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IMPLEMENTATION OF A MICROSOFT HOLOLENS 2 FOR SUPPORTING DIAGNOSIS AND MONITORING TREATMENT OF SCOLIOSIS

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Summary: Scoliosis is a condition in which the spine deforms to the left or right side, evaluated by a lateral curvature larger than 10 degrees. When observed from frontal view, the scoliotic spine may seem to be S-shaped or C-shaped. Idiopathic scoliosis is a complex 3D musculoskeletal deformity of the spine, developed by unknown reasons, that may seriously affect the patients' health, physical appearance, and quality of life. In younger subjects, aged 8 to 12, progression of the deformity status is more likely than in patients with finished skeletal growth. Several diagnostic methods, such as X-ray assessment, are employed if an anomaly is suspected and/or discovered. The Cobb angle, which is produced by two perpendicular lines drawn from the upper endplate of the topmost vertebra to the lower endplate of the lowermost vertebra from the most significant curvature segment, can be used to determine the severity of the curvature. Because of the growing deterioration of the spine, untreated scoliosis can lead to back pain and further complications in maturity. To make an appropriate assessment of the development deformity, radiographic images are required to evaluate and monitor the condition. Although radiography examinations cause a modest risk of radiation exposure, frequent examinations are linked to higher cumulative radiation exposure, which can have unfavourable repercussions for the patients' health. Because the tissues of growing youngsters can be particularly affected by x-ray radiation, radiography investigation should be reduced to a minimum. Based on earlier experimental results we made a hardware upgrade and used Microsoft HoloLens 2 as an Augmented Reality HMD to construct the cutting-edge application for aiding medical specialists in recognizing, recording, and tracking the evolution of adolescent idiopathic scoliosis (AIS). The application running on the Microsoft HoloLens 2 was designed with Unity3D, a programming tool for a range of platforms. The developed framework, designed in Unity3D, was primarily used to evaluate/assess and document the scoliosis condition. The basic function of the developed application is to identify the spinal curvature by using HoloLens's tracking system on the patients' dorsal surface, thus creating its 3D digital representation as a 3D mesh and allowing calculation of deformity curvature. In the following step, markers are placed on the prominent anatomical landmarks of the 3D surface using specially developed algorithms. A generic 3D model of a physiologically normal spine will be then registered with the patient-specific 3D surface. The application is able to display X-ray images taken for the same patients in accordance to the standard medical practice. Other features include a data management system which enables archiving, searching and retrieving patients' medical records including 3D visualizations of the patient-specific spines. Another feature facilitates statistical analysis of the diagnostic parameters from follow-up monitoring sessions. Future application development will include a clinical evaluation by medical specialists which will be the backbone of the final ready to use solution in clinicals environment. This may include more sophisticated hardware like high-quality 3D scanners to improve the scanning process, generating the 3D model and enabling a dynamic spinal analysis.