OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Proper Monitor Selection and Setup for Forensic Image Examinations

Describe the need: Best practices for the selection and calibration of computer monitors to improve and enhance the human examiner experience when viewing biometric imagery

Keyword(s): Proper monitor selection, monitor calibration, photo editing monitors, operational lighting, color reproduction

Submitting subcommittee(s): Facial Identification **Date Approved:** May 14, 2021

(If SAC review identifies additional subcommittees, add them to the box above.)

Background Information:

1. Does this research need address a gap(s) in a current or planned standard? (ex.: Field identification system for on scene opioid detection and confirmation)

We have identified that the human biometric authentication field lacks proper psychophysical studies to develop adequate guidelines and techniques that improve the human examiners experience when performing forensic comparison of digital biometric images. Previous academic psychophysical-biometric studies aimed at the explanation of automated facial recognition algorithms performance (e.g., Nicholson 2020 and Richard Webster et.al., 2018). To the best of our knowledge, previous psychophysics work studying the interaction between human examiner, visual display, environment, and the biometric modalities are non-existent. There are no academic publications, best practices, or guidelines on the need to properly select and deploy computer monitors to improve the human examiner aspects of forensic image examinations.

2. Are you aware of any ongoing research that may address this research need that has not yet been published (e.g., research presented in conference proceedings, studies that you or a colleague have participated in but have yet to be published)?

As stated in #1, to the best of our knowledge, previous work specifically addressing the impact of displays and illumination on human examiners is non-existent. With that said, there is a body of work and guidelines to optimize a digital workflow system for proper color reproduction. These guidelines and studies are mainly intended for the manufacturing, printing, and graphic arts industries. In the past ten years, the medical field has seen an increase in the use of digital media for the storage and display of medical images. This revolution has resulted in unique guidelines for this industry (Badano et al. 2015). Thorstenson 2018 in "The Social Psychophysics of Human Face Color: Review and Recommendations" compile a list of academic work to demonstrate that face color influence our judgment, that humans assign face color based on pre-conceived bias, and that each individual has a unique way to process color stimuli. Moreover, studies such as Kim et.al. 2009 show that our modern and powerful displays may rely on outdated calibration models that may hinder our ability of resolving certain tones and features. The possibility of overlooking key details in a forensic biometric examination due to improper display setup and its psychological consequences justify the need for studies exclusively focused on biometric digital workflows for human examiners. Similarly, to the medical industry, it is

worth understanding if the human biometric examiner-specific guidelines could be created for the biometric community.

3. Key bibliographic references relating to this research need: (ex.: Toll, L., Standifer, K. M., Massotte, D., eds. (2019). Current Topics in Opioid Research. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88963-180-3)

Hamish Nicholson, "Psychophysical Evaluation of Deep Re-Identification Models," Thesis Harvard College, https://arxiv.org/abs/2005.02136, (2020)

B. Richard Webster, S. E. Anthony and W. J. Scheirer, "PsyPhy: A Psychophysics Driven Evaluation Framework for Visual Recognition," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 41, no. 9, pp. 2280-2286, 1 Sept. 2019, doi: 10.1109/TPAMI.2018.2849989.

Aldo Badano et. al., "Consistency and Standardization of Color in Medical Imaging: a Consensus Report," Journal of Digital Imaging, 28(1) pp 41-52 (2015)

Christopher Thorstenson, THE SOCIAL PSYCHOPHYSICS OF HUMAN FACE COLOR: REVIEW AND RECOMMENDATIONS, Social Cognition, 36(2) pp 247-273 (2018)

Kim, M., Weyrich, T., Kautz, J. 2009. Modeling Human Color Perception under Extended Luminance Levels. ACM Trans. Graph. 28, 3, Article 27 (August 2009), 9 pages. DOI = 10.1145/1531326.1531333, http://doi.acm.org/10.1145/1531326.1531333.

4. Review the annual operational/research needs published by the National Institute of Justice (NIJ) at https://nij.ojp.gov/topics/articles/forensic-science-research-and-development-technology-working-group-operational#latest? Is your research need identified by NIJ?

Development and validation of standardized forensic methods and conclusions

Determination of accuracy and reliability of forensic analyses and conclusions, including potential sources of error

Novel and/or improved evidence recognition, collection, and visualization tools and analytical instrumentation for field and lab use

Determination of the optimal content and frequency of proficiency tests to evaluate performance and mitigate risk

Understanding of the cognitive processes involved in pattern recognition as applied to forensic comparative analysis

5. In what ways would the research results improve current laboratory capabilities?

Proper selection of how IT based purchases: video cards, photo editing monitors, operational lighting, etc can affect human based forensic examinations of digital imagery.

Proper understanding of how operational lighting can affect human based forensic examinations of digital imagery.

Proper understanding of how monitor calibrations can affect human based forensic examinations of digital imagery.

Scientifically validated techniques to prove the holistic effects of monitors, lighting, calibrations, and the human experience can strengthen analysis, comparisons, and conclusions.

6. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

There is a draft FISWG document detailing this topic which has not been published for draft comment due to considerations which have not been addressed. If this topic was properly addressed it could enhance and improve all forensic examinations done by humans using computer monitors in that proper color reproduction from biometric imagery is critical for the examination.

Additionally:

- Reduce eye fatigue
- Holistic enhancement of image features and quality
- Digital evidence better matches reality
- Understand the impact of poor color reproduction on decision making

7. In what ways would the research results improve services to the criminal justice system?

Ensuring the human examiner performing forensic examinations on any image based biometric will benefit here.

8. Status assessment (I, II, III, or IV): I

	Major gap in current knowledge	Minor gap in current knowledge
No or limited current research is being conducted	I	III
Existing current research is being conducted	II	IV

This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.