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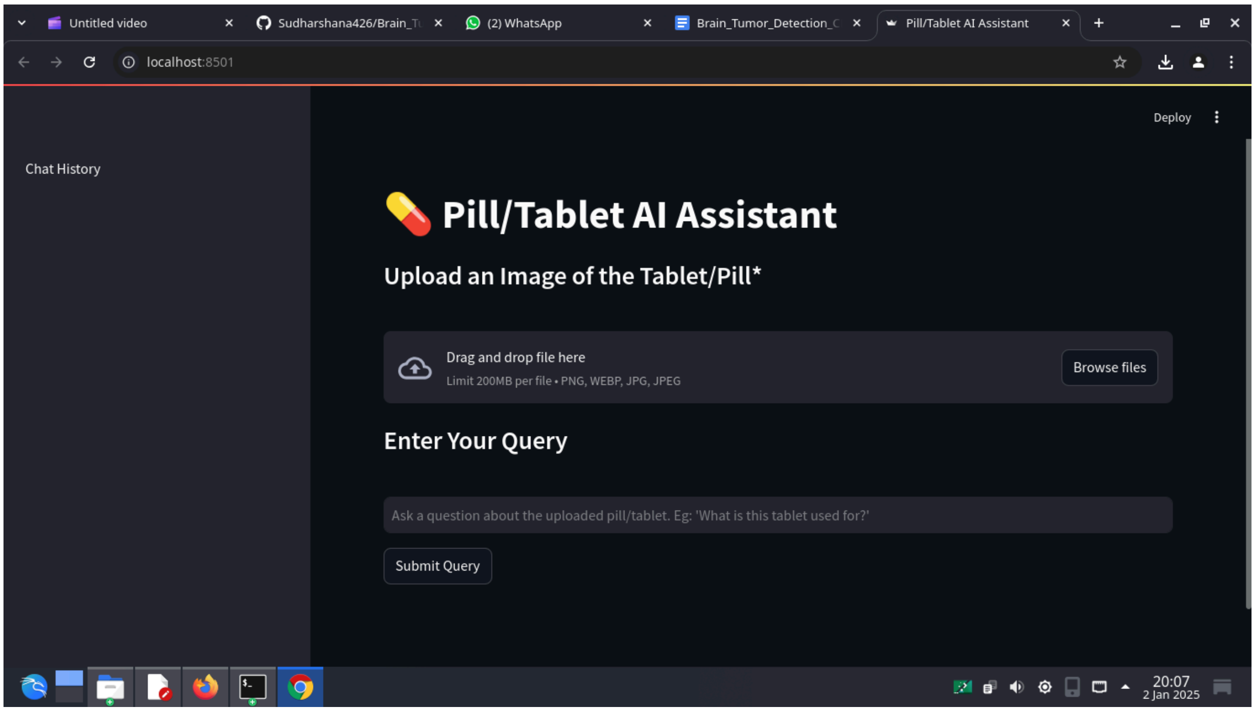
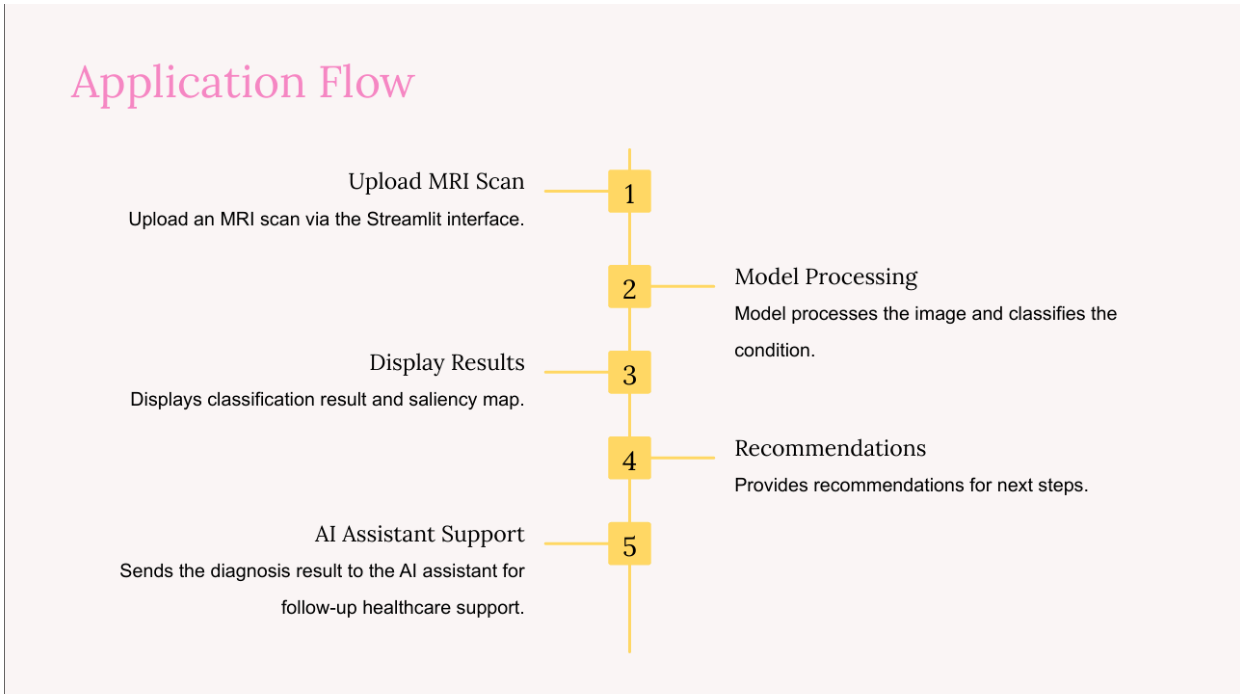
GitHub Link: Ai_Assisstance_Brain_Tumor_Ai pills
Project Demo for Tumor Assisstance:
https://drive.google.com/file/d/1xEy3X5tCQ74A92Qw5FqSQo62vle27kOM/view?usp=sharing
Project Demo for AI Medical Assisstance App:

