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What is Trending in Eye Tracking Scanpaths on Web Pages?

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Eye Tracking on the Web

In this paper, we introduce a new concept called trending scanpath that represents the most popular scanpath among users.

Eye tracking has commonly been used to analyse user behaviours on the Web [2]. When users navigate on web pages, they make a series of fixations. In other words, their eyes become relatively stationary at certain points. These series define their scanpaths on the pages. Figure 1 illustrates an example of a user scanpath on the Godaddy page that is segmented into its visual elements such as menu items and search boxes [1, 4]. The circles represent the fixations where the sizes of the circles are directly proportional the durations of the fixations. Besides, the sequence is represented by the numbers inside of the circles. By tracking eye movements of users, we can investigate which parts of web pages are popular among the users and which paths they follow to complete their tasks.



Figure 4. A scanpath of a particular user on the Godaddy page

In order to analyse how users interact with visual elements of web pages, their scanpaths should firstly be represented in terms of the visual elements of the web pages. In particular, if a user firstly fixates the element O, secondly the element F, thirdly the element L and finally the element M on the Godaddy page, his or her scanpath should be represented as OFLM.

A number of different techniques have been proposed and/or applied to analyse scanpaths in the literature [3]. These techniques have mainly been used for (a) determining similarities/dissimilarities between a pair of scanpaths, (b) computing transition probabilities between the elements of a web page, (c) detecting patterns in multiple scanpaths, and (d) identifying a common scanpath of users on a particular page by combining their scanpaths [3]. In this paper, we introduce a new concept in combining multiple scanpaths into a single scanpath called trending scanpath.

Trending Scanpath

Trending scanpath is the most popular scanpath on a particular page among users. The main features of this scanpath are as follows:

- The trending path shows a **general direction** which is followed by most users to complete their tasks. Existing techniques try to identify a path shared by all users as a common scanpath [3]. However, these techniques are likely to lose some shared elements in intermediate levels of processing due to a variety of the positions of the elements in the scanpaths. Therefore, the shared elements may not be included in their resulting scanpaths. Because of this reason, these techniques have a reductionist approach which means that their resulting scanpaths can be unacceptably short (or nothing) to understand user behaviours. In contrast, the trending scanpath includes both the elements shared by all users and other elements which get at least the same attention as the shared elements in terms of the total duration of fixations and the total number of fixations on the elements.
- The trending scanpath is incrementally **developed** by adding new users. When there is no user, the trending scanpath is empty. As illustrated in Figure 2, after a certain point, the scanpath becomes stable and that is the one we call trending path [4].
- The trending path is developed based on the current content of elements and can be **changed** as the content of the elements change. For example, an element may include an article which is about a popular news and the element may be included in the trending path. However, when the content of the element is changed, it may not attract attention of users anymore, as a consequence it may not be included by the trending scanpath.

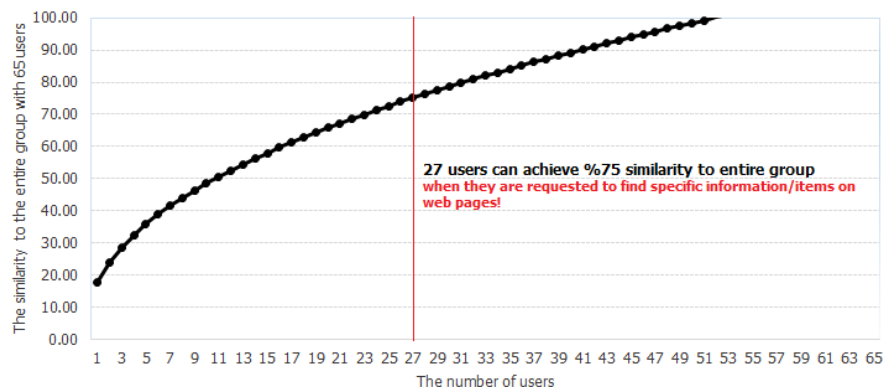


Figure 5. The similarities between the results of the sub groups of 65 users to the entire group [4]

As the Oxford English Dictionary¹ defines *Trend* as “a **general direction** in which something is **developing** or **changing**”, we believe that the trending scanpath term is the most appropriate term here. In the literature, when scanpaths are combined into a single scanpath, the scanpath is typically referred to as a common scanpath. According to the Oxford English Dictionary², one of the definitions of *Common* is “shared by, coming from, or done by two or more people, groups, or things”. Hence, the common scanpath term by itself may lead us to understand that there is only one path and it is shared by all users. Therefore, this term is not suitable for representing our concept here because there is no restriction to include only shared elements.

As illustrated in Figure 3 [4], to identify a trending scanpath, trending elements should be identified by analysing user scanpaths. In other words, we should identify which visual elements should be in the trending scanpath. These elements should then be combined based on their overall positions in the user scanpaths.

Specifically, a trending scanpath should be comprised of trending visual elements. When a particular visual element is shared by all user scanpaths, it should be identified as a trending element. Even though existing techniques focus on the shared elements, they tend to lose them because of their positions [3]. For example, when the user scanpaths OFLM and FLNM are available the Goddady page, FLM cannot be discovered as a

¹ <http://www.oxforddictionaries.com/definition/english/trend>

² <http://www.oxforddictionaries.com/definition/english/common>

pattern by the *eyePatterns* scanpath analysis tool because of the element N [5]. However, the trending scanpath should include the shared elements regardless of their positions. Other elements with at least the same attention as the shared elements should also be identified as trending elements. The trending elements should then be positioned in the trending scanpath according to their overall positions. For example, when a particular element is firstly fixated by most users, it should be positioned at the beginning of the trending scanpath.

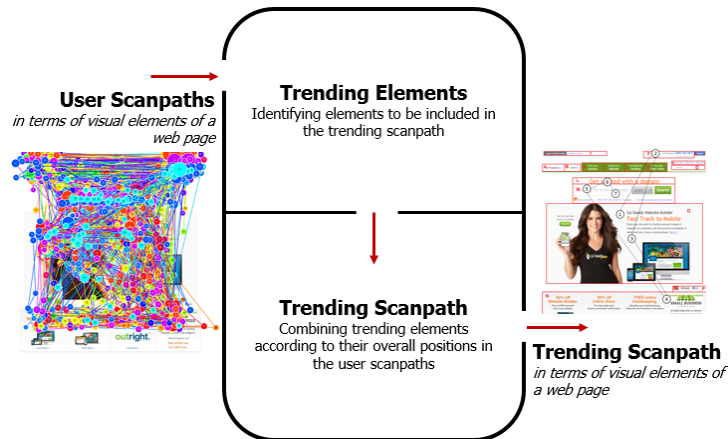


Figure 6. A concept to identify a trending scanpath of users in terms of visual elements of a web page.

Contributions of Trending Scanpaths

We introduce a trending scanpath in this paper. It contributes to user behaviour research on the Web by addressing the weaknesses of existing research [3]. It could be used for different objectives. Specifically, a trending scanpath on a particular web page can be counted as a guide to transcode (namely, re-engineer) the web page to make it more accessible in constrained environments such as on small screen devices and in audio representation [6]. By making the firstly and commonly visited visual elements more accessible, small screen device users can access these elements without the need of a lot zooming/scrolling and visually disabled users can access these elements without spending a lot of time on unnecessary things. This is known as “Experiential Transcoding” in the literature [6].

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