BEYOND THE VISIBLE

Team Name: Infinity Coders

Theme: Healthcare Tech & Bioinformatics

Team Details

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Problem Statement

AI-Assisted Medical Imaging Analysis - Detect anomalies in X-rays, MRIs, or CT scans automatically.

Challenges

Late Diagnosis of Vestibular Schwannoma (VS):
Tumors are often detected in later stages due to subtle early symptoms and delays in MRI interpretation.

Traditional Methods Offer Only Binary Classification:
Existing diagnostic systems typically classify tumors as present or absent — they do not quantify the seriousness or stage of the tumor

No Quantitative Confidence Score:
Traditional diagnostic reports do not provide a confidence score or severity scale to guide clinical decisions.

Symptoms Often Ignored or Misclassified:
Patients' self-reported symptoms are not integrated with imaging for holistic evaluation.

Proposed Solution

- We propose a deep learning pipeline combining volumetric tumor analysis and symptom-based scoring to quantify vestibular schwannoma severity.
- A CNN regression model is trained on preprocessed DICOM MRI scans, using tumor volume-derived confidence scores as ground truth for supervised learning.
- The system integrates multi-modal inputs — image-based predictions and patient-reported symptoms — to output a unified confidence score and stage classification.
- The final output not only predicts the tumor's severity but also dynamically generates AI-driven clinical suggestions for improved patient awareness.