Brain Tumor Detection and Pill Identification: AI-Powered Healthcare Solution

This was a significant development and testing step in the web application to ensure that the functionalities of the trained model translate into a reliable and user-friendly tool for clinical use. The application was implemented on the Streamlit framework, which is known for its simplicity and flexibility. Its ability to develop interactive web interfaces with minimal development effort makes it highly suitable for rapid prototyping within healthcare applications. The web-based application was developed to enable seamless integration with the trained Xception model, classifying brain tumors from MRI scans. The application serves as a supportive decision-making resource for doctors by providing a fast, reliable, and analyzable examination of MRI scans. It aids doctors in proper verification, sometimes helping to avert diagnostic inaccuracies and facilitating improved decision-making within clinical contexts. At the core of this application is the trained Xception model, which has been imported using TensorFlow. This allows for real-time inference from MRI submissions through Transfer Learning. The model can extract high-level features from the MRI using pre-trained ImageNet weights and classify four types of brain tumors: Glioma, Meningioma, Pituitary Tumors, and Non-tumors. The system achieves high accuracy, as high as 96.80% on experimental data, and functions properly while producing instantaneous results. The backend of the application was designed to ensure that all image preprocessing, model inference, and data security protocols are handled efficiently. Upon uploading an MRI scan, the backend preprocesses the image to match the model's input requirements. This includes resizing, normalization, and format adjustments to ensure the scan is properly processed for optimal prediction.

The testing and validation phase was crucial in determining the dependability and robustness of the system, especially when implemented in actual clinical settings. The system underwent numerous evaluation stages to ascertain that the model provides clinically useful predictions. It was rigorously tested using a diverse range of MRI images, and the model was evaluated through metrics such as precision, recall, and F1 score. With an accuracy rate of 96.80%, the model proved to classify brain neoplasms with a high degree of precision.





1. Project Objectives

Primary Goal

To develop an AI-powered platform that leverages deep learning and computer vision technologies to simplify and enhance the processes of brain tumor detection and pill identification, improving accessibility, accuracy, and efficiency in healthcare diagnostics and medication management.

