LOCARNA
Real world eye tracking

Visual Fixations in a Video Stream

Rapidly annotate eye tracking data using eye gaze and visual fixation information

Summary

Video annotation enables one to associate and tag meanings to important sections of video. Without Locarna's annotation tools, annotation of eye tracking videos can be a tedious and expensive process requiring many hours of analysis for every hour of collected eye tracking video. Typical video annotation involves analyzing collected videos on a frame-by-frame basis, and defining regions of interest on frame-by-frame basis. With Locarna's visual fixation based annotation methods, users can annotate eye tracking videos significantly faster than traditional methods – typically less than 1 hour of analysis for every hour of collected eye tracking video.

Background

Traditional video annotation and coding tools require users to view and tag frames of interest using a frame-by-frame based technique. For example, someone coding collected video will play subsequent frames of video, often in slow motion, until an interesting event is observed within a sub-sequence of video frames. The coder will then associate a tag, or otherwise, mark or code the sequence of video. For example, if the person is tagging video frames that contain an image of a ship, the coder will typically view the video frame-by-frame until a ship is observed, then associate a tag, such as "ship", to the video frames where the ship occurs.

Visual Fixations in a Video Stream

A visual fixation involves a person's eye gaze remaining within a defined region (such as a small circle), for a defined length of time (such as 100 – 300 ms). Visual fixations are known to occur when a person is particularly engaged at something within their visual field of view.

Using Locarna's visual fixation annotation method, users can shorten the time to annotate (i.e., associate meaningful tags to sub-sequences of video) – often less than one hour of annotation time for each hour of collected video. This method is detailed within US patent application No. 12/626,510, "Identification of Visual Fixations in a Video Stream" filed on November 25, 2009.

Using an eye tracker, such as Locarna's PT Mini, one can collect video data containing eye gaze and visual fixation information. Figure 1 illustrates the concept of annotation using visual fixations, which have been implemented in tools such as Locarna's Annotator software.

In Figure 1, labels A-E show, (a) a video frame from the scene camera, (b) augmented graphics showing eye gaze (e.g., the green crosshair), (c) augmented graphics showing a visual fixation (e.g., the white circle), (d) a widget to navigate the video using fixations, and (e) a set of tags for associating meaning to visual fixations in the collected video, respectively. In this example, the collected video contains 543 visual fixations, and we are currently viewing visual fixation 43. The green cross hair (B) and white circle (C) show that the user is visually fixating on a sail. Assuming we are interested in comparing when a user visually fixates (e.g., is particularly interested in) sails, ship hulls, water, mountains, and sky, we can define tags "Sail", "Ship hull", "Water", "Mountains", and "Sky", respectively, as shown in E. We can also define "Other" as an explicit placeholder for annotations that are not of of interest. In Figure 1, we would associate (i.e., annotate) the tag "Sail" to this particular sub-sequence of video frames that define visual fixation 43.

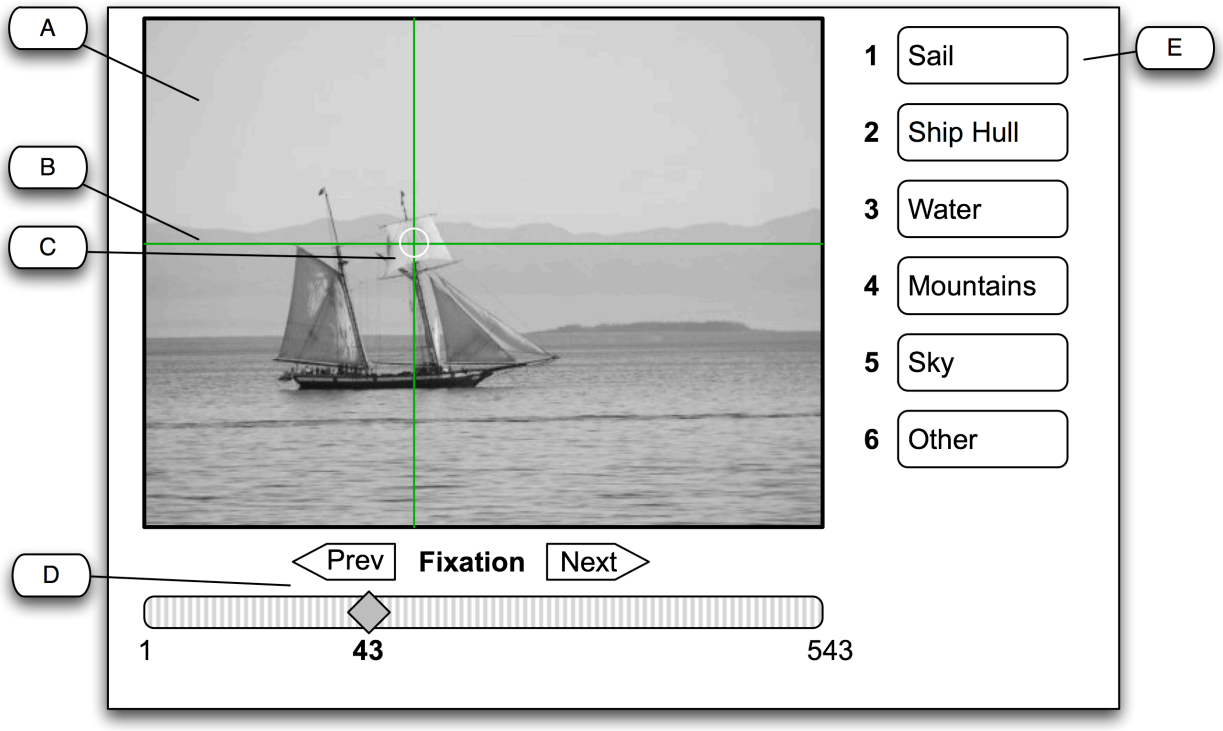

Figure 1: A conceptual representation of an annotation tool, such as Locarna's Annotator, for tagging video using visual fixation data.

