CompaCT: Fractal-Based Heuristic Pixel Segmentation for Enhanced Lossless Compression of High-Color DICOM Medical Images

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Digital medical image storage requirements are growing significantly with each passing year. Medical images require a high color depth of 12 bits per component for accurate assessment and analysis by physicians. The Digital Imaging and Communications in Medicine (DICOM) format provides an international standard for saving and transferring medical files. In this project, a new medical file compression format is developed to improve transmission speeds and reduce image storage requirements without losing quality for extensive DICOM medical image archives. A novel algorithmic compression and decompression pipeline was constructed using fractal pixel traversal on an image map and a unique heuristic pixel segmentation system to exploit inherent spatial redundancy in medical scans. This novel approach also allowed lossless image reconstruction during decompression to enable reduced storage costs without sacrificing reliable and accurate image analysis. The developed algorithm was compared with several industry standards and third-party techniques (JPEG2000, RLE, ZIP, PNG) to assess the compression efficiency. The algorithms were evaluated on an archive of 3952 high-color abdominal and lung CT scans and quantitatively compared in terms of various compression metrics. The evaluation results proved that the proposed fractal segmentation algorithm yielded, on average, 37% improved compression ratios compared to current industry standards. This examination provides an innovative, space-efficient approach for a high-color image compression codec. If implemented as a new industry standard, it can drastically reduce storage costs and aid with the efficient transmissibility of DICOM medical images.

Awards Won:

Second Award of $2,000