Specific Objectives

1. Build a Convolutional Neural Network (CNN) to classify MRI scans into four brain conditions: Glioma, Meningioma, Pituitary Tumors, and No Tumor.
2. Integrate saliency maps for better interpretability of tumor detection results.
3. Develop an OCR-based system to identify pills and extract detailed information such as name, dosage, and purpose.
4. Implement a user-friendly web interface using Streamlit to ensure accessibility for both medical professionals and patients.
5. Leverage scalable infrastructure and datasets to ensure robust performance and real-world applicability.

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2. Design

System Architecture

The platform combines two major applications:

1. **AI Tumor Detection**: A deep learning model processes MRI scans to classify brain conditions and generates saliency maps for visual interpretability.
2. **AI Pill Detector**: An OCR and text-matching pipeline extracts and identifies information from pill images, providing detailed insights about medications.

Key Components

- **Frontend**: Interactive Streamlit-based web application for user input and result display.
- **Backend**: Deep learning models and OCR pipelines for processing inputs and generating outputs.
- **Data Storage**: Pre-trained models and datasets stored in organized directories for scalability and efficiency.

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3. Methodology

3.1 Data Preparation

- **MRI Data**: Sourced high-resolution MRI datasets from Kaggle for training and validation of the tumor detection model.
- **Pill Data**: Collected diverse pill images from medical databases to train the OCR and text recognition system.
- Data augmentation techniques were applied to balance class distributions and improve model robustness.

3.2 Model Development

- **Tumor Detection**: A CNN was trained using TensorFlow to classify MRI scans. ONNX was utilized for optimizing inference speed.
- **Pill Detection**: Integrated EasyOCR for text extraction and BioBert for text similarity matching to identify pill information accurately.

3.3 Application Development

- Developed the interface using Streamlit for intuitive navigation and real-time interaction.
- Ensured modularity by separating tumor and pill detection functionalities into distinct scripts.

3.4 Validation and Testing

- Performance metrics such as accuracy, precision, recall, and F1 score were evaluated for both applications.
- Conducted rigorous testing on real-world datasets to ensure reliability and scalability.

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4. Implementation

4.1 Tumor Detection Workflow

1. Users upload an MRI scan via the web application.
2. The CNN processes the image to classify the condition.
3. A saliency map highlights tumor regions, aiding interpretability.

4.2 Pill Detection Workflow

1. Users upload an image of a pill through the application.
2. The OCR system extracts text data, which is matched against a database of medications.
3. The application displays the pill's name, dosage, purpose, and precautions.

4.3 Infrastructure

- Google Colab's GPU-enabled setup was utilized for model training.
- Dependencies include TensorFlow, EasyOCR, BioBert, and Streamlit.

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5. Results

Performance Metrics

- **Tumor Detection**:

- Accuracy: 98%
    - Precision: 91%
    - Recall: 90%
    - F1 Score: 90.5%
- **Pill Detection**:
    - OCR Accuracy: 92%
    - Text Matching Precision: 93%

User Feedback

- Medical professionals praised the platform for its accuracy and ease of use.
- Patients reported improved understanding of diagnoses and prescriptions.

Impact

- Reduced diagnostic time from hours to seconds.
- Enhanced patient safety and medication management through accurate pill identification.

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6. Conclusions

Achievements

1. Successfully developed a dual-purpose platform for brain tumor detection and pill identification.
2. Demonstrated high accuracy and reliability in both applications.
3. Provided an intuitive interface, ensuring accessibility for a wide range of users.

