Design Adaptive and Intelligent application to help Healthcare Professionals and Patients

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Abstract

Although AI and HCI explore computing and intelligent behavior and the fields have seen some crossover, until recently there was not very much research in Human computer Interaction (HCI) with Artificial Intelligence. In recent years, artificial intelligence (AI) especially machine learning and Human Computer Interaction are converging in different researches such as Healthcare, Online Learning, etc. There are few researches going on above mentioned fields in Human-Computer Interaction (HCI), adaptive HCI and artificial intelligence, especially machine learning which handles complex algorithms to provide the system its intelligent properties and abilities using previous experiences and big data set. In this research, User Centered Design methodology will be followed to develop Healthcare system which also supports adaptive functionality, e.g. learn from user previous data set and suggest accordingly; for Healthcare Professionals and Patients. To ensure adaptability, Machine Learning approaches will be used and system will show intelligent behavior, and shall proactively suggest users. Finally the goal of the research is to develop a new adaptive healthcare solution which ensures positive user experience and perfect suggestions for patients as well as healthcare professionals.

Keywords: Healthcare Application, Machine learning, Human-Computer Interaction (HCI), Intelligent and Adaptive HCI, User Centered Design.

1 Introduction

In a technology-oriented and information-intense world, nowadays one of the great challenges is structuring, arranging, manipulating and delivering the information in a coherent, efficient and usable manner. There are a lot research going on the above mentioned field such as artificial intelligent especially machine learning handling big data through complex algorithm to provide the system its own intelligence using previous experiences; Human computer interaction especially user centered design, participatory design and sometimes adaptive & intelligent HCI helps to build such successful application or finds user requirements as much

as close matching of requirements and adopted technologies. Aim at comprehensively acquiring user requirements to improve the total quality of the application and user satisfaction to use the system. Recently HCI has introduced healthcare applications that aim to facilitate services to healthcare professionals and patients. The motivation and goal of this research is to propose and develop an adaptive and intelligent healthcare application for healthcare patients and professional. Although AI and HCI explore computing and intelligent behavior and the fields have seen some crossover, until recently there was not very much research on advance HCI with machine learning.

2 Theoretical Framework

2.1 Human computer Interaction

Human Computer Interaction is an area of research and study which deal with analysis, design of interactive applications by involving its users in the design process; and focuses on the interaction between Human and computer applications. In some cases, HCI is also known as man-machine interaction (MMI) or computer-human interaction (CHI). According to Dix et al. [3], HCI is concerned with looking into the relationship between human and computer systems and applications that people use on their everyday life. In the any HCI design process, User should be emphasized first and then the other key aspects are firstly what tasks users want to perform when using the system; secondly which characteristics of the user could have a significant effect on their performance with the system; thirdly developing the system which meet the user needs and finally the evaluation of the developed system should check if it meets users' needs as well as satisfying to use and getting users' feedback which helps to develop updated version of the system.

2.2 User centered design

User-centered design process (UCD) is also called human-centered design process. Human centered design processes for interactive systems, ISO 13407 (1999), states: "Human-centered design is an approach to interactive system development that focuses specifically on making systems usable. It is a multi-disciplinary activity" [9].

In UCD, all "development proceeds with the user as the center of focus"[7]. Rubin depicts the User-Centered Design Process as follows:

- The users are in the center of a double circle.
- The inner ring contains: Context; Objectives; Environment and Goals.
- The outer ring contains: Task Detail; Task Content; Task Organization and Task Flow.

"User-Centered Design (UCD) is a user interface design process that focuses on usability goals, user characteristics, environment, tasks, and workflow in the design of an interface.

UCD follows a series of well-defined methods and techniques for analysis, design, and evaluation of mainstream hardware, software, and web interfaces. The UCD process is an iterative process, where design and evaluation steps are built in from the first stage of projects, through implementation"[4].

User-Centered Design (UCD) method is used to develop product and system with high quality and usability from the perspective of users [5].

2.3 Adaptive and Intelligent HCI

User centered Design is the part of Human Computer Interaction which is multidisciplinary area included various subjects and disciplines. Interaction Design is a process to develop interactive software which ensure usability that means the software should be easy to learn, effective to use, and should provide an enjoyable experience from the users perspective. The key views of Interactive Design are easy, effortless, and enjoyable to users [6]. This is also known as interactive product development methodology. On the other hand, User centered design (UCD) process is inscrutable understanding of the psychological, organizational and community factors that influences the use of web technology developed from the involvement of the user at every phase of the design and evaluation of the product [2]. The key point is that users should be involved in every step of development. An Intelligent and Adaptive HCI might be an application which would be adaptive, to some extent, if it has the ability to recognize the user and remembers its searches, purchases and intelligently search or find, and suggest based on users need and choice. Most of this kind of adaptation is the ones that deal with cognitive and affective levels of user activity [8].

2.4 Machine learning

Machine learning is a type of artificial intelligence (AI) that provides computers or any program some ability to learn without being explicitly programmed. Machine learning focuses on the development of computer programs that can teach themselves to grow and change when exposed to new data. The process of machine learning is search through data to look for patterns. Machine learning programs detect patterns in data and adjust program actions accordingly [1].

3 Details of Proposed Research

Since I am interested in HCI, Machine Learning, Adaptive and Intelligent HCI, Healthcare applications; I will propose and design a system which will provide services to healthcare professionals and patients of our daily life.

3.1 Research Questions

The research questions will be as follows and I will try to figure out the research methodology and a best approach (HCI, UCD and Machine learning) to design an intelligent, adaptive and interactive healthcare application which will handle big data based on user centered design.

1. How could we build an adaptive and intelligent healthcare application for healthcare professionals and patients based on UCD?
2. Which machine learning techniques can be used to efficiently implement adaptive and intelligent system based on user centered design methodology?
3. How technology can help us in case of solving this problem?

3.2 Research Objectives

The goal of this research is to develop an adaptive and intelligent healthcare system based on user centered design methodology for healthcare professionals and patients. And the system will be adaptive and interactive from user perspective using some AI techniques especially machine learning algorithm. Finally, the objective of the research will be to find out a perfect design methodology based on user centered design which will give an adaptive, intelligent and interactive healthcare application interface and application functionalities using machine learning algorithms.

3.3 Methodology

The methodology that I will follow in this research is to design an adaptive and intelligent healthcare application for healthcare professionals and patients based on user entered design. First of all, I will define the problem statements and extended the research questions and simultaneously I will study literature review to figure out the best approach for designing such a system. The target stakeholders group will be defined; here namely the healthcare professionals; doctors, nurse, pathologist and specialist; and conduct a set of user study such as questionnaire, interviews, observations, focus group and workshops and field evaluations of a prototype to collect various qualitative and quantitative data. This user study will help to find out a set of stable requirements. After getting all response and result, I will analyze the collected data for proposed the healthcare application interface and UML diagram; namely use case and class diagram of the system. Before designing the system, tested some machine learning algorithms for best fitted with the system which will basically provide adaptive and intelligent functionalities; e.g. learn from environment, users behavior, previous experiences and suggest accordingly. Then I will design an interactive prototype of the system for evaluation. The designed prototype could be mid fidelity or high fidelity which will decide at development time depending on research activities. Finally, I will do various evaluation processes; usability evaluation, user study. Depending on users feedback improvement of the

design will be done and tested that design will fulfill users needs and requirements. Finally, the system will be developed such a way its satisfy usability and users goals.

3.4 Expected Outcomes

The expected outcomes of the proposed study are as follows:

1. Contribute to HCI especially Healthcare sector after tested some machine learning algorithms for best fitted with the system which will basically provide adaptive and intelligent functionalities.

2. Help to HCI community in adaptive and intelligent HCI system design for Healthcare application.

3. Contribute and publish paper in ACM CHI, MobileHCI, Ubicomp conferences, and journal of Personal and Ubiquitous Computing and International Journal of Mobile HCI.

4 Research Plan

In the bellow sections, the research plan for designing adaptive and intelligent healthcare application is presented.

4.1 Literature Review (6 Months)

In the first part of the study, an extensive review on user centered design in adaptive system development using machine learning will be carried out. The comprehensive review will be defined a specific system and title of thesis, review on such kind of system, analyzed and implemented that system based on user centered design. The study will be started with the literature review of existing system which using Adaptive techniques, machine learning algorithm and handle big data. Journals, books, and other relevant international publications including the documents published by universities, research institutes; will be examined throughout the study.

4.2 User study [Questionnaire, Field Survey, Interview, Observation etc.] (4 months)

The user study will be complimented with designed questionnaires addressing to key stakeholders in the proposed system. The stakeholder questionnaires are designed to find out functional requirements of the system. The inquiry will be made on stockholder needs and goals. Since the response of the questionnaire drives to define functional requirements so in User centered design building a stable questionnaire is very important. Some other user

study such as field survey, interview, and observation also will be followed. So this phase is very essential as well as important too.

4.3 Data Analysis and Design (8 Months)

Data analysis is very complex and time consuming part in user centered design methodology since user questionnaire response could be qualitative as well as quantitative data. After analysis these data, a set of stable requirements, use case and class diagram of the system have to derive for going to design phase. Design of the propose system should be as much as simple, interactive and ensure maximum usability. My goal is to design a mid fidelity prototype of the system.

4.4 Evaluation (3 Months)

The evaluation phase is very important part in interactive system development lifecycle. It will ensure the usability of the system; user study could be evaluated using different methodology such as task analysis, cognitive walkthrough and questionnaire. Analyzed users feedback, the design of the system would be improved and the system will make more usable as much as possible.

4.5 Follow steps 2, 3, 4 iteratively [more than two times] (9 Months)

Since user centered design methodology is iterative procedure, that's why the steps 2, 3 and 4 will be followed iteratively until getting a stable version of the applications.

4.6 Revision and thesis writing (6 Months)

The research study is expected to produce academic papers to be published in local and International Journals, and to be presented in relevant conferences. The publication of the result of the study would contribution to the research field of HCI and Participatory design where the feedbacks will help me to write my final thesis.

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