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Geometric Transformations of Scan path and Fixation Points in Virtual Driver Test

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Abstract

Driver's test for youths is sometimes too intimidating, the prospect of learning how to drive in a real-life scenario takes a lot of emotional turmoil that would reduce the magnitude and effort to learn and increase driving skills. This process eliminates the risk of accidents while it is fun, real and safe for a personal driving instructor. The nervousness and fright experienced by novel learners are removed and they can experience comfort and confidence before a real-time situation. Finding ways to optimise this process and increase comfortability is the area of research with a more comprehensive e-learning system embedded in computers that provides access to comprehensive learner's licence education for interactive computers. This paper approached this by providing a geometric transform of scan-path that tracks fixations made by eye movement on a virtual driving simulator for four participants. The pupil measure is based on both dilation and constriction on the same scenarios; performance between the fixation and scan path is compared and both possess the same scanning process on all scenarios and the authenticity of using a driving simulator before the real-life scenario.

Keywords: Driving simulator, Pupil response, Dilation, Constriction, Eye movement, Pupil authenticity, Real-life scenarios

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1 Introduction

Scan path and fixations were one of the first methods used by Noton and Stark ((Noton and Stark, 1971b,a; Coltekin et al., 2010)) on analysis in Vision Research and Science, this is based on saccade eye movements while viewing and acknowledging patterns that can be applied in areas like driving simulator experience for pattern perception.

The research claimed that when a particular visual pattern is viewed sequences of eye movements are immediately executed which is very important in accessing the visual memory for the eye movement patterns made. The research further discovered that eye fixations with natural images and scenes that the human gaze location selects are informative i.e. the eye fixations tend to fall on important details like risk scenes in driving.

Several very important techniques have been discovered recently((Morris and Masnick, 2015; Fernandez-Vidal et al., 2000; Baranes et al., 2015; Liu et al., 2021; Graham, 2019)) that explore the statistical properties of eye fixation patterns and their relation with important characteristics of a virtual scenario. For this paper, we consider a scan path as a geometric transform of eye movement data which is collected by a gaze-tracking device on a driving simulator. The information is recorded about the basic trajectories of motion in all scenarios in the driving simulator and analyses on any kind of visual risk scene can be detected and controlled automatically that could be applied in a real-life scenario. Some disciplines ((Popa et al., 2015; Biaas and Szyszka, 2019; Wang et al., 2014; Franco-Watkins and Johnson, 2011)) have made use of eye tracking methods to determine user perception for decision making and some of this includes cognitive scenes on driver test, psychology, visual world paradigm, human factors and human-computer interactions that include ergonomics. Human activity recognition is one of the basic research areas where eye tracking is employed, and recently this application is now been investigated in the field of real-life driving simulators. The use of eye tracking while driving a car in real life in a difficult situation is been intensely investigated, from frames of narrow road eye–tracking to high-way eye-tracking, this and other fields of virtual driving are discussed in the following section.

2 Literature Review

Research on Frames from narrow road eye-tracking has investigated on eye movement of two groups of drivers which were filmed with special head cameras by a team of the Swiss Federal Institute of Technology (SFIT) on both novice and experienced drivers. They had their eye movement recorded while approaching a narrow bend road. The images were condensed from the original series to display two (2) eye fixations per image on a particular captured risk-driving scene. Each of these series has a corresponding 0.5 seconds when compared in real-time. This series of images indicates a simple example of the eye fixations of a typical novice and an experienced driver. Experimental frame from narrow road eye tracking, where the eye movement of two groups of drivers was filmed with a special head camera by a team of the Swiss Federal Institute of Technology [], both novice and experienced drivers had their eye-movement recorded while they approached a narrow road, two eye fixation showed on each image with better comprehension on the direction of their gaze at risk point. From an approximated few, each still from these images corresponds to 0.5secs in real-time. A comparison of the images indicated that the experienced driver always checks the curve and even bends while the novice driver needs to check the road signs and estimate the length and distance of cars parked nearby. Further investigation also shows that middles images are also an object of concentration on the point where an advancing car can be seen from the start point while the novice driver simply concentrates more on his view of the parked cars. The experienced driver uses peripheral vision for concentration while the novice driver is busy with making estimated measurements of the distance between the left wall and the cars parked nearby. These methods of estimating drivers' skills have reached their advancement where a driving simulator is used to estimate these potentials for cognitive

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