQL, MongoDB (options)
- Tutorials:
  - Django W3 Schools: https://www.w3schools.com/django/
  - Django Official Website: https://docs.djangoproject.com/en/4.2/
  - Clip Model: https://github.com/openai/CLIP
  - Autofaiss: https://github.com/criteo/autofaiss
  - GitHub Installation: https://www.pluralsight.com/guides/using-git-and-github-on-windows (however, first open an account into GitHub)

How Front End and Back End will Communicate?

Servers:

- Terra (computing server)
- Hawking (database server)
- Giacconi

Need to connect to the global protect (VPN) first:
Download link: https://www.cs.odu.edu/~cs_rmali004/
Gateway Setup: gp.cs.odu.edu



How to access these servers?
– ssh <user_name>@terra.cs.odu.edu
– ssh <user_name>@giacconi.cs.odu.edu
– ssh <user_name>@hawking.cs.odu.edu

Git Commands

– git clone (this command is used to clone the repository)

Example: git clone https://github.com/lamps-lab/ImageSearchEngine.git

– git status (this command is used to see the status of adding, modifying, or deleting the files in the directory)

– git add . (this command is used to add files)

– git pull (this command is used to submit a pull request and download all files that has been added already, modified)

– git commit (this command is used to commit the files that is added or modified)

Example: git commit -m “files added” (i.e., -m means message)

– git push (this command is used to push the files to the main/master branch)

Example: git push origin main/master (you need to identify whether the directory is the main or master branch)