Eye Movement Model based on Reinforcement Learning

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ABSTRACT

This study introduces the queuing network based computational cognitive model, which is used for analysis and prediction of human oculomotor behaviors. The study presents the queuing network cognitive model of eye movement and three case studies based on the cognitive model. The model consists of three parts; (1) visual stimulus conversion system (2) cognitive architecture (3) reinforcement learning process. Visual stimulus conversion system introduces the standardized method of understanding visual stimulus and provides ways of simplifying visual images. Therefore, the output of the conversion system, which is a set of matrixes representing attributes of visual stimulus, is able to be fed into the computational cognitive model. The attributes of visual stimulus are utilized for the attributes of entity in the queuing network. As proceeding to information processes, the attributes are selectively processed, and provide additional attribute, available within the network system. To study a visual task, visual attention is the core of understanding the eye movement. Eye movement pattern is result of series of decision on where to look next which means where the next visual attention would be located. The decision process is modeled with the reinforcement learning algorithm, and the policy for each visual task represents strategy under eye movements. Case study introduces three visual tasks; (1) picture viewing (2) visual search (3) target detection tasks. The picture viewing task demonstrated the top-down effect on eye movements. Whereas the visual search task demonstrated the bottom-up effect. Use of computational cognitive model to simulate the target detection task demonstrated the prediction of eye movement and response time using simulation method. Also, the relation between the oculomotor behavior and the visual stimulus was identified since attributes of visual stimulus affect on the eye movement strategy which is underlying the eye movement patterns.

Keywords: Cognitive model, eye movement, reinforcement learning