Eye Pupil Tracking based App Option Selection for People with Cerebral Palsy

Abstract— This paper is focused on the development of a system that could track eye pupils in order to select different options within a desktop application for children with cerebral palsy, having issues with verbal communication. In specific case of cerebral palsy called, "Spastic Quadriplegia/Quadriparesis", which is one of the most severe form of cerebral palsy, all four limbs, the trunk and the face are affected and the person have no control over his/her muscles limiting one's verbal communication. In such cases, they communicate by using some regular repetitive signs or gestures only with their parents, caretakers, and with persons who are regularly around them. In order to provide them the ability to communicate with people, this system with eye tracking functionality was developed. The system was built as a desktop application, using the python platform and had used a web-cam, monitor and an audio output of the laptop as additional components besides the processing unit. In the backend, the system performed image processing-based eye tracking algorithm, within the video captured from web-cam and generated audio output as per the selection made within the app. In the front-end part, the desktop app showed the window with image buttons that can be triggered with the input from the eye-movement and would generate audio output accordingly. The system showed the sensitivity of 86%, 76% and 80% for right movement of pupil, left movement of pupil and blink respectively. Likewise, specificity of 74%, 74% and 82%. The accuracies were obtained as 80%, 75% and 81% for each case respectively. The shifting speed was 614millisecond and the blink response detection was 1.023 seconds. The obtained results can be useful for the development of an enhanced voice communication system for people with cerebral palsy with verbal communication issues.

Keywords— CP (Cerebral Palsy), Dlib, Eye Closure Ratio, Eye Gaze Ratio, Eye Gesture, Eye Monitoring, Eye Tracking, Histogram, OpenCV, Playsound, Pupils, Python, Spasticity (stiff muscles), Spastic Quadriplegia/Quadriparesis, UI (User Interface), Verbal Communication.