Tools & Technologies

Language

- Python

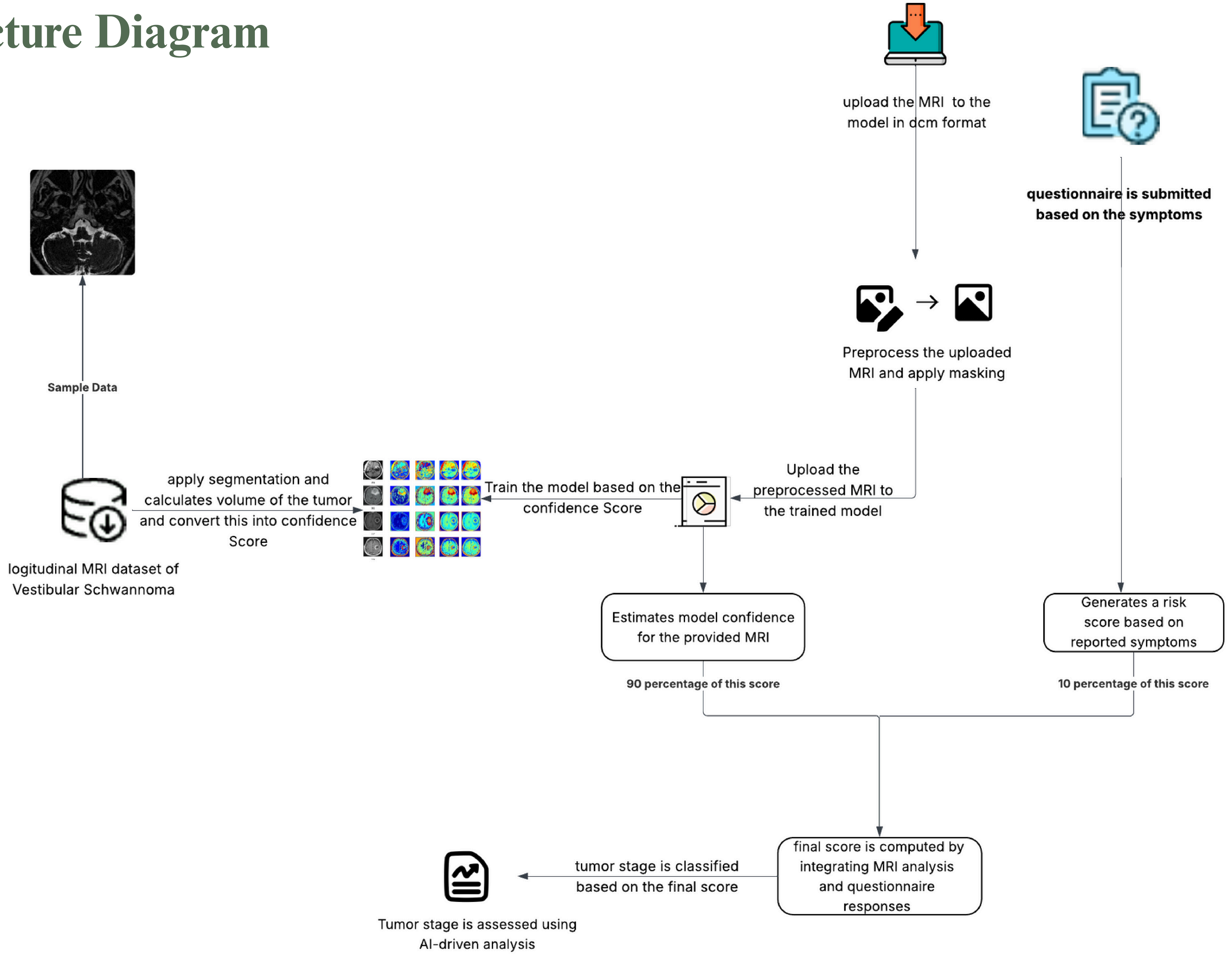
Framework

- Pytorch

Tools

- Pycharm

Architecture Diagram



Dataset Overview

- The longitudinal MRI dataset of Vestibular Schwannoma has been taken in the format of raw DICOM volumes, organized by patient and scan series.

- 124 subjects were analyzed, and the Scan Modalities are T1, T2-weighted. Each patient folder contains multiple timepoints/series.

Questionnaire

- A symptom-driven screening tool designed to gather patient-reported indicators commonly associated with Vestibular Schwannoma (VS).

- It transforms subjective clinical symptoms into quantitative scores

Preprocessing

- Original MRI scans in DICOM format are converted to NIfTI (.nii) format for standardized 3D volume representation.
- Volumes are cropped to the region of interest to a fixed shape. Tumor region is encoded as 1, and background as 0, forming a binary 3D mask of the same shape as the input MRI scan.
- Preprocessed NIfTI volumes are saved as .npy files for faster loading during training and inference.
- Metadata is linked to each volume with its subject ID, scan date, and label, which is used to build growth pairs mapping how a tumor evolves.
- Outputs a confidence score that quantifies the certainty of the prediction by the tumor volume.

Trained CNN Model

🧠 BEYOND THE VISIBLE

Upload MRI & Answer Symptoms

Upload DICOM MRI File:

Choose File 1-05.dcm

Symptom Questionnaire

Do you experience hearing loss in one ear?

High

Do you hear ringing or buzzing sounds (tinnitus) in one ear?

Less

Do you feel a sensation of fullness or blockage in one ear?

Less

Do you often feel unsteady or lose balance while walking?

Less

Have you experienced vertigo (spinning sensation)?

Less

Do loud sounds in one ear feel more irritating than usual?

Moderate

Do you have any facial numbness or weakness?

Less

Have you experienced nausea or vomiting with balance problems?

Less

Do you frequently have headaches without a clear cause?

Extremely High

Have you noticed changes in your vision or blurred vision?

Less

Submit for Analysis

📊 Analysis Result

MRI Score (90%): 18.44

Questionnaire Score (10%): 32.5

Final Score (out of 100): 19.85

Tumor Stage: Stage 0 - No Tumor

← Back to Home

🧠 AI-Generated Suggestions

- 💡 Avoid long exposure to loud noise or headphones.
- 💡 Incorporate vestibular balance exercises such as Tai Chi or Yoga.
- 💡 If balance issues or ringing in the ear persist, an ENT or neurologist consult is advised — even if the MRI is clear.

Evaluation

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📊 Evaluation Metrics:
Mean Absolute Error (MAE): 20.24
Mean Squared Error (MSE): 696.76
R² Score: -0.01
Accuracy (approx): 79.74%
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Accuracy

The trained CNN model demonstrates a strong foundational performance, achieving an accuracy of 79.74% (approximately 80%) in predicting tumor confidence scores.

Confidence Score

MRI Confidence Score (90%):

Model processes DICOM MRI scans and outputs a confidence value between 0–100.

Questionnaire Score (10%):

- Calculated based on answers to 10 symptom-related questions.
- The questionnaire captures subjective symptoms like hearing loss, vertigo, imbalance, facial numbness, etc. This adds clinical context that might not show strongly in early MRI scans.

Final Confidence Score:

final_score = (0.9 * mri_score) + (0.1 * q_score)

Tumor Stage Classification

Stage 0: final_score < 20 ----->*Stage 0 - No Tumor*

Stage 1: final_score < 40 ----->*Stage 1 - Early*

Stage 2: final_score < 60 ----->*Stage 2- Moderate*

Stage 3: final_score < 80 ----->*Stage 3- Advanced*

Stage 4: final_score > 80 ----->*Stage 4- Severe*