

The Emerging Trend of Cognitive Ergonomics for the Digital Environment

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Abstract:- The objective of this paper was to demonstrate how cognitive ergonomics can be used in building a digital environment with the help of various artificial intelligence technologies. The ultimate goal was to make human life more easier and fatigue free by creating a digital environment to improve productivity and reduce human error. Artificial intelligence has been spread out all over and has been widely used, here in this paper Artificial intelligence techniques were used to develop UX which led to build a cognitive ergonomics which would help to set up an efficient digital environment.

Keywords:- Cognitive Ergonomics, Digital Environment, Human Computer Interaction.

I. INTRODUCTION

Human workers will always be preferred in many areas over robots as they have superior ability to respond to variations in assembly instructions and take decisions quickly to address deviations from the normal process flow. However, the fact that the human is a thinking, learning, processing being that is constantly changing, also poses some consistency problems for performance. Sometimes, the basis of plenty of experience, humans can misinterpret information, make mistakes or make ill-advised choices, like deciding to take shortcuts in a process, which has in the past resulted in dire consequences such as costly, unnecessary mistakes, or even fatal consequences for health and safety.[6] In today's world everything has been revolving around automation and it has become a need in order to survive in the ever developing world full of data. With automation work can be done quickly with less physical and mental stress also with an assurance of less error rate. The automation not only helps in doing work efficiently but also increases the productivity of the work. This paper presents how cognitive ergonomics is used in making the process of creating a digital environment automated.

➤ *The Digital Environment*

Here the digital environment is referred as smart environment. The name smart environment comes from the concept of ubiquitous computing. Digital environments aim to

make life of individuals easier in every environment, by replacing the hazardous work, physical labor, and repetitive tasks with automated agents. [1]. There are various technologies involved for interacting with the digital environment which may include wireless communication, speech recognition, image processing and recognition etc.

➤ *Cognitive Ergonomics*

Ergonomics is the science of designing user interaction with equipment and workplaces to fit the user. One of the types of ergonomics is Cognitive ergonomics which deals with the mental processes and capacity of humans at work. Cognitive Ergonomics aims:

- Guidelines for ensuring good usability
- Enhancing performance of cognitive tasks
- Increase human reliability

Cognitive ergonomics is used with UX to make implementation of any system for the reduction of negative results as there are less errors. Cognitive ergonomics does not use the concepts of UX which were used before but has now evolved by using smart ways to communicate with the system. Cognitive ergonomics has been used in the past for complex airplane cockpits so it would have been unrealistic in the past but it is now being used in most of the apps, wearables, or recently developed self-driving cars. It requires particularly the user's unconscious approach for performing the tasks.

II. METHODOLOGY

A. *Setting up a Digital Environment*

The digital environment is not been specific to one type, the environment depends upon the requirement or the physical world environment. The digital environment is been implemented using embedded systems and one of the well know terms related to it is IOT (Internet of Things). IoT is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which allows these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating

opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. [4]. Poslad^[5] differentiates three different kinds of digital environments for systems, services and devices: virtual (or distributed) computing environments, physical environments and human environments, or a hybrid combination of these:

- *Virtual computing environments*: enable smart devices to access pertinent services anywhere and anytime.
- *Physical environments*: may be embedded with a variety of smart devices of different types including tags, sensors and controllers and have different form factors ranging from nano- to micro- to macro-sized.
- *Human environments*: humans, either individually or collectively, inherently form a smart environment for devices. However, humans may themselves be accompanied by smart devices such as mobile phones, use surface-mounted devices (wearable computing) and contain embedded devices (e.g., pacemakers to maintain a healthy heart operation or AR contact lenses)

A digital environment should have methods to perform different tasks since the working for the tasks would vary with various aspects.

➤ *Data Collection Method*

The prevalent use of analytics tools is due to the massive growth of data available to enhance the digital marketing process. The problem now lies is how an internet marketer acquires data effectively and efficiently. Both your data collection strategies and digital marketing insights should go together to optimize your digital marketing solutions. In view of this, we aim to help you in identifying a better data collection strategy that you can use in order to enhance your digital marketing results and return of profits.

➤ *Cognitive task Analysis*

Cognitive task analysis (CTA) is a type of Task analysis aimed at understanding tasks that require a lot of cognitive activity from the user, such as decision-making, problem-solving, memory, attention and judgement. The cognitive task analyses methods analyze and represent the cognitive activities users utilize to perform certain tasks. Some of the steps of a cognitive task analysis are: the mapping of the task, identifying the critical decision points, clustering, linking, and prioritizing them, and characterizing the strategies used

➤ *Human error identification*

Two related criteria sets were used in the review. The first was useful for HEI comparative validation exercises, and the second for more qualitative evaluations. Since formal empirical validation is outside of the scope of this project, the

latter criteria set are the one that is used in this review. They are namely: Comprehensiveness, Consistency, Theoretical validity, Usefulness, Document ability, Acceptability.

➤ *Usability testing*

Usability Testing is a phase of testing where application(s) are tested to determine if they are Useful, easy to Navigate, Accessible, Usable, & Desirable. In essence, it ensures that the end-product satisfies users' demands and can deliver a consistent & seamless user experience. Usability Testing is the key to success, and if done right, provides a good user experience that enriches a brand and leads to more uses, more users, and ultimately more growth. With the growing number of mobile devices and browsers, Automation of Usability Testing has a significant role to play.

B. *Emerging Artificial Intelligence with UX for Cognitive Ergonomics*

Artificial Intelligence can be combined with user experience to build an efficient cognitive ergonomics. The use of AI has been broadening the ideas that can be implemented in any field. There are various techniques of AI which can be used in order to learn a day to day environment of a user and its experience also called as UX which can be in turned be used a build a ergonomics which can efficiently allow to process the work. The Ergonomics can be build using following technologies according to our digital environment

➤ *Natural Language Processing (NLP)*

NLP makes the work of communication between human and computer more convenient by analyzing and processing texts (oral or written) in a human-like way in many applications. Representation is done in some forms that are converted into suitable forms with the help of various tasks shown in figure 1. NLP can be used for ergonomics to develop the communication by providing means of communication with the user to make the digital environment more understandable to the user's needs. It can also allow to make changes in the working of digital environment according to the users requirement which results in an efficient system. One of the common example is a Chatbot which has been used in many websites and application in order to help the user to resolve all their queries.

➤ *Image and Facial Recognition*

Facial and image processing is an area of research that is dedicated to the extraction and analysis of human faces, information which is known to play a central role in social interaction include recognition, emotions and intention. Computer will extract meaningful information from the

images.[8] Even though text and voice has been used largely in vogue yet image and face recognition has not been left behind. It is mostly used for security purpose but the application of face and image recognition is prevalent. Facial recognition can initiate various algorithms that work for our well-being or safety.

- Face detection
- Facial expression recognition
- Head turns and viewing direction recognition
- Person tracking
- Articulated body tracking
- Gesture recognition
- Speech recognition

For example, uses of this recognition can be implemented in cognitive ergonomics for the development of smart parking system. The smart parking system which is currently in used detects the locations in the city for parking but the system build with cognitive ergonomics with facial and image recognition will help in getting parking space according to the convenience of the car owner and the destination.

➤ Case Study

• The Problem

As the increase in the complexity of the systems in the aircraft systems. Cockpit technologies have been advanced to reduce workload in situational conditions and it also has to manage if one or or both pilots are not there in the aircraft.

• The Solution

A research and development project called ACROSS was set up to investigate this issue. There were three levels set up: operational, task and crew, human-machine-interface to cover each of the local technologies function:

Aviate: Departure Assistance, multi-touch screen, and tactical flight control, and upset detection reduce immediate task demand.

Manage mission: Reduced demand in weather avoidance, re-routing to an alternate airport, aircraft separation.

Communicate: The Future Radio Management Panel interface improves flight planning, simplifying cockpit communication, severe weather and peak workload.

Manage system: Automating lower level actions, and co-locating system commands reduces demand.

Monitor crew: Human factor analysis, advisory group, and review of recent activity, as well as monitoring current activity.

Proactive Workload Management: It enables anticipation and spread the anticipated workload better.

Immediate Workload Management: Uses automation with enhanced decision support

Reactive Workload Management: Detect pilot incapacitation and suggest mitigations.

• The Impact

The change in automation involved new HMI concepts which included schematic representation, delegation of functions, new HMI and intuitive use. Automation can be used under pilot control with new technologies with better anticipation and planning, and system diagnosis and rectification. If one pilot is incapacitated the remaining pilot would receive increased air traffic control and ground stations. And in case of both pilots need for transfer for control to ground station.

C. Making Digital Environment Efficient with Cognitive Ergonomics

The human-computer interaction has been given the most priority in technology for the success of digitization. Cognitive ergonomics for the use of the information environment in a fit way as it can be said to allow humans to cooperate with the technical system in the better way. This is the main motive of cognitive ergonomics to develop a environment to reduce the stress and ease human work. There are such complicated and complex works that are to be done by human and machines would not completely be able to work with it so Cognitive Ergonomics will only be in regards to the constant technological advance that may have a direct or an indirect impact in the capability and quality of the work done. The ways in which Digital Environment is made efficient:

- Enhance flexibility and adaptability
- Increased automation
- Less physical and physiological burden
- New employment
- Increased understanding

III. DISCUSSIONS AND CONCLUSION

This paper provided the application of cognitive ergonomics using artificial intelligence for digital environment. The research focus on the enhancing the technology to create a digital environment and to make it work in an effective way by the significant ease of human-computer interaction. This will also increase the use for cognitive ergonomics technology. The cognitive ergonomics alone is not capable to function in the workload of the environment so artificial intelligence is been integrated with it. This system will be more efficient than the present system. Although there might be difficulties in initial stages to develop but once

developed the system itself can create more systems. Cognitive ergonomics can be used in various fields such as design field to make decisions which can be integrated with many other computer science fields to ease the work. This system will undoubtedly have a great development with the growing technologies. It increases the technology level which requires intelligent people to operate such systems. The cognitive ergonomics has been used in various fields is without a doubt increasing the efficiency and making new ways to improve the future capabilities of system.

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