Developing a Kinect Assisted Keyboard for an Injured Veteran

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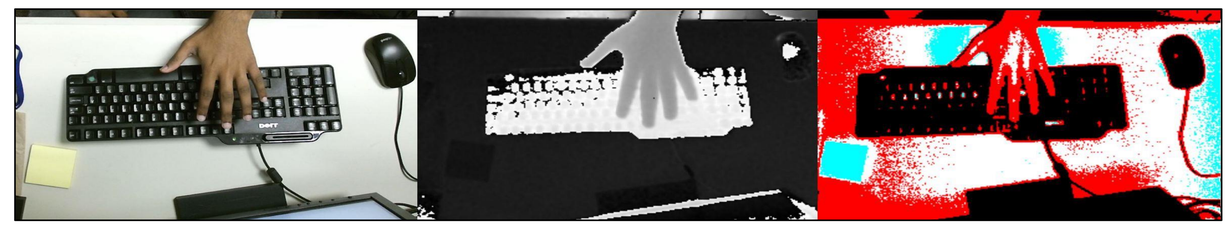
Purpose

During his 5th combat deployment, this time in Afghanistan, Captain A was severely injured when his vehicle was hit by an improvised explosive device (IED). He suffered two strokes, two heart attacks, an anoxic brain injury, and cardiac arrest, resulting in severe impairment to his speech, vision, and dexterity. These limitations increase the difficulty of performing everyday tasks and made it difficult for him to effectively use a regular computer keyboard. Due to his impaired dexterity and vision, Captain A usually uses the middle finger of his right hand to strike the keys. When he types, he frequently hits a key that is up to 4 keys away from the intended key. To help him with this problem, we decided to design and implement a custom system that will allow him to be more accurate and efficient in his use of a computer.

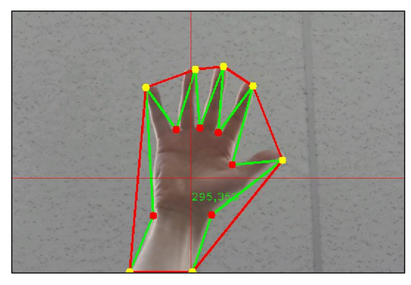
Background

Prior to my mentorship at NIH, there was an existing system created to help Captain A use a keyboard. This system employed a regular color-vision camera mounted directly above the keyboard facing downwards to track Captain A's hands over the keyboard. This implementation had various shortcomings such as being unreliable in suboptimal lighting conditions. Unlike a regular camera, the Microsoft Kinect v2 has depth and infrared sensors alongside the color camera. With these additional sensors, the Kinect works well in suboptimal lighting conditions, which resolves the multiple issues with the previous implementation.



Methods

The infrared image was thresholded to isolate the objects within the image and remove the background interference of the table. This eases the detection of the hand, as it is the largest object.



To find the fingers, a polygon is approximated over the outline of the hand. The vertices of this polygon (yellow points) are defined as the fingertips.

To detect the physical key locations, the corners of the keyboard are detected. The location of the individual keys are then extrapolated.

Future Work

I. Addition of a stabilization algorithm to reduce erratic movement of detected fingertip
II. Implement an algorithm that predicts the movement of the finger to increase accuracy

I would like to thank Mr. Kosek for assisting me with my project. I would also like to thank Mr. Lampazzi and Mrs. Luxenberg for coordinating the mentorship program

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