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Eye tracking of moving objects

Lukáš Marko, Radoslav Vargic
Faculty of Electrical Engineering and Information Technology, Slovak University of Technology
in Bratislava, Ilkovičova 3, 841 04, Bratislava, Slovakia

Overview

Objective of this research is to create a environment and methodology to be able to evaluate the eye tracking of moving objects on the screen. The contribution focuses on scenario creation, analysis of gaze deviations in time and position. Contribution of head and eye movements can be analyzed separately.

Introduction

The eye tracking technology is becoming more efficient and has been widely applied to better understand many perception and cognitive processes. Many experiments were created using fixed content scenarios (images, scenes, objects, …). The construction on moving objects scenarios followed by detailed analysis can help in many cases such as schizophrenia or other perceptual disorders[1].
Therefore we created an environment that allows to construct various scenarios with moving objects, followed by graphical and numerical analysis of the experiments. The environment was created on the unity platform. Scenarios were designed to test the environment. The scenarios were to compare eye observations in healthy individuals and those with possible attention deficit disorder. During the research scenario, the person watched and followed the object on the screen. The person had an eye tracker on his head, which examined the movement of the eye. Eye tracker uses two types of cameras - stage and eye. Pupil Capture software recorded pupil coordinates over time, head movement, and fixation. Pupil Player was used to process the measured data and exported into CSV format. We also received output data of the monitored object in unity. Matlab was used to time-synchronize and plot the position data of the object and the eyes.

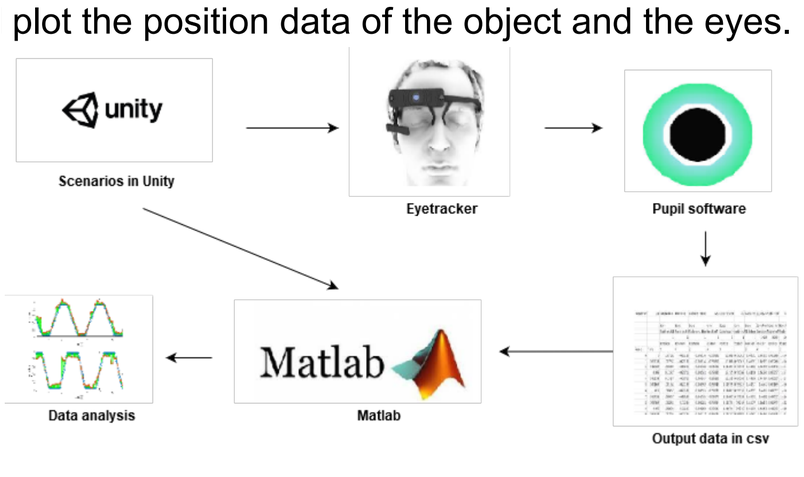

Fig. 1 Architecture of the proposed system

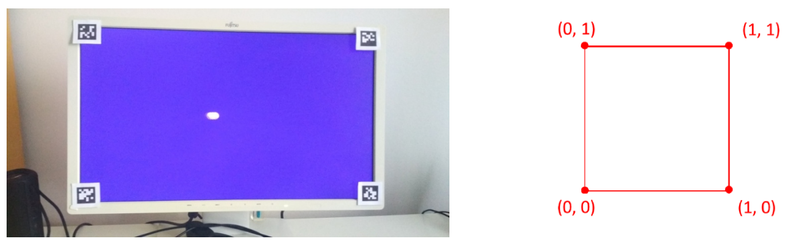

Fig. 2 Monitor setup – attached paper codes for monitor screen position tracking (left) relative coordinate system of monitor – inside of the paper codes (right)

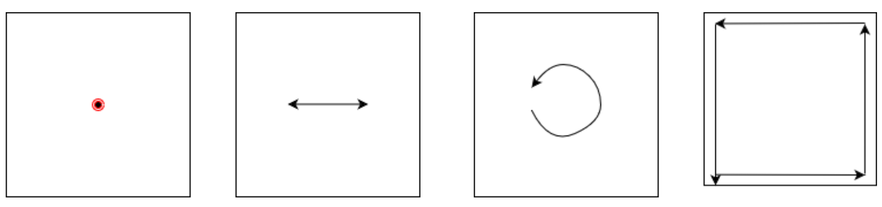

Fig. 3 Schematic visualization of basic scenarios movements, from left to right: steady object (no movement), horizontal left-right movement, circular movement, rectangular movement

Experiments and results

For demonstration purposes of the created environment, we examined subjects under conditions: vigilance, fatigue. A tired subject has reduced attention and the response to stimuli is different. The measurement was performed on two healthy subjects aged 23 and 50 years. The results varied and depended on several factors. The experiment was performed at 10am and 10 pm. The task was to follow the movement of the ball on the stage as accurately as possible. The resulting graphs show the movement of the object (blue) and the movement of the eyes (red). Eye values were found for object values by interpolation (green).

