Exploring Human Computer Interaction in the Design of Graphical User Interface

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Abstract
This article describes the utilization of proper Graphical User Interface Design in developing Human Computer Interaction, their relationship and how they are necessary for the success of both designs. The usability of the interfaces is important to the improvement of the human-computer-interaction. Several papers and projects were presented having different scope of input and output flows, from simple text, to speech, to multiple dynamic images for facial recognition and image processing for detection of brain tumours. The paper also proposed possible inputs for future designs of both GUI and HCI and to consider the following aspects as well, visual based, audio based, task environment, machine environment, areas of the interface, input flow, output, feedback, and fit. Careful consideration in iterative process of internal design procedure to accommodate intrinsic needs of user is tantamount to some experimental design principles, paving the way for its success. As technology evolves user interface improves thus the human computer interaction advances further.
Keywords: Human-Computer Interaction, Graphical User Interface, Database Management System

I. INTRODUCTION

Graphical User Interface (GUI) had been associated with how we use the computers today. Internet browsers, computer and mobile apps, information system and the likes must be properly designed to make the system user friendly. The advent of human-computer interaction (HCI) or one that researches the design and use of computer technology, focusing particularly on the interfaces between people (users) and computers [1] strongly intensified the process in which to deliver easy to use system designs. Hardware interfaces are vital to the design, computer architecture and embedded designs are crucial components of HCI, but all of these will be in vain if the user interface design lacks attractiveness and ease of use. Software and hardware inputs must be matched so that user processing will be fast enough and not disruptive to the work flow [2]. Poor designs can lead to some or bigger problems as well.

With the goal of studying the ways in which humans make, or don't make, use of computational artefacts, systems and infrastructures [1] HCI need to consider a lot of factors. Designing the visual composition and behaviour of a GUI is a vital part of software application programming in the are of HCI, but in doing so, much of the research in the field seek to `improve' human-computer interaction by improving the `usability' of computer interfaces. How `usability' is to be precisely understood, how it relates to other social and cultural values and when it is, and when it may not be a desirable property of computer interfaces is increasingly to be debated. Usability will be a design principle with the goal of enhancing the efficiency and ease of use for underlying logical design of a stored program [2] and should be always considered in the composition of their interaction.

II. RELATED WORK

The concept of affective computing in 1997 by Since Picard proposed that the role of emotions in human computer interaction attracted many researchers in the field of computing, computer science, biotechnology, computer informatics [3]. Although the domain of HCI has not achieved more success and is still in its infancy [4], still computers are best utilized when it is interfaced with humans and whether we used related works such on the use of emotion, speech recognition, by touch or using the mouse in computer interaction still graphical user interface will be utilized in all these aspects.

2.1. Articles about Human Computer Interaction

Researches had emerged over the years concerning Human Computer Interaction. It includes, *A glance to the Future of Human Computer Interaction* tackling the possible future in HCI, in this research paper they

proposed a model that shall be meeting the future human computer interaction needs possessing linguistic human computer interference environment based on surface technology, automation and photonic computing, which would be reliable, efficient and quicker satisfying all the future artificial intelligence pre requisites [4]. Another is *Emotion Detection from Text* using text input to detect user emotion, describing it as Emotion Detection in text documents as essentially a content – based classification problem involving concepts from the domains of Natural Language Processing as well as Machine Learning. In this paper emotion recognition based on textual data and the techniques used in emotion detection are discussed [7].

Perhaps using audio in HCI were utilized in the paper *An Artificial Immune System for Human Computer Interaction Through Speech* where it uses speech recognition for input human computer interaction through speech inspired by natural immune system. The HCI model has been designed by mimicking the principles of immune system. Initially the system is trained for a particular set of queries through speech and gradually it learns the traits of foreign queries. During the speech recognition, the system was subjected to environmental noise. From the result it can be analyzed that the error rate is much lower when the system is devoid of noise [3]. Whether the input is text or speech or any other parameters, the GUI must be able to properly assist the operator to accommodate non disruptive flow of information and efficient output as quickly as possible.

In a more advanced area, *A survey of the trends in facial and expression recognition databases and Methods*, automated facial identification and facial expression recognition, facial and even expression recognition find applications in human-computer interfaces, with the evolution trends in databases and methodologies for facial and expression recognition can be useful for assessing the next-generation topics that may have applications in security systems or personal identification systems that involve "Quantitative face" assessments [5]. With inputs like static and dynamic images, processing will be a lot easier with proper GUI handling.

One successful project that uses GUI, Detecting brain tumor from MRI image Using Matlab GUI program, might be the project about detecting Brain tumors from MRI images using an interface of GUI in Matlab. Using the GUI, the program can use various combinations of segmentation, filters, and other image processing algorithms to achieve the best results. Starting with filtering the image using Prewitt horizontal edge-emphasizing filter followed by what they call "watershed pixels." The most important part of this project is that all the Matlab programs work with GUI "Matlab guide". This allows us to use various combinations of filters, and other image processing techniques to arrive at the best result that can help us detect brain tumors in their early stages [6]. Again smooth transition of input and output flow becomes possible with the appropriate GUI handling.

In the system development of Tobruk University Grading system for College of Nursing, the 4th Generation Technique (4GT) which includes vital tool using the non-procedural language for report generation, database query, data manipulation, user interface, code generation, spread sheet capabilities and more [8], with emphasis on user interface for the system to be viable up to present.
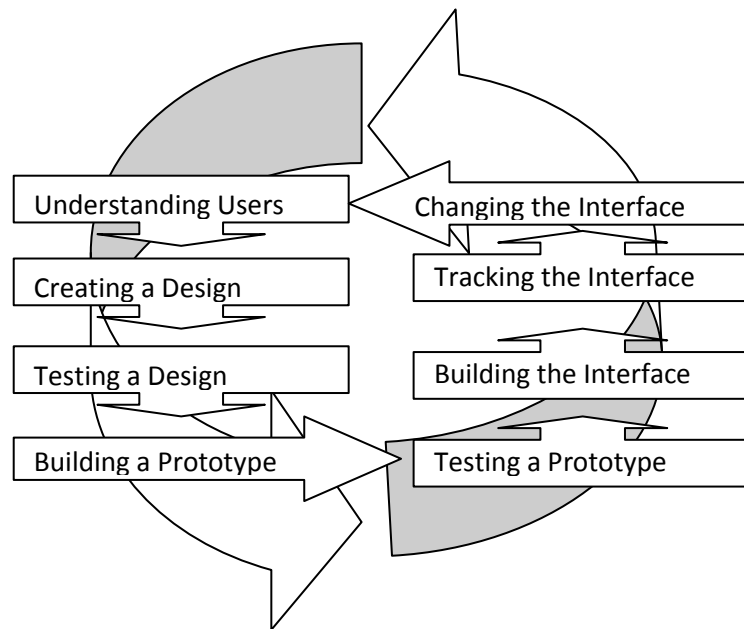
III.   PROPOSED USER INTERFACE DESIGN CONSIDERATION

In the future the biggest resource would be component of time and wasting time for a key board entry or a mouse input would be unbearable so the need would be of the computer interaction environment that along with the complexity reduction also minimizes the time wastage in the human computer interaction [5]. So the need of a better proper design is tantamount.

The HCI interface can be described as the point of communication between the human user and the computer [1]. Most or all of the following aspects should be considered in the user interface design: visual based, audio based, task environment, machine environment, areas of the interface, input flow, output, feedback, and fit. These can be described as the loop of interaction optimizing both the computer design and human resources needed to accomplish the task in hand.

When evaluating a current user interface, or designing a new user interface, it is important to keep in mind the some experimental design principles: Early focus on user and task by establishing how many users are needed to perform the task and to determine valid users. In addition, define the task the users will be performing and how often the task need to be performed; Empirical measurement by testing the interface early on with real users who come in contact with the interface on a daily basis; Establish quantitative usability specifics such as the number of users performing the task, the time to complete the tasks, and the number of errors made during the task; Perform iterative design after determining the users, tasks, and empirical measurements to include, perform the following iterative design steps, Design the user interface, Test, Analyze results, Repeat and then again repeat the iterative design process until a sensible, user-friendly interface is created [2].

To illustrate and summarize the scenario on how to determine the proposed GUI for HCI the following iterative procedure is proposed:

Figure 1: Proposed internal design model

Figure 1 or the proposed internal design model, iterative procedure test for the creation of GUI will handle all intrinsic needs of the user, the system and further improvements in the future design. Understanding the user's needs followed by the creation and testing of the design will bridge the gap between user and the system as well as also boosting user customization. Building and testing of the prototype followed by building and tracking and then changing of the interface will smoothen the input output flow. There will always be changes at certain point in time but considering this procedure will eliminate possible future flaws in the system and satisfying the needs of the user. Satisfaction rating will change so the need for pacing up increases as well.

The factors of change will be improve as well as the proposed design might decrease hardware costs leading to larger memory and faster systems, miniaturize hardware leading to portability, reduced in power requirements leading to portability, new display technologies leading to the packaging of computational devices in new forms, specialized hardware leading to new functions, increased development of network communication and distributed computing, increasingly widespread use of computers, especially by people who are outside of the computing profession, increasing innovation in input techniques (e.g., voice, gesture, pen, emotion), combined with lowering cost, leading to rapid computerization by people previously left out of the "computer revolution" and wider social concerns leading to improved access to computers by currently disadvantaged groups. All these forces for the improvement of computing power of the masses will be beneficial to in the evolution of technology.

3.1. Future of HCI and GUI using the proposed design

Uncertainty and volatility are the challenge ahead for the success of HCI and GUI but it will always be there to change the world, innovation and precision will always be a part of the dare. Nobody expected that GUI will be a partner of HCI as we've seen from the past when computer revolution started with punch cards then command line interface as a prerequisite. Wherein keyboard is the norm for the human and computer to interact, lines and lines of code should be interpreted to understand each other at least on screen. Mouse pave the way for user interfaces to be graphical in form coupled with the personal computers being available for home use, advances in interaction greatly shaped future designs. Social media shaped what we have today and different ways of computer input have been in view. In the future as we look forward to having multimedia output, virtual reality with data gloves and suit has the potential to direct our very own interaction with the computer and the world. A brief summary of the HCI scenario is presented in Table 1.

Table 1: Yesterday, Today and Tomorrow of the computing world

Scenario	Input	Output
Early Days	• Connecting Wires • Paper Tapes • Punch Cards • Keyboard	• Lights on display • Paper • Teletype
Today	• Keyboard • Cursor Keys • Mouse • Microphone	• Scrolling glass teletype • Character Terminal • Bit mapped screen • Audio
Future	• Data gloves + suit • Computer jewellery • Natural Language • Cameras	• Head mounted displays • Ubiquitous computing • Autonomous agents • Multimedia

Table 1 presented the scenario of the Computing world from yesterday, today and tomorrow, the input from keyboards to punch cards in the past, to mouse, audio, video and several possibilities in a manner easy to understand by ordinary users, to give us efficiency and provide satisfactory output and any possible form of media.

IV.   CONCLUSION

The HCI cannot be completed successfully without considering the user interface design, in fact they go together, attractive and easy to use GUI encourages the user to perform properly and reduced time usage and errors arising from poor or improper user interface. But then again the improvement of GUI is because of what we need in HCI. Getting a step further to the future needs a look back from the past.

In this paper it is important to note the temporal scenario as a prerequisite to development of GUI in HCI. Progress had been found in the projects presented in the related literature and paving the way for the proposed user interface design considerations. Loop of interaction, experimental design principles and the proposed internal design model were anticipated to shape at least in part the future of GUI and HCI. Several standard models can be adopted for comparison and execution.

In the future, careful consideration on human computer interaction and graphical user interface must be considered when developing application system not only in the proponents university but also when developers in general consider creating one.

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