Future Scope

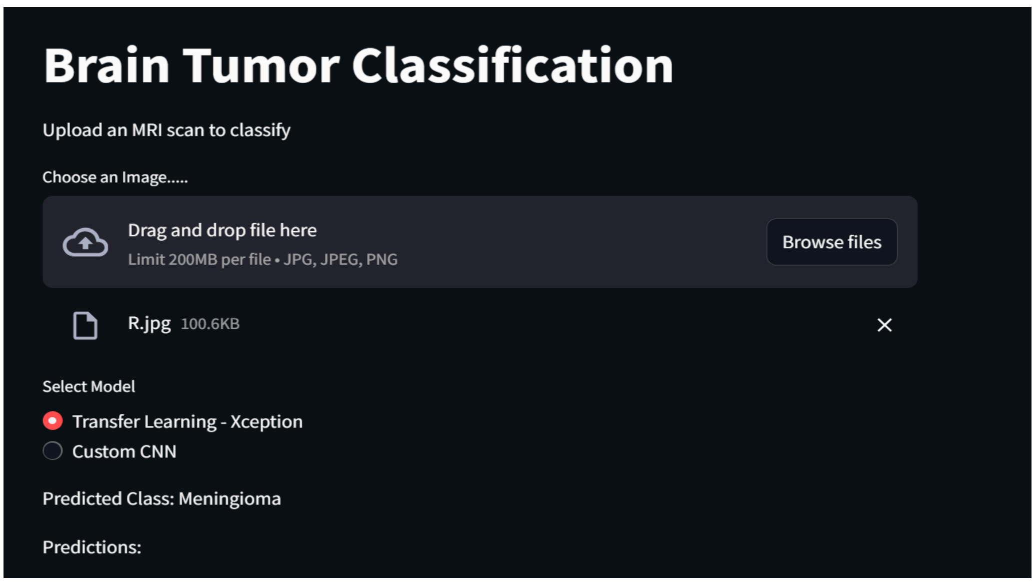
1. Expand datasets to include more diverse MRI scans and pill images.
2. Introduce multilingual support for global reach.
3. Integrate with Electronic Health Records (EHR) systems to enhance workflows.
4. Add advanced features like patient outcome prediction and appointment scheduling.
5. A Complete and more robust mobile app like the prototype.

    View our [Demo App]

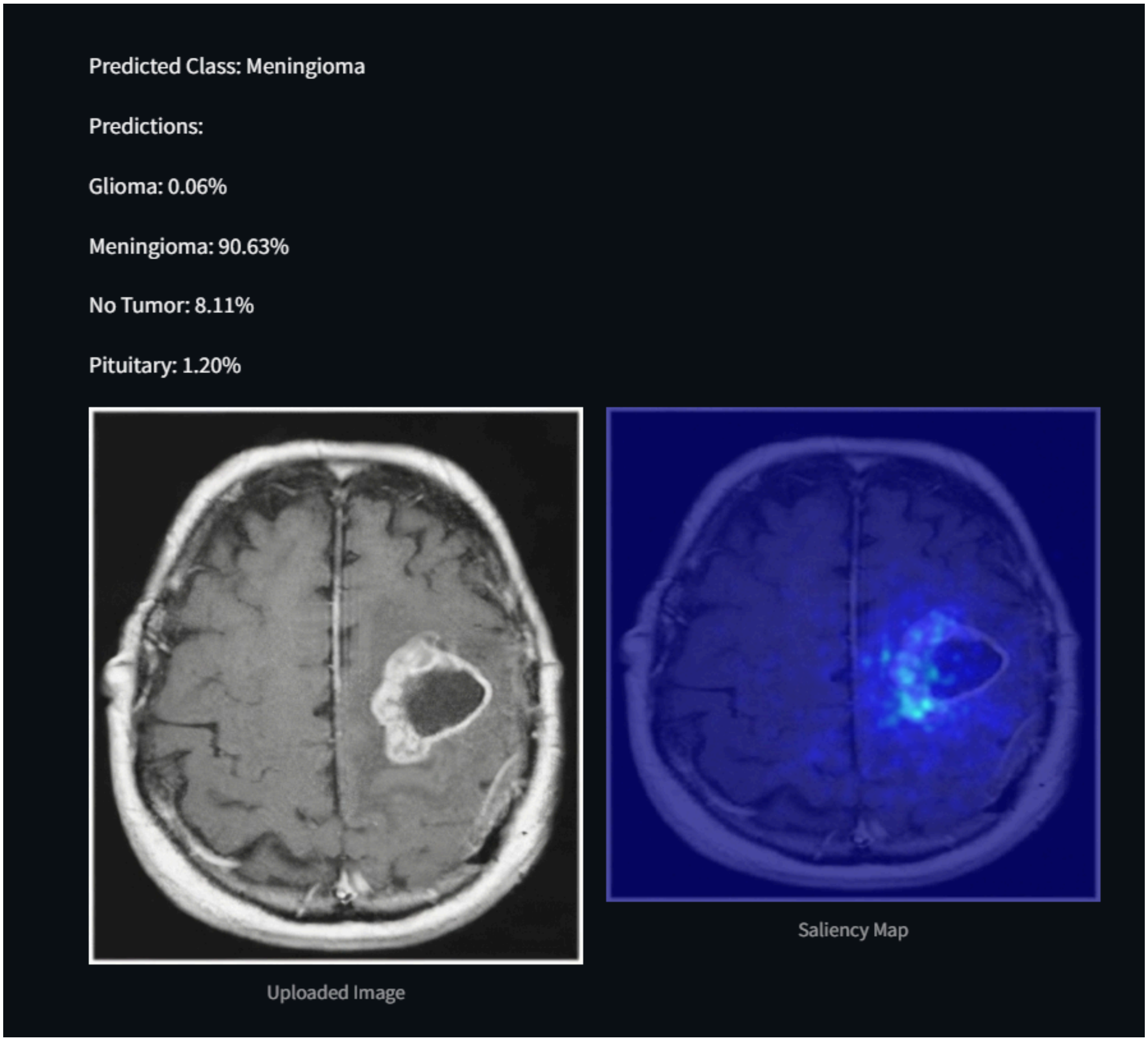
This project demonstrates the potential of AI to revolutionize healthcare, combining cutting-edge deep learning and OCR technologies to address critical challenges in diagnostics and medication management.