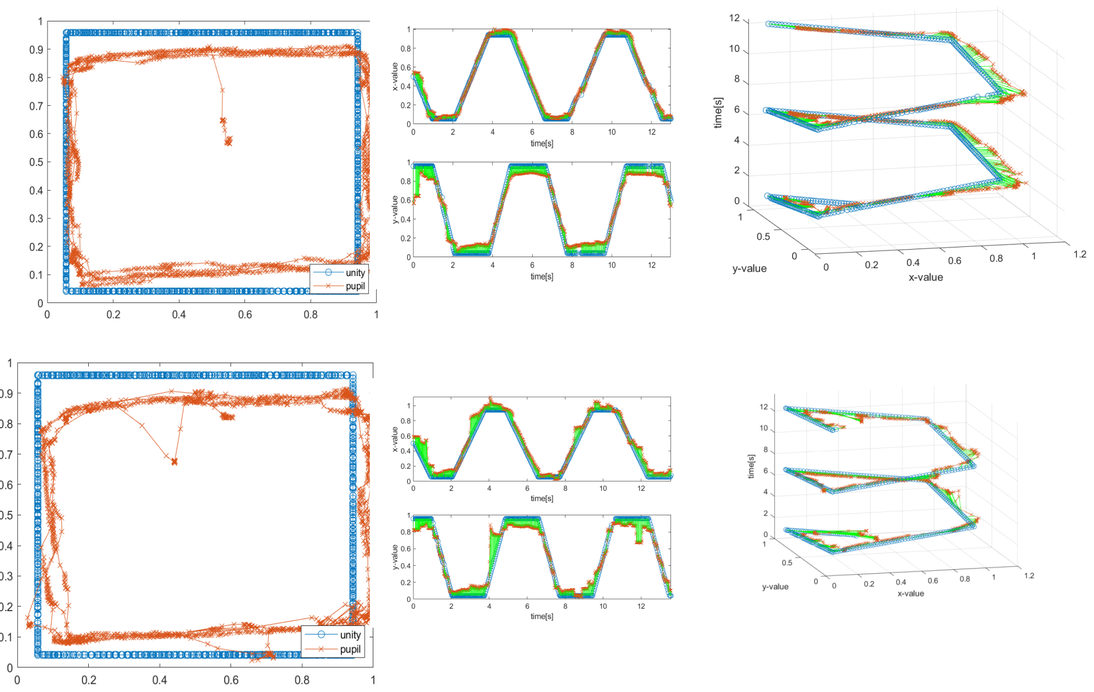

Fig. 4 Examples of the results from the rectangular movement scenario. Subject conditions: upper row vigilance, lower row fatigue. Three basic diagrams are shown.

Interpolation showed the distance of the real eye position from the expected position. It can be seen that when a person gets tired, the view of the object is less accurate. The view runs away from the object several times. The obtained results are presented in Fig. 3.
Another set of experiments, where environment could be useful follows from the research [1] - People, who have a perceptual disorder, have trouble slowly watching moving objects. When individuals followed a fixed point, their gaze did not stand.

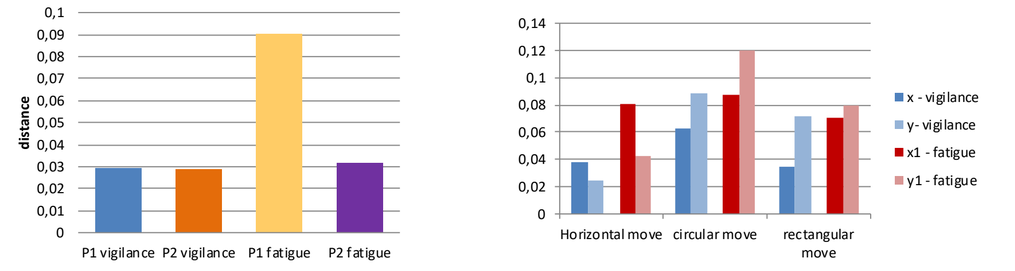

Fig. 3 Example results: Left - steady object scenario - farthest measured gaze distance from object, Right – movements scenarios cumulative gaze position difference during scenario. Distance/difference is in multiples of screen size.

Conclusion

In the research, we created an environment and processed data from the eye tracker, with which we can define the relation between the expected and real eye movement. The created environment can evaluate the movement and make interpolation. It may help in future research on schizophrenics or other disorders and diagnoses

[1]Benson, P., J., Beedie, S., A., Shephard, E., Giegling, I., Rujescu, D., St. Clair, D., Simple Viewing Tests Can Detect Eye Movement Abnormalities That Distinguish Schizophrenia Cases from Controls with Exceptional Accuracy, Biological Psychiatry, 2012, Vol. 72, Issue 9