

Automated Curvilinear Planar Reformation in CBCT: A Morphology-Agnostic Pipeline for Standardized Panoramic Reconstruction

Saba Sarwar

Department of Computer Science, Faculty of Sciences, Jamia Millia Islamia, New Delhi, India

Suraiya Jabin

Department of Computer Science, Faculty of Sciences, Jamia Millia Islamia, New Delhi, India

Deepa Anand

GE Healthcare, Bengaluru, India

Mandeep Kaur

Oral Medicine & Radiology, Faculty of Dentistry, Jamia Millia Islamia, New Delhi, India

Virender Gombra

Oral Medicine & Radiology, Faculty of Dentistry, Jamia Millia Islamia, New Delhi, India

Abstract

The ideal format for dental practitioners has always been panoramic radiography, which provides detailed information about the dental arch. Though the volumetric information provided by the 3D Cone Beam Computed Tomography (CBCT) is more accurate, the conversion of the volumetric data into the 2D panoramic format, referred to as the Curvilinear Planar Reformation (CPR), has always been associated with variability and distortion. In the proposed study, a reproducible automated method for the extraction of the dental arch, followed by the generation of the 2D panoramic radiographic image, has been provided. The objective of the study is to minimise the necessity of manual point selection, facilitating the reproducible "unrolling" of volumetric data. The proposed hybrid methodology was validated by the accurate extraction of the arch midline for a dataset of 280 CBCT volumes, resulting in a success rate of 96%. This was achieved by the transition from the Maximum Intensity Projection (MIP) to the thickness-optimized Average Intensity Projection (AIP). This resulted in the reduction of the "dental stretching" artifacts, meeting the professional radiologic standards. The study has successfully addressed the critical technical problems associated with the reproducible generation of the panoramic radiographic images, including the extension of the arch to cover the posterior anatomy, as well as the reduction of noise in the high-density areas. The proposed methodology has proven the reproducibility of the CPR process, allowing for anatomically accurate 2D radiographic images without the need for the involvement of a radiologic professional. This innovation has the potential to increase the efficiency of the radiological reporting process.

Keywords

Cone Beam Computed Tomography (CBCT), Curvilinear Planar Reformation (CPR), Panoramic Radiograph, Dental Arch Detection, Dental Imaging Automation.