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Selecting video analytics using cognitive ergonomics: A case study for operational experimentation

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Abstract

The objective of this research is to achieve innovation with a disruptive edge in a human-driven operational environment where layering key information is critical to the customer's current story-boarding solution space. However, new online video data sources present an increasing complexity, with visual cues trapped in hours of video data with no automated means to easily locate and extract key data nuggets. The solution is the introduction of disruptive concepts with an 'operational experimentation' focus to mimic the customer's approach. This new method will embrace the larger 'tell me a story' perceptive approach to automate the process of building a user defined text story representation based on the accurate discovery / identification of relevant content in the online videos. This paper will cover overall components of the operational experimentation methodology which is part of a long-term (12-24 month) software research and development (R&D) prototyping strategy to operationalize software through a customer driven partnership. This methodology borrows ideas from multiple disciplines including cognitive ergonomics, computer science and industrial engineering. This case study emphasizes the importance of incorporating how humans cognitively process film based stimulation as a 'story', to design a system that will assist humans by automating the processing of online social media based video streams and imagery. The significance of this work demonstrates a paradigm shift in how automated video analysis is designed and accomplished through sharing pros and cons of selecting and operationally testing analytics through a series of vignettes. Beginning with an on-line video and concluding with a text based story of that video that is now searchable, understandable, and available to traditional cloud based analytics tailored to an organization's particular needs. This paper will include the results of the customer's experience through the seven stages of the operational experimentation process for Phase 1 of system development.

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Keywords: Video Intelligence; Operational Experimentation; Cognitive Ergonomics

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1. Introduction

The objective of this research is to create a user-driven process for generating innovative ideas to complement unique problems that do not have immediate (6-9 month) solutions. This process must incorporate our customers' ideas and not be influenced by aggressive technology creep, which tends to ignore customer desires and does not deliver on their expectations upfront. The concepts used in the operational experimentation process, seek to eliminate many of these shortcomings and strive to be both user friendly and bridge gaps between end-users, research technologists and developers. This paper details the operational experimentation methodology covering pros and cons of related cognitive ergonomic theories, exploring the seven-stage experimentation process and general assessment criteria applied to each experiment. The paper will walk through how the operational experimentation concepts are applied to a case study to design and develop a video processing system that meets the requirements of an intelligent analyst's (a.k.a. end-user) scenario of tasks. Each of the analyst driven R&D efforts are commonly referred to as experiments or projects throughout this paper.

2. Operational experimentation

The operational experimentation concept grew from the desire to develop a way to incorporate our end-user community into the problem-solving and developmental processes associated with accomplishing cutting edge R&D. While this experimentation methodology can be applied to other technology domains, this paper deals solely with the application to the identification, development, and testing of software frameworks and tools in support of intelligence analyst fusion needs. The two major goals that derive from this approach require the end-user to (1) define the prerequisite problem(s) and (2) assist in the operationalization of the capability solution space. The direct injection of the end-users or operators into the experimentation process is critical to the success of each adventurous endeavour. The concepts presented represent ideas taken from several multidisciplinary fields including cognitive ergonomics, industrial engineering (e.g. experimental design, product development and acceptance testing, customer feedback techniques), and computer science (e.g. agile software). This section will compare and contrast the key sub-fields associated with the operational experimentation concept. The section will also cover the seven stages user-centric process framework for this methodology and conclude with the three general criteria used to gauge success of the different experiments.

2.1. Multidisciplinary sub-fields

The field of cognitive ergonomics is especially important for information intense environments that are user-centric, requiring decisions and problem-solving of time sensitive actions with numerous dynamic ongoing events [1]. While cognitive ergonomics has long dealt with the complexities that arise between human interactions with growing socio-technical systems, emerging software coupled with rapidly increasing information represents an evolving challenge for the intelligence analysis community.

Some traditional cognitive ergonomic methods that have focused on user-centric knowledge elicitation theories include: advanced knowledge acquisition and design (AKADAM) [2], cognitive interviewing, cognitive task analysis [3], and group task analysis [4]. The solutions that result from these theories typically represent a merger of cognitive, system design, and practical engineering concepts. The resulting frameworks would aid the technical engineering community in eliciting and capturing knowledge from the end-users. While these elicitation methods are ideal for some system designs, these approaches do not clearly capture the individual or group complexities associated with the level-5 'human fusion elements' [5] being accomplished by our analyst community.

The ideas presented by the joint cognitive system (JCS) are better aligned with the end-user driven concepts associated with the JIEDDO operational experimentation methodology. The JCS framework has evolved from historical study of issues related to technology centric automated systems that lacked support for cooperative human interactions [6]. The JCS proposes a more "human centered" automation that focuses on supporting the end-user or human team without resorting to replacing the majority of human actions in the system [6]. Based on this approach, operational experimentation seeks to extend the JCS concepts and further strengthen the incorporation of the end-