

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

Ramesh, Krithik (School: Cherry Creek High School)

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. 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 would guide 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 were used to build and predict spine structures and behavior. The real-world testing was conducted through an augmented reality headset and data was validated post-operatively from 34 observed surgeries. 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 suggest that the developed navigational system would be a pragmatic and economically viable replacement for fluoroscopy. The easily integratable 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).

Awards Won:

Intel ISEF Best of Category Award of \$5,000

First Award of \$3,000

Gordon E. Moore Award

Fondazione Bruno Kessler: Award to participate in summer school "Web Valley" in Trento, Italy

King Abdulaziz &

his Companions Foundation for Giftedness and Creativity: Award of \$1500 in Machine Learning in Real-World Chemistry or Environmental Applications