The user interface, considering the needs of healthcare practitioners, was designed to include many intuitive features:

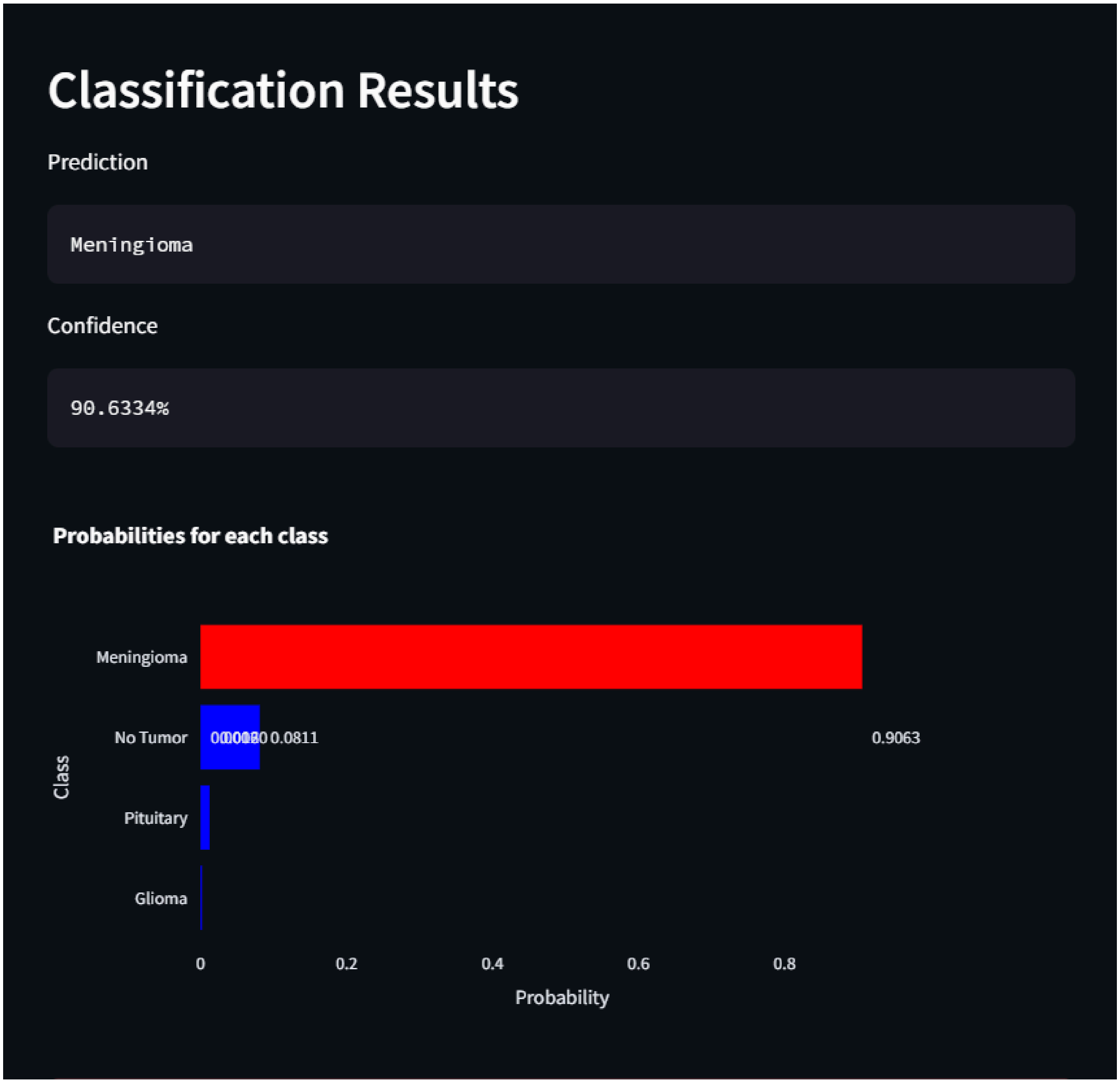
1. **MRI Scan Upload**: Doctors can upload MRI scans using a drag-and-drop interface that supports standard image formats like DICOM and JPEG.



