Using Eye-Tracking to Improve Management of Video Feed

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***Abstract*—This paper was originally submitted to Xinova as a response to a Request for Invention (RFI) focusing on new Decision and Response Techniques for Security Applications. This paper describes a method of using eye-tracking technology to monitor and manage video feeds from security cameras.**

In more detail, this describes how video feeds can be managed based on the security personnel's behavior towards the delivered feeds.

I. Abstract

As the price of installing and operating video based systems had decreased rapidly, security systems today can have a large number of video feeds, hundreds or even thousands. The number of video feeds available for a security personnel to watch is much greater than the number of screens they can watch. The number that can actually be shown is small, a lot of effort goes into ensuring that those selected are a good selection. The number of video. Otherwise, the person may lose focus or develop "blindness" after watching too many feeds.

It is important to monitor how the feeds selected are viewed by the person in control. This could have many usages such as:

1. Knowing which feeds have been actually seen by the control person
2. Checking that the control person is paying attention
3. Improving feed selection by noting control person's reactions

II. Summary of the invention

The invention has multiple components, not all of which must be used

1. Eye tracking component used by control to see where he is looking at
2. Classification of scenes according to control attention
3. Validating wakefulness of control (Optional)
4. Feed refreshing based on eye tracking
5. Improving feed selection based on control reaction
6. General logging and evaluation of attention shown by control

Fig. 1. System Output

III. Detailed Explanation

The invention is composed of multiple component, that are both innovative and useful.

Component one - Eye tracking component

This not new and the technology is well established (https://en.wikipedia.org/wiki/Eye_tracking). It is an existing and not very expensive technology. Likely, the eye tracker used may look like Figure 2 below.

Fig. 2. Typical Eye tracker

This means that there will be some type of small device in front of the operator. It may also be a worn device. In any case the result will be that the eyes of the operator will be tracked and we will know:

1. Which screen he looks at, at any time.

2. Which location on the screen he is looking at, and how much time spent there.

3. Is he concentrating hard on what he is looking at (using pupil dilation).

Component two - Classification of feeds according to eye tracking data

Each feed was selected for a reason. When we look at the eye tracking data we can classify the response of the person looking in the following way

1. Has not looked at the screen (this usually says very little on the feed itself)

2. Has looked at the screen but has not seen anything interesting (short look, few saccades, no dilation)

3. Has looked and found it interesting (more time, dilation)

4. Has looked and, in addition, taken action related to what he has seen. Typical actions could be to look for additional view, direct attention of others in control (we track their gaze as well), direct someone on the ground …

In addition, if there is a specific segment of the screen that the software think may be of interest we can classify the look according to

1. Has looked at the screen but has not seen the part of interest (from the location of the saccade)

2. Has looked at the screen, has seen the part that is interesting, but has not found it interesting (short look, few saccades, no dilation)

3. Has looked, found the part, and found it interesting (more time, dilation)

Component three - Validating wakefulness of control. (optional)

The method is to create artificial situation that requires attention, and that control should see. When he sees such situation (we know he is looking and paying attention due to the eye tracking) we mark it as artificial. Examples of such situation are people doing things that are dangerous, or any other very high level priority scene. The scene shown can be obvious, or subtle (but needs attention). The scene will be implanted into the feed using image processing (for example, a fight, a person with a fire arm, someone falling, etc.). As this can be done regularly, in random feeds, it will ensure that the people in control are awake and responsive.

Component four - Feed refreshing based on eye tracking

When we show multiple feeds to control, without this invention, we work in open loop. We don't know when control has seen it. The problem is that there are multiple screens, and control may have been watching something else. If there is an event, we don't know how long to show it. With the feedback, once control has seen what we had to show, if there was no action, we may move to the next feed to show. This optimization of the time to show a feed will make the entire system more efficient.

Component five - Improving feed selection

Feeds are selected based on an algorithm which may not be fully customized for the specific event. We can look at the way control look at things, in particular we check, using the classification in Component 2

A. What control finds interesting (and not interesting). Scenes that they looked at and classified this way. We also find on which scene they take action (high priority is perceived).

B. Feeds the looked at and missed the important part

Using this information, we can do the following changes: mark scenes that are interesting but not obvious better (for example with a circle around them on the screen), and improve feed selection according to thing that are interesting, and things on which action is taken. For example, let's assume that the feed selection algorithm has watching criteria for group A and group B, as both are somewhat suspicious. We see that group A is interesting but group B is not from the way the person in control watches the feed. This is feedback to feed selection to increase the preferences of group A compared to group B in feed selection.

Component six - Logging purposes

Currently we know what the feeds are. We need to be able to post mortem the event, to train and to understand what happened. For this purpose we will log not only which feeds were shown, but also what the personnel looked at (eye tracking). This can be used to analyze how skillful the person is in looking at the feeds, and for other reasons.

IV. Conclusion

The invention makes better use of the screens deployed (by timely replacement of feeds). It enables better choice of feeds. It allows the security personnel response and interest level to be a part of the feed selection process. At the same time, it allows to differentiate between the feeds displayed and the feeds watched. Monitoring the control person's behavior can assist in controlling the switching

time between feeds and allows to test and raise the alertness level automatically.

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