



Chapter 8

Automated Detection of Osteoporosis Using X-Ray Image Based on Optimized Recurrent Neural Network and Context Encoder Network


Kiruthika V.

 <https://orcid.org/0000-0003-1915-6315>
Vellore Institute of Technology, Chennai, India

Sheena Christabel Pravin

 <https://orcid.org/0000-0001-8520-3322>
Vellore Institute of Technology, Chennai, India

Arivarasi A.

 <https://orcid.org/0000-0001-6774-0626>
Vellore Institute of Technology, Chennai, India

ABSTRACT

Loss of bone mineral density (BMD) is the primary cause of osteoporosis, a prevalent skeletal condition. In the healthcare industry, inefficiencies are typically caused by a degree of variability resulting from manual and semi-automated processes used in medical data analysis. Therefore, the automatic prediction is considered as essential in order to detect whether the patient is affected by osteoporosis or not. However, the primary issue with existing techniques is imprecise disease diagnosis at early stages, as well as a lack of processing approaches. In order to overcome this issue, deep learning-based approach is developed. Initially, the x-ray images

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are collected and pre-processed using frost filter, reformed histogram equalization in order to improve the image resolution. Then the pre-processed image was segmented to obtain the region of interest (ROI) required for prediction. Values for these metrics will be better and suited for early osteoporosis diagnosis to improve the living standard of people.

INTRODUCTION

Low density of bone minerals and micro-architectural degradation, which weakens bones and raises the risk of fractures, are the characteristics of the systemic disease osteoporosis (Bhadada et al., 2021). It affects hip, spine, and wrist fractures, lowering patient quality of life and raising mortality risk. Global public health concerns about osteoporosis are growing with the population's age and life expectancy rises, affecting more than 200 million individuals (Lesnyak et al., 2020). An osteoporotic fracture is predicted to occur in a third of women and one in five men over the age of fifty, according to the International Osteoporosis Foundation. Disease first develops without symptoms and goes misdiagnosed due to a lack of symptomatology, with the first manifestation frequently being a vertebral or long bone low-energy fracture (Whitney et al., 2020).

Dual-energy X-ray absorptiometry (DXA) tests of bone mineral density are commonly used to diagnose osteoporosis (Chen et al., 2023). However, the availability of this method for diagnosing the entire population is restricted, and it is costly and complex. Since digital dental panoramic radiographs (DPRs) are widely used studies have demonstrated that in dental treatment for elderly people having longer lifespans that osteoporosis screening and BMD estimation are feasible using panoramic radiography, DPRs have been considered an important and cost-effective image data for osteoporosis screening. Medical applications are being researched to minimize workload, improve performance accuracy, and improve gadget usability, ultimately enhancing healthcare efficiency (Haleem et al., 2022). Traditional techniques of diagnosing osteoporosis are time-consuming and complicated, resulting in errors and patient suffering. Because of high diabetes incidence and healthcare inequities, many persons with osteoporosis go undiagnosed, potentially resulting in irreversible vision loss and blindness (Newman-Casey et al., 2023). A fully automated computer-aided approach for categorizing DR is urgently required to provide proper assessment and treatment while removing the chance of analyst error (Aminizadeh et al., 2023). This strategy seeks to reduce burden while increasing healthcare efficiency.

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