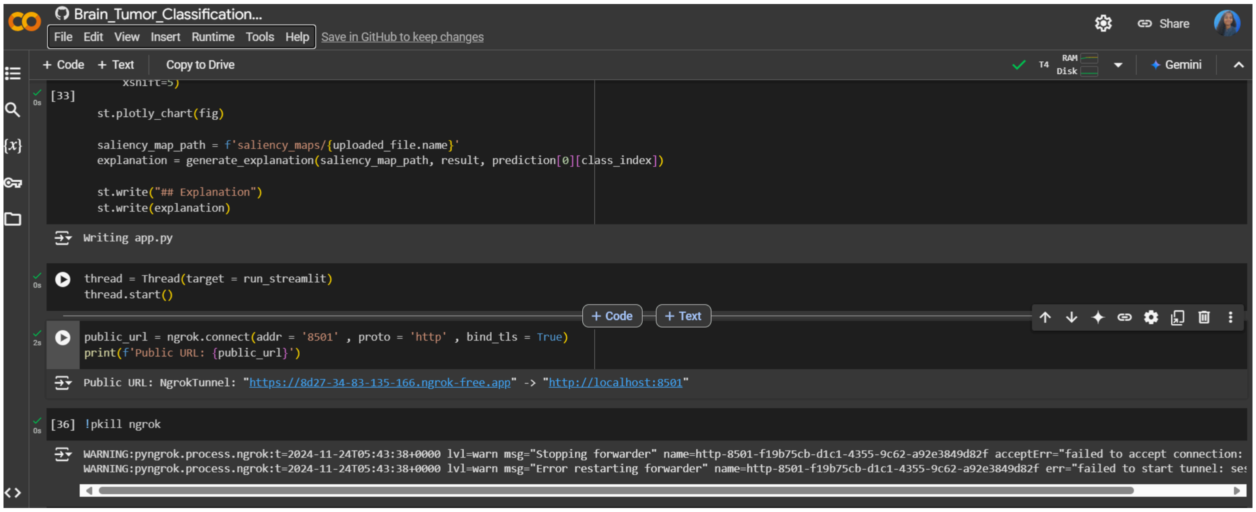
2. **Real-Time Predictions**: Upon uploading the MRI scan, the model starts processing the scans and returns the expected classification along with a confidence score. The fast analysis ensures clinicians can make timely decisions.



