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Utilizing Computer Vision Systems and Machine Learning to Develop a Live Time Navigational and Surgical Aid for Spinal Reconstructions

The existing navigational system for spinal reconstructions called fluoroscopy presents significant visual and physiological disadvantages. Fluoroscopy has a limited field of view of the spinal column and emits a significant amount of radiation that affects the patient and the surgical team. Implementation of a machine learning (ML) and computer vision based navigational system eliminates these risks. Microsoft HoloLens, an augmented reality headset, gives the surgeon the ability to see the real-world and pertinent medical data. These data were parsed through ML algorithms that mapped the spinal column, suggested the best approach, and guided the surgeon in real-time. The project was tested in two phases: algorithmic and real-world viability. Algorithmically, the performance was measured by training and testing over 2,000 patient's publicly available CT and MRI scans. The data was used to build a spine model. The real-world testing was conducted through Microsoft HoloLens, and data was validated post-operatively. Algorithmic performance measured found that the algorithm created a map of the spine within 88 seconds with 98.6% accuracy. The real-world testing found that the headset was able to map the vertebrae and suggest the correct approach 96.6% of the time within 1.33 mm accuracy of the true values. The data suggests that the developed navigational system would be a pragmatic and economically viable replacement for fluoroscopy. The easily integratabtle and mobile nature of the diagnostic device makes it viable in both medical centers as well as remote locations (i.e. war zones and developing regions).