To help a user identify and code moving visual fixations, the annotation tool can repeatedly cycle among the frames that collectively define a particular visual fixation. For example, in Figure 2, we show a dotted green cross hair and a solid green cross hair

to delineate the starting and ending video frames that correspond to the start and end of the visual fixation. Other techniques, such as repeatedly cycling through the sequence of video frames for a particular visual fixation can also be performed.

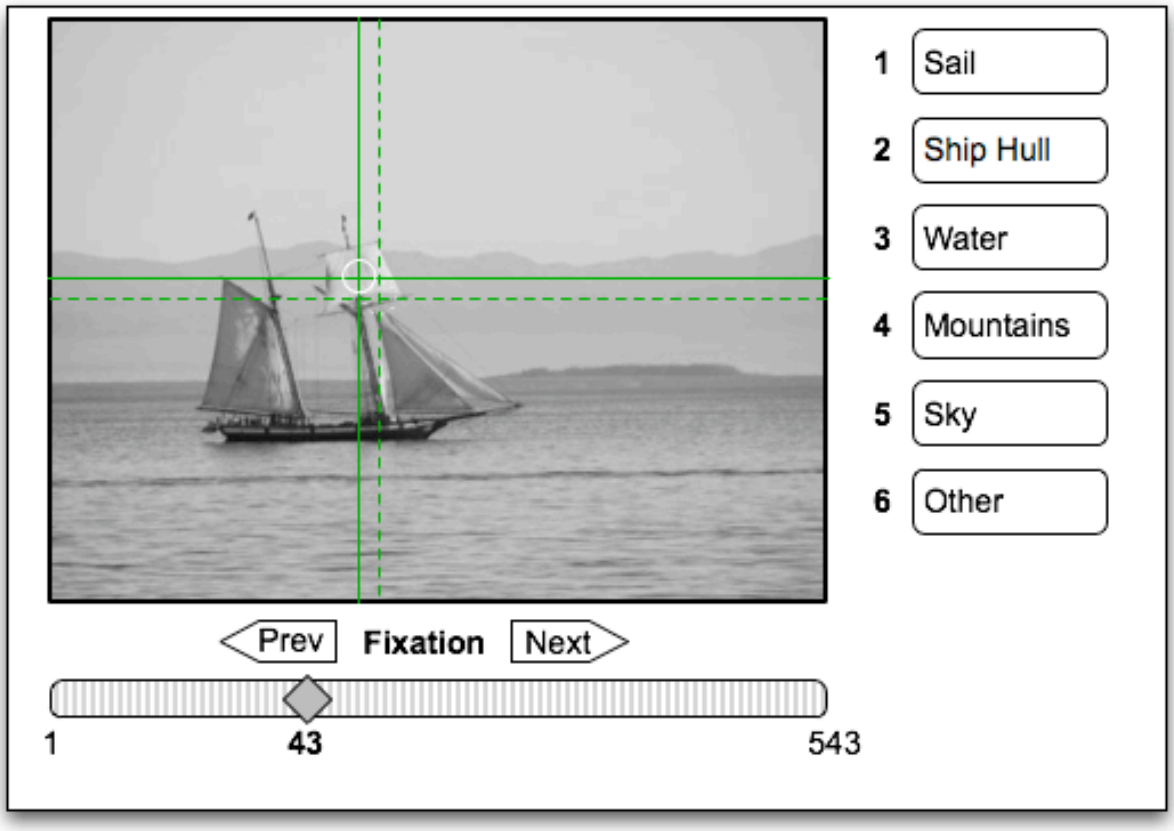

Figure 2: Two cross hair graphics illustrate the start and end points of a visual fixation on a sail.

Application Example 1

This application scenario describes how visual fixation annotation helps surgical training using a Locarna eye tracker within an operating room. When training a resident, an instructor may wish to compare visual fixation pattern differences between experts and novices. For example, one might define tags "tool", "patient", and "medical staff" to define visual fixations, and eye tracking video sub-sequences, during a real or simulated surgical procedure. Comparing lengths of time and visual fixation patterns, surgeons can quantitatively identify and correct surgical techniques, which in turn reduce training times, reduce costs, and improve patient safety. The time savings in analysis afforded by Locarna's visual fixation annotation methods (i.e., rapidly identifying and coding visual fixations of interest), constructive feedback can often be given to medical staff the same day as a training regime.

Figure 3: Eye tracking in an operating room

Application Example 2

This application scenario describes how visual fixation annotation helps a retail shopper participating in a market research field study. In this example, we associate tags that are not related to physical objects. Suppose we have collected eye tracking data in a retail clothing store. We could annotate visual fixations in the collected eye tracking video using tags such as "comparing prices", "interacting with cashier", "engaged with greeter", "engaged with floor sales staff", and "interacting with other customers". We could also associate tags related to visual fixations on merchandise or store displays, then compare customer behaviours and staff interactions to other retail information such as point-of-sales transactions, time of day, and other non-eye tracking related data.

Figure 4: A retail shopper viewing products