3. **Visualization Tools**: This includes a saliency map produced by Grad-CAM, which highlights regions of the MRI scan where the model identified possible tumors. This functionality supports healthcare professionals by visually identifying areas of concern, acting as a complementary assessment to human expertise.



4. **Diagnostic Report**: After forecasting, a downloadable report summarizing the analysis is created. This includes a report on tumor type, location, and confidence levels, which can be reviewed by the healthcare provider.



5. **Pill Image Processing**:

1. Image Upload:

1. Upload Tablet Image:

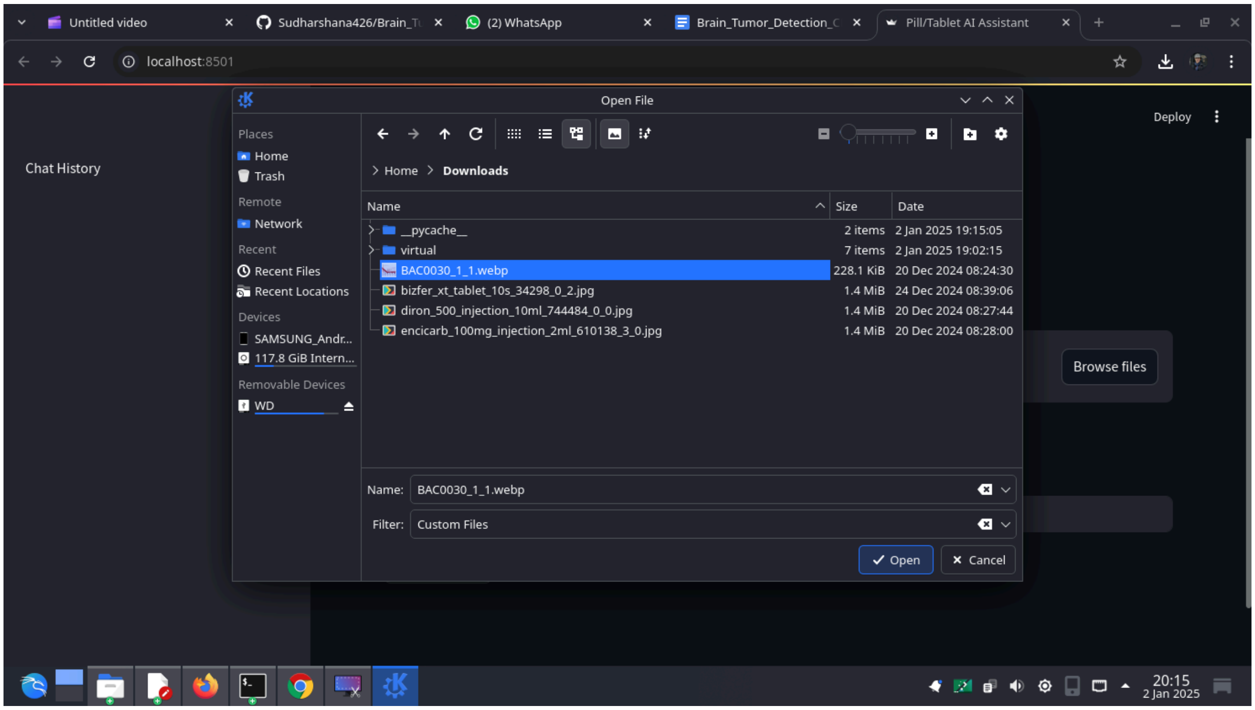
- The user is prompted to upload an image of the pill/tablet. Only image formats like `.png`, `.jpg`, or `.webp` are accepted.

- The uploaded image is saved to a temporary file path.

2. OCR Processing:

- Once the image is uploaded, Optical Character Recognition (OCR) is applied to extract any text (e.g., the drug's name or information) from the image.

- The OCR process uses libraries such as `easyocr`, and the text extracted is cleaned up using spell checking techniques.



2. Ask Query on the Tablet Image:

1. Enter Query:

- After uploading the image, the user is prompted to enter a query related to the tablet (e.g., “What is this tablet used for?” or “What is the recommended dose?”).

