

# Automated Collection and Multimodal Search Engine for Medical X-Ray Imagery

## 1. Introduction:

The objective of this project was to build a comprehensive search engine for medical X-ray images. The system addresses three core challenges: automated dataset collection from diverse public sources, text-based retrieval using natural language processing, and content-based image retrieval (CBIR) using deep learning.

## 2. Methodology

- **Data Collection:** We implemented a Python script using the `duckduckgo_search` library to scrape over 500 images across 5 distinct categories (Chest, Spine, Dental, Fracture, Knee). Metadata, including source URLs, was automatically logged into a CSV file to ensure traceability.
- **Text Search:** We utilized **TF-IDF (Term Frequency-Inverse Document Frequency)** to vectorize image metadata. This allows users to query images using keywords (e.g., "viral pneumonia"), with relevance ranked via Cosine Similarity.
- **Image Search:** For reverse image search, we employed a pre-trained **ResNet50** deep neural network. By removing the classification layer, we extracted 2048-dimensional feature vectors for every image. When a user uploads a query image, the system computes the cosine similarity between the query's vector and the database vectors to find the nearest visual matches.

## 3. Implementation

The system is deployed using **Streamlit**, offering a user-friendly web interface. It supports:

- **Keyword Search:** Instantly filters images based on metadata tags.
- **Visual Search:** Analyzes uploaded X-rays to find visually similar pathologies.
- **Filtering:** Users can narrow down results by anatomical category.

## 4. Conclusion

The resulting system successfully demonstrates a "multimodal" approach to medical data retrieval, combining the speed of text search with the diagnostic relevance of visual similarity search.