Chapter 56
Investigation of Human Monitoring Capabilities for Multiple Watch Windows

Osita Eziolisa
Wright State University, USA

Dakota C. Evans
Wright State University, USA

Mary E. Fendley
Wright State University, USA

ABSTRACT

Due to an abundance of data and dynamic nature of tasks, challenges with information retrieval in surveillance and target identification tasks have risen in today's Intelligence, Surveillance, and Reconnaissance (ISR) community. In this study, two variables, Area of Coverage and Amount of Activity (AOC/ACT), are manipulated to study their effects on the number of Watch Windows an observer can monitor. This research describes the analyst's task model, and explains how the level of AOC/ACT and number of Watch Windows affects the analyst's cognitive load. Results showed a significant difference in performance and physiological indicators of workload between high AOC/ACT conditions and low AOC/ACT conditions. A linear correlation was exhibited between the number of Watch Windows and the number of fixations. The results show that these variables can be manipulated in tasking to maintain appropriate levels of cognitive workload.

INTRODUCTION

The ability to use aerial and satellite imagery to acquire visual data has increased human visual tasking load in surveillance and target identification. Therefore, in the Intelligence, Surveillance, and Reconnaissance (ISR) domain, the human bears the responsibility of signal recognition and initiation of best course of action. Due to the abundance of data and the nature of tasks in today's surveillance and reconnaissance,

DOI: 10.4018/978-1-5225-8356-1.ch056

the human is often tasked with monitoring multiple displays of visual data simultaneously. Subject matter experts (SMEs) suggest that when an observer is tasked to monitor activities in a multiple-window display, two main elements, area of coverage and the amount of activity, affect workload perceived by the observer (Paul, 2014). These elements subsequently affect the number of windows the observers can successfully monitor.

The motivation for conducting this research is to improve our understanding of the limitations of surveillance and monitoring type tasks where attention is divided across multiple areas. A major challenge is to provide Image Analysts (IAs) with systems that allow for effective target identification and assessment of the world as they see it through a sensor. The study described in this work is unique in the sense that it investigates the impact that the variables Area of Coverage and Amount of Activity have on the performance of an observer who is monitoring up to six watch windows within tasking similar to that of an image analyst. Subjective and physiological measures, along with task performance are used to evaluate cognitive workload.

BACKGROUND

Intelligence Surveillance and Reconnaissance (ISR) is a critical community to the U.S Department of Defense (DoD) that account for about $40 billion annually; and its functions involve various methods of information acquisition for national security decision makers (Best Jr., 2005). An Intelligence Analyst or Image Analyst (IA) is the person who specializes in performing tasks such as monitoring, detection and recognition of various targets. Their tasks can be performed using either still imagery or motion imagery. IAs can perform static or dynamic recognition activities. Static refers to detection and recognition of objects while dynamic refers to detection and recognition of activities (Irvine et al., 2005).

Because information processing currently involves observers watching multiple windows, the ISR community faces several challenges in the area of visual surveillance. These challenges involve information overload, information fusion, and fleeting targets that appear within a short period of time, thus demanding a quick response, and relocatable targets (Barber, 2001; Duncan & Ayache, 2000; Jones, Shapiro & Roshon, 2007; Pham, Cirincione, Verma, & Pearson, 2008). The term watch window refers to a geographic area on a computer screen on which an observer is tasked to observe and report. Accuracy of the observer's decision-making in a watch window study involves signal detection, which is based on odds that favor certain possibilities of outcomes (McNicol, 2005; Abbot & Sherrat, 2013; Wixted, 2007; Hautus, O'Mahony, & Lee, 2008; Pleskac & Busemeyer, 2010; O'Mahony & Hautus, 2008; Verghese, 1994, 2001; Palmer, Ames, & Lindsey, 1993; Eckstein, 2000; Ramos-Alvarez, 2012).

The most common method of imagery collection in the ISR community are using UAVs, which range from hand-held devices to orbiting satellites; therefore, many studies involving visual tasks have used UAVs for aerial data acquisition (Trinh & Kuchar, 1999; Dixon, Wickens, & Chang, 2005; Freed, Harris, & Shafto, 2004; Srinivasan et al., 2004; Ruff et al., 2004; Wickens, Dixon, Chang, 2003; Hickman & Mirchandani, 2008; O'Kelly, Matisziw, Merry, & Niu, 2005). This study uses aerial imagery to understand performance and differences in cognitive workload in monitoring multiple watch windows under high and low ACT/AOC conditions.

The approach taken in this study was to assign number of watch windows and level of AOC/ACT as variables that would contribute to performance and perceived difficulty. According to stated objectives of the study, the following research questions were addressed:

Related Content

A Model for Predicting User Intention to Use Voice Recognition Technologies at the Workplace in Saudi Arabia
Khalid Majrashi (2022). *International Journal of Technology and Human Interaction (pp. 1-18).*
www.irma-international.org/article/a-model-for-predicting-user-intention-to-use-voice-recognition-technologies-at-the-workplace-in-saudi-arabia/300287

Knowledge Recovery: Applications of Technology and Memory
Maria E. Burkeand Chris Speed (2014). *Uberveillance and the Social Implications of Microchip Implants: Emerging Technologies (pp. 133-142).*
www.irma-international.org/chapter/knowledge-recovery/95989

Using High-Frequency Interaction Events to Automatically Classify Cognitive Load
Tao Lin, Zhiming Wuand Yu Chen (2015). *Human Behavior, Psychology, and Social Interaction in the Digital Era (pp. 210-228).*
www.irma-international.org/chapter/using-high-frequency-interaction-events-to-automatically-classify-cognitive-load/132585

Touch-Based Access to Mobile Internet: User Experience Findings
Minna Isomursuand Mari Ervasti (2009). *International Journal of Mobile Human Computer Interaction (pp. 58-79).*
www.irma-international.org/article/touch-based-access-mobile-internet/37461

Facilitating E-Learning with Social Software: Attitudes and Usage from the Student's Point of View
Reinhard Bernsteiner, Herwig Ostermannand Roland Staudinger (2009). *Human Computer Interaction: Concepts, Methodologies, Tools, and Applications (pp. 1402-1421).*
www.irma-international.org/chapter/facilitating-learning-social-software/22323