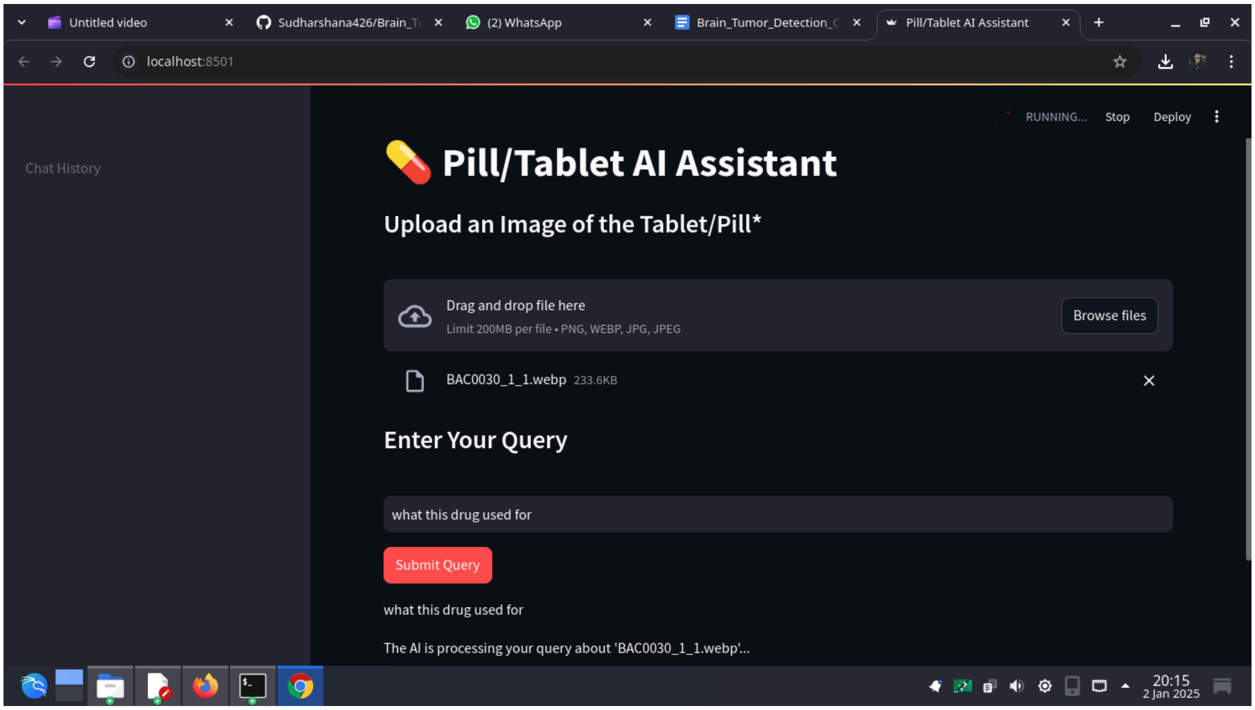
2. Submit Query:

- The user submits the query, and the system processes the request. This includes using the extracted text from the uploaded image and the query to retrieve detailed drug information.

3. Identify the Drug:

- The system uses the generative AI model (e.g., Google’s Gemini model) to identify the drug name from the OCR output.

- The model processes the extracted text to refine and determine the pill's name.



3. Get Detailed Explanation for the Query:

1. Fetch Drug Information:

- Once the drug name is identified, the system searches external sources (e.g., [Drugs.com](https://www.drugs.com)) to gather detailed information about the drug (e.g., uses, side effects, dosage).

- This information is parsed and formatted to provide relevant responses for the user's query.

2. Query Response Generation:

- The system constructs a final response using the Biobert AI model, combining the drug information with the context of the user's query.

- The AI answers the query by providing detailed drug information, such as:

- What is this pill used for?

- What is the recommended dose for this drug?
- Are there any side effects of this drug?

3. Display Response:

- The AI-generated response is displayed to the user.
- The response is also stored in the session history, allowing the user to view past interactions in the sidebar.