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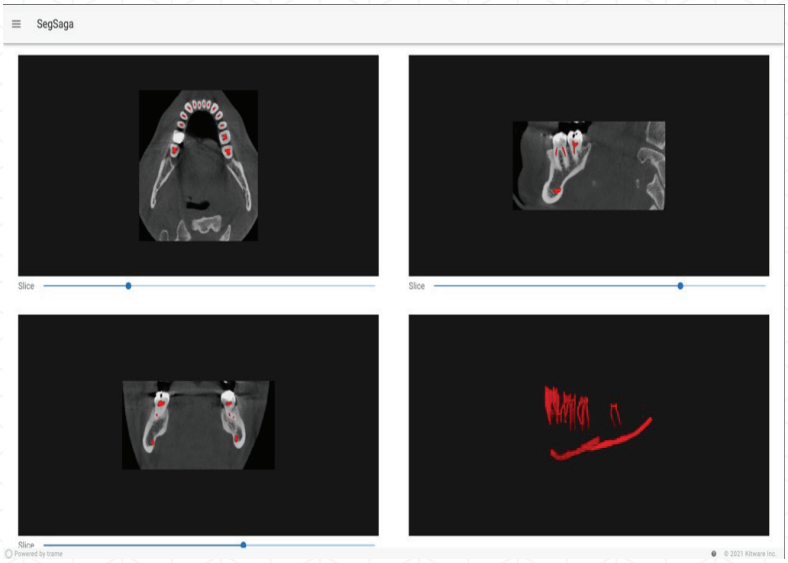
ICT R&D Newsletter in Egypt

Use of an Artificial Intelligence Model to automatically segment hard and soft dental and paradental tissues from CBCT scans.

Smart-CI Alexandria University

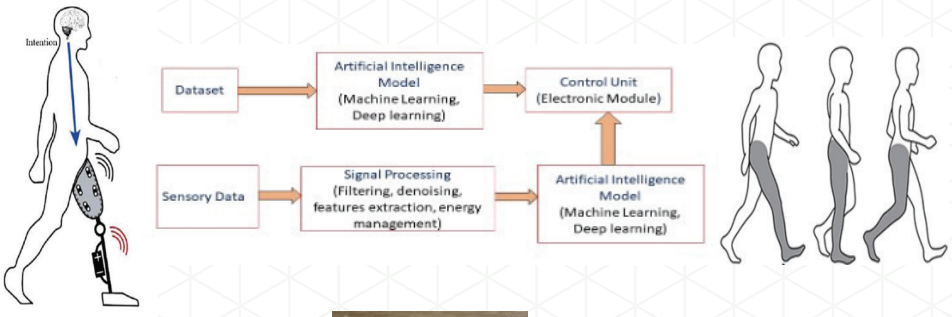
Researchers at Alexandria University's SmartCI Center have developed an AI-powered software toolkit that automatically segments both hard and soft dental tissues from CBCT scans with unprecedented accuracy. Using advanced deep learning architectures based on nn-UNet trained on over 500 annotated CBCT scans, the system reduces segmentation time from hours to just 5 minutes while maintaining expert-level precision. Accurate diagnosis and treatment planning in dentistry have long depended on manual interpretation of Cone Beam Computed Tomography (CBCT) scans—a time-consuming process prone to human error that could take up to 7 hours per case. This challenge becomes critical when treating conditions affecting dental pulp, planning orthodontic interventions, or positioning dental implants, where precision directly impacts patient outcomes. The novelty lies in the system's ability to perform multi-view analysis of 3D volumetric data, handling the complex crown-to-root topology and low-contrast boundaries that challenge traditional methods. The solution employs sophisticated voxel patching techniques and positional embedding to capture both local and global anatomical features. Key achievements include: successfully segmenting pulp chambers and root canals in both single-rooted and multi-rooted teeth; accurate identification of hard tooth structures, alveolar bone, and inferior alveolar nerve; and deployment as a user-friendly standalone application. "The AI tool provides standardized diagnostic support, reduces clinician workload, and enables more predictable treatment outcomes across endodontics, orthodontics, and implantology applications' says Dr. Marwan Toki Associate Professor at Faculty of Engineering, Alexandria University



Smart Data Acquisition System for Lower Limb Exoskeletons (SDALLE)

Arab Academy for Science, Technology and Maritime Transport (AASTMT) and Ain Shams University

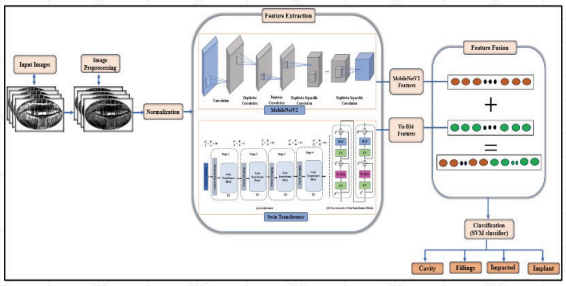
Researchers from AASTMT and Ain Shams University developed SDALLE which introduce a portable, modular DAQ system designed to acquire and process bio-signals in real time. The Smart Data Acquisition System for Lower Limb Exoskeletons (SDALLE) marks a major step forward in Egypt's development of intelligent rehabilitation technologies. The project addresses the growing need for wearable robotics capable of monitoring and assisting human motion, particularly for patients with gait or mobility impairments. The unit integrates electromyography (EMG) and inertial measurement unit (IMU) sensors mounted on the hips and knees to record muscular and motion activity simultaneously. A real gait dataset was collected from nine subjects, covering five activities: walking, running, stair ascent, stair descent, and standing. To enhance signal clarity and reliability, a new framework for conditioning, denoising, filtering, feature extraction, and activity classification was proposed. After evaluating several signal-processing techniques—Wavelet Transform (WT), Principal Component Analysis (PCA), and Empirical Mode Decomposition (EMD)—an Autocepstrum Analysis (ACA) approach proved most effective. The refined signals enabled high-accuracy classification using Artificial Neural Networks (ANNs), Support Vector Machines (SVMs), Random Forests, and Temporal Convolutional Networks (TCNs). The outcomes include a fully functional portable prototype, a public dataset. "By combining embedded sensing, AI, and wireless data streaming, SDALLE stands as a fully Egyptian innovation that advances healthcare robotics and supports Egypt Vision 2030' says Dr. Hanady Husain Abdelkader Professor at Electronics and Communications, Engineering Department, Arab Academy for Science, Technology and Maritime Transport.



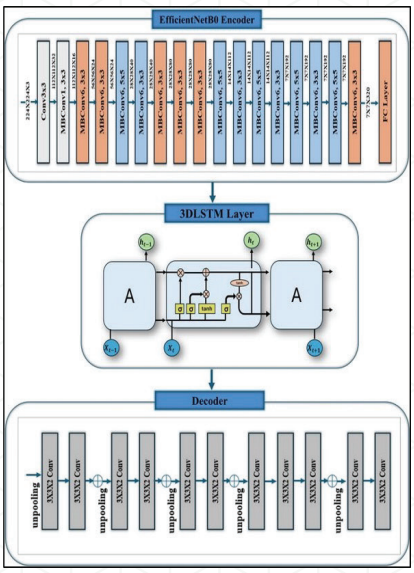
3D-RecDental: Revolutionizing Dental Diagnosis with AI and 3D Reconstruction

Mansoura University

A research team from Mansoura University has developed 3D-RecDental, an innovative AI-based system that transforms dental diagnosis and treatment planning through advanced image analysis and 3D reconstruction. Dental diseases, such as cavities, gum infections, and bone loss, affect millions worldwide, and early detection is vital for effective treatment. Traditional diagnosis methods depend on visual inspection, which is time-consuming and prone to human error. The core technology behind 3D-RecDental combines computer vision and deep learning techniques to automatically detect and classify dental problems using X-ray scans. A dual-stream architecture integrates Swin Transformer for capturing global image context and MobileNetV2 for extracting fine local details. The system then combines these features and classifies dental conditions using an ensemble learning model, achieving an outstanding accuracy of 95.6%. Beyond diagnosis, the project introduced a 3D reconstruction module that converts 2D dental X-rays into accurate 3D models using an encoder-decoder network with 3D LSTM layers, providing dentists with an interactive 3D visualization of dental structures. This advancement supports more precise treatment planning, particularly for patients who cannot undergo conventional 3D scanning. “The main achievements of 3D-RecDental include its high diagnostic accuracy, efficient image processing, and potential for seamless integration within existing dental systems. The project demonstrates how AI and 3D imaging can transform the future of dental healthcare, enhancing both clinical efficiency and patient outcomes’ says Dr. Mohammed El Mogy Professor at the Information Technology Department, Faculty of Computers and Information, Mansoura University.



Dental Diagnosis System



3D Dental Reconstruction System

Smart Spout Transforms Egypt's Water Safety with AI Powered Monitoring

Menoufia University and EA for Software Solution

In response to mounting concerns over drinking water safety in Egypt's rapidly growing cities and industrial zones, researchers from Menoufia university and EA for software solution have introduced "Smart Spout' project, an intelligent water-quality unit for households, commercial buildings, and factories that turns every connection point into a real-time monitoring node. The system integrates low-cost IoT sensors installed at inlets of distribution lines with a cloud platform that applies big data analytics and machine learning to classify water quality, detect anomalies, and trigger instant alerts to consumers, facility managers, and water authorities. This AI-driven approach moves beyond traditional lab-based sampling by offering continuous, high-resolution insight into parameters such as pH, turbidity, temperature, conductivity and flow, enabling faster response to contamination events and better long-term planning for the Nile, municipal networks, and industrial users. Smart Spout's key advantages include affordable hardware, scalable cloud analytics, and user-friendly mobile and web dashboards that give all customer segments a clear traffic-light view of unit status and parameter readings, as showcased in the live management reports at https://smartspout.geteafss.com/management-reports.html and in the multi-screen mobile app interface. "Early prototypes have demonstrated successful integration of the sensing unit, edge-to-cloud data pipeline, Machine learning models and production-ready dashboards, establishing a practical blueprint for smart-city and industrial water quality services that can be replicated across Egyptian municipalities and industrial estates' says Prof. Ayman El-Sayed Omera, former Dean of Faculty of Electronic Engineering, Menoufia University.