DeepTherapy: A Mobile Platform for Osteoarthritis Rehabilitation Utilizing Chain-of-Thought Reasoning and Deep Learning

Avci, Muhammed Ferit (School: Bursa Halil Inalcik Bilim ve Sanat Merkezi)

Osteoarthritis (OA) is a widespread degenerative joint disease affecting over 528 million people globally. Physiotherapy is essential for treatment but it is expensive, time-intensive, and inaccessible for many patients. Existing tools focus on whether or not a movement occurred without evaluating the quality of execution or offering detailed guidance for improvement. This project introduces DeepTherapy, an AI-powered mobile platform to support OA rehabilitation by integrating deep learning and an LLM to provide structured, physiotherapist-like feedback. A custom dataset of rehabilitation exercises was collected and processed using pose estimation to extract detailed kinematic features. These features were used to train sequence-based LSTM models capable of classifying exercise phases. A rule-based system segmented individual repetitions and computed biomechanical performance metrics to assess movement quality. To convert these metrics into structured textual feedback, a chain-of-thought prompting strategy was designed based on practical examples from experts, enabling the LLM to reason step-by-step and deliver context-specific corrective guidance. The system was tested on OA patients, and its outputs were independently evaluated by expert physiotherapists, demonstrating a strong alignment between the generated quality scores and expert assessments. The LLM-generated feedback was consistently rated as clinically relevant, clear, and helpful. Additionally, the top-performing model achieved 96.2% accuracy in exercise phase prediction. These results indicate that DeepTherapy can effectively assess exercise quality and provide physiotherapist-like feedback, offering a scalable, AI-driven solution to enhance the accessibility and effectiveness of OA rehabilitation.

Awards Won: