Computer technology has has evolved much over the past three decades. However, computers still heavily rely on clunky user-interfaces, such as mice and joysticks. Recent advancements in touch-screen technology has made interfacing more natural, but this is only useful for manipulation of 2D environments.

We have created two computer interfaces which allows the user to manipulate a 2D map on the screen, as well as a flying quadricopter using just the user’s eye and head position. We achieved this by using a stationary SR Research eye tracker, which measures the position of the eye’s and head with an infrared light source and a high-resolution camera. The user’s head position is measured by tracker a target sticker placed on the user’s forehead.

The first interface allows for a 2D manipulation of the map. Wherever the user focuses on the map is brought to the center of the screen. This allows for easy panning through the large map by just looking at where the user wants to go. Zooming in and out was accomplished by double blinks. Also, most other eyetracking software requires the user to maintain a steady head position to acquire a clear signal. This requires the user to put his/her head into a mount to prevent random head movements. We were able to eliminate this inconvenience by tracking the head, and auto-calibrating the user’s eye position relative to the screen. This allows the user to move his/her head naturally and still maintain usable signal from the eye tracker.

Much of the difficulty of the interface was providing a seamless and robust calibration system which is suitable for all potential users. Much signal processing and filtering needed to be done to create an intuitive, easy-to-use interface. We were able to get the application to level where it feels natural to use your eyes to pan and zoom large images.

We were also able to extend the application to control an AR Drone remotely. The AR Drone streams a video to the host-PC, where the user is looking at the video. Depending on the location of user’s eyeposition. If the user looks left or right, the drone turns. If the user looks up or down, the drone moves forward and backwards. Future iterations of this interface will include other biosignals such as electroencephalography to provide more degrees of freedom.

Biosignal such as eye position is becoming more prolifent in human-computer interfaces. This experience at the Neural Imaging and Signals Processing lab was a good start into the world of computer programming, neuroscience, and brain-computer interfacing.