Physiological Reaction Monitoring

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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. In this paper, a method to monitor physiological reactions is proposed.**

In more detail, this describes a new concept to the software/operator system by which data collected from operators is used as part of the analysis and presentation algorithms, in order to improve response.

I. Introduction

While image analysis and decision support software quickly improve as aids in video event monitoring, the decision about the exact nature of a suspected event still remains with the human controllers. There is still a need to improve the risk-detection capabilities of the system.

II. Summary of the Invention

As presented in the RFI, the normal configuration of a video-surveillance and security system comprises multiple video cameras covering the area to be monitored, a video processing computer which analyses the video streams and flags specific images which are suspect and need to be evaluated by the operator, and a command center with multiple screens on which the different video streams are presented.

Normally there are many more cameras than there are display screens, so the software switches between cameras based on some protocol offering a time-multiplexed view of the area. The operator has the ability to call up video from any camera to any screen at will if needed.

The idea presented here calls for adding one or more physiological sensors applied on or in the immediate vicinity of the operator.

III. Detailed Explanation

Many such sensors are known in the industry and are available as off-the-shelf devices directly connectable to the computer. These sensors may include, but are not limited to:

A. Galvanic Skin Response (GSR), usually applied on the fingers. Changed in the GSR signal usually indicate changes in the stress level of the operator

B. Pupil diameter sensors, usually in the form of special glasses worn by the user. A sharp increase in the pupil diameter usually indicates that something alarming or frightening was in the users' field of view, even if the user is not fully aware of it.

C. Heart rate sensors, usually applied as a chest band or a finger PPG probe. An increase in the heart rate usually indicates that the user is excited, stressed or frightened.

D. Respiration rate sensors, usually applied as a chest band. An increase in the respiration pattern usually indicates that the user is excited, stressed or frightened.

E. Limb movement sensors, usually applied as a watch on the non-dominant hand. A drop in activity measured on the hand usually indicates that the user is not alert, or is dosing off.

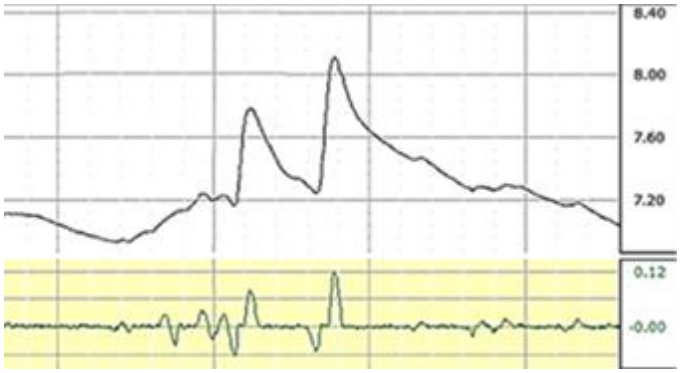
The software controlling the display of video streams on the screens in front of the operators may use these physiological data streams in order to optimize the chances that a suspected risk situations presented to the operators will be correctly identified and acted upon. These changes may include, but are not limited to:

1. Divide new events presentation between multiple operators based on their level of stress – if a specific operator shows signs of increased stress, decrease the rate at which he/she needs to make decisions, or route less-critical events or lower risk-probability events to this operator.

2. If pupil distension is detected when a new image or video segment is presented to an operator, but no action follows, route the same image or replay the same segment to a different operator or alert the operator to re-examine the image. This may indicate that something in the image triggered an unconscious alarm reaction, and it may be important to find out what before dismissing the image.

3. When a fast heart rate or respiration rate is detected in one of the operators during the management of a crisis, it may be beneficial to alert the person in charge who may take over, or rearrange the workload, thereby preventing a drop in effectiveness due to over excitement or fatigue.

4. If an operator activity sensor reports that this operator is less active than normal, or compared to other operators, the system may issue an alert to the supervisor, or flash a warning in front of this operator to "wake him up".



Typical skin response to stimulus

IV. Conclusion

In adopting such measures, there are a number of merits that are associated with this solution. In synchronizing software with human performance, including:

- Asking for a second opinion about an image if physiological signs indicate an emotional response, but the image is discharged as safe.
- Slowing down image switching rate when officer is tired or anxious.
- Sending less sensitive images, or less risky areas to tired or agitated officers.
- Alerting a supervisor when performance deteriorates
- Ability to divide new event presentations based on operator level of stress
- Option to extend this to officers in the field

Acknowledgment

This research was originally submitted to Xinova, LLC by the author in response to a Request for Invention. It is among several submissions that Xinova has chosen to make available to the wider community. The author wishes to thank Xinova, LLC for their funding support of this research.

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