Cognition Based User Interface Design for Healthcare Systems

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Summary
Healthcare facilities today are relying on the composite technical equipment. Advancements in user interface design are necessary for the healthcare systems. The quality of user interface is essential in the healthcare field, as the consideration of healthcare experts is generally on the patient but not on healthcare system, and so less cognitive user interfaces can lead to serious medical mistakes. The study presents a brief survey of user interface design in which it discusses about the issues in current healthcare systems. It examines the importance of cognition based user interface design according to some of the recent trends in domain. The purpose of this study is to pinpoint that improvement of user interface design is important for the healthcare quality and performance which can be done by building cognition based user interface design. Through some cognitive psychology methods, it is useful for assessing the usability of healthcare systems and medical devices in hospital surroundings cognitive walk through is an appropriate method to assess the healthcare systems with multilevel menus.

Key words:
User Interface Design, Healthcare Systems, Medical Devices, Emergency Medical Services, Cognitive Interface Designs.

1. Introduction

Information technology is useful in various professional areas and practically implemented in almost all areas of existing services. Technology is altering people daily life and work contexts in various methods. Technology is a dominant concern for the manufacturers, human factors engineers, practitioners, and regulatory bodies [1]. One of the areas which need specific attention is health sector. It is a valuable sector for the population well-being where mistake can have serious effect. People life and welfare demand quality of medical facilities. Medical errors are one of the leading causes of death in the United States [2]. Several trends are currently pushing towards more efficient and universal implementation of information technologies in healthcare.

Healthcare applications development is an emerging field that is changing the way people interact with health data. The downside of current healthcare systems is inability to handle mistakes on run time. These systems do not allow users to perform tasks efficiently. Tasks such as data extraction, association, summary, verification,

mathematical calculations, etc. are not executed in the background and system resources are not freed for other tasks [3].

For better performance of healthcare applications, user interfaces should be interactive and efficient [4]. Many studies have shown that existing healthcare systems and medical devices have numerous usability issues. The reason is usability professionals are not involved in the system development process. These systems are still in use in clinics and hospitals. These usability defects possibly can create some serious issue or a major injury to the patient in some emergency cases. This is commonly viewed as an inactive mistake in the devices. Human and machine awareness, understand reasoning and