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# 3D Design of Orthotic Braces and Casts in Medical Applications Using Microsoft Kinect Sensor

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**Abstract :** Orthotics is the branch of medicine that deals with the provision and use of artificial casts or braces to alter the biomechanical structure of the limb and provide support for the limb. Custom-made orthoses provide more comfort and can correct issues better than those available over-the-counter. However, they are expensive and require intricate modelling of the limb. Traditional methods of modelling involve creating a plaster of Paris mould of the limb. Lately, CAD/CAM and 3D printing processes have improved the accuracy and reduced the production time. Ordinarily, digital cameras are used to capture the features of the limb from different views to create a 3D model. We propose a system to model the limb using Microsoft Kinect2 sensor. The Kinect can capture RGB and depth frames simultaneously up to 30 fps with sufficient accuracy. The region of interest is captured from three views, each shifted by 90 degrees. The RGB and depth data are fused into a single RGB-D frame. The resolution of the RGB frame is 1920px x 1080px while the resolution of the Depth frame is 512px x 424px. As the resolution of the frames is not equal, RGB pixels are mapped onto the Depth pixels to make sure data is not lost even if the resolution is lower. The resulting RGB-D frames are collected and using the depth coordinates, a three dimensional point cloud is generated for each view of the Kinect sensor. A common reference system was developed to merge the individual point clouds from the Kinect sensors. The reference system consisted of 8 coloured cubes, connected by rods to form a skeleton-cube with the coloured cubes at the corners. For each Kinect, the region of interest is the square formed by the centres of the four cubes facing the Kinect. The point clouds are merged by considering one of the cubes as the origin of a reference system. Depending on the relative distance from each cube, the three dimensional coordinate points from each point cloud is aligned to the reference frame to give a complete point cloud. The RGB data is used to correct for any errors in depth data for the point cloud. A triangular mesh is generated from the point cloud by applying Delaunay triangulation which generates the rough surface of the limb. This technique forms an approximation of the surface of the limb. The mesh is smoothened to obtain a smooth outer layer to give an accurate model of the limb. The model of the limb is used as a base for designing the custom orthotic brace or cast. It is transferred to a CAD/CAM design file to design of the brace above the surface of the limb. The proposed system would be more cost effective than current systems that use MRI or CT scans for generating 3D models and would be quicker than using traditional plaster of Paris cast modelling and the overall setup time is also low. Preliminary results indicate that the accuracy of the Kinect2 is satisfactory to perform modelling.

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