Progress Report – Case Study

Project Title:
AI-Driven Detection and Grading of Knee Osteoarthritis in Radiographic Data

Reeve Gonsalves

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1. Project Overview

The objective of this project is to develop a deep learning–based system for automated detection and severity grading of knee osteoarthritis (KOA) using radiographic (X-ray) images. The system aims to classify knee joints according to the Kellgren–Lawrence (KL) grading scale and provide interpretable predictions through explainable AI techniques.

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2. Work Completed Since Expose Submission

Since the submission of the expose, the following tasks have been completed in alignment with the proposed project timeline:

- Finalization of the project scope with a focus on knee osteoarthritis
- Investigation of publicly available datasets suitable for KL grading
- Initial literature review of deep learning approaches for KOA detection
- Setup of the project repository with a clear folder structure
- Creation of initial notebooks to prepare the experimental environment and configuration

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3. Dataset Investigation Status

A preliminary investigation of publicly available knee osteoarthritis datasets has been conducted. The Osteoarthritis Initiative (OAI) dataset has been identified as a primary candidate, as it provides large-scale knee X-ray images annotated with Kellgren–Lawrence grades.

Key observations include:

- Availability of standardized KL grading (0–4)
- Large dataset size suitable for deep learning
- Expected class imbalance across severity grades
- Requirement for dataset access registration and preprocessing

Backup datasets such as the MOST study have also been identified in case of access delays or complementary experimentation.

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4. Literature and Method Exploration

An initial literature review has been initiated to understand current state-of-the-art methods for knee osteoarthritis detection and grading. The review focuses on:

- CNN-based approaches for KL grading from knee X-rays
- Transfer learning using architectures such as ResNet and DenseNet
- Data augmentation strategies to address class imbalance
- Explainable AI methods, particularly Grad-CAM, for visual interpretation

This review ensures that the project will build upon established and competitive approaches rather than simple baseline models.

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5. Repository and Implementation Setup

A GitHub repository has been created to support reproducible development and version control. The repository currently includes:

- Structured folders for notebooks, references, reports, and source code
- Dataset investigation and literature review documentation
- An initial project setup notebook defining the experimental configuration and development environment

All future notebooks and experiments will be committed regularly as the project progresses.

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6. Planned Next Steps (Next 3 Weeks)

The next phase of the project will focus on implementation and experimentation:

- Finalizing dataset access and download
- Performing exploratory data analysis and visualization
- Implementing baseline CNN models using transfer learning
- Conducting initial training and validation experiments
- Refining methodology based on observed results

GitHub Repository:
https://github.com/Reevegon/Reeve-Case-Study2