Chapter 1
A Perspective on Intelligent Imaging Techniques for Early Prediction of Knee Osteoarthritis

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ABSTRACT

A serious skeletal illness that lowers well-being and increases fracture risk, osteoporosis affects a large number of people worldwide. Early detection of osteoporosis in the knee is essential for successful treatment. This study presents deep learning, machine learning, and image processing techniques. It entails taking images of the knee joint using thermal imaging, x-rays, or other techniques, then processing them to improve quality and standardize format. The knee region is the target of methods such as region-of-interest (ROI) extraction. Numerous images are examined, encompassing geometric dimensions, bone mineral density, and textural features. Predictive models, such as decision trees, support vector machines (SVM), and convolutional neural networks (CNNs), classify knee joints as osteoporotic or healthy. The study also explores using an ensemble of multiple machine-learning models to improve system robustness and effectiveness.

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INTRODUCTION

Knee osteoarthritis, often known as KOA, is a progressive joint disorder characterized by the gradual deterioration of the protective cartilage that coats the ends of the knee bones. It is among the most prevalent types of arthritis, especially in the elderly. Osteoarthritis is an illness marked by pain, stiffness, and limited mobility due to protecting cartilage in the joint deteriorating over time. Although the precise origin of knee osteoarthritis is unknown, several variables are thought to be involved, such as ageing, genetics, obesity, overuse or damage to the joint, and misalignment of the joint. Bones may start to rub against one another as cartilage deteriorates; causing more injury and the development of bone spurs (Ondrésik, 2016).

The bones within the knee joint may experience friction, resulting in discomfort, rigidity, inflammation, and restricted mobility. Significance of identifying knee osteoarthritis early intervention and management aim to address and control the condition promptly. Pain relief strategies are implemented to alleviate discomfort. Preservation of joint function is prioritized to maintain optimal mobility. Preventing disability is a crucial objective to ensure long-term functionality. Enhancing quality of life is a central focus of the treatment approach. Customized treatment plans are developed to cater to individual needs. Preventing complications is a crucial aspect of the overall care.

The most prevalent type of arthritis that causes pain and mobility restrictions is knee osteoarthritis (KOA), a degenerative knee joint condition. Osteoarthritis of the knee (KOA) is a long-term musculoskeletal disease that impairs function and quality of life by causing persistent knee pain and incapacity. It is difficult to evaluate the degree and intensity of the pain that people experience since pain in KOA is subjective and idiosyncratic.

More than 250 million individuals globally suffer from knee osteoarthritis (OA), a chronic joint ailment that is the leading cause of disability. Knee OA causes the disease's majority (83% of the entire burden). Particularly in women over the age of 55, knee OA is more common (Ondrésik, 2016).

Timely detection of knee osteoarthritis (OA) is essential for mitigating disease progression, alleviating pain, and enhancing quality of life. Prompt recognition of osteoarthritis reduces the likelihood of surgical intervention by facilitating rapid management, which encompasses lifestyle modifications, physical therapy, and targeted treatments. However, the existing approaches for early diagnosis, such as x-rays and clinical evaluations, demonstrate limitations. They frequently exhibit insensitivity to nuanced variations, are subjective, and are susceptible to inconsistencies among observers. As a result, these methods often neglect pre-symptomatic or moderate cases. Thus, machine learning for osteoarthritis detection can analyze recognized patterns in imaging, biomarkers, and clinical data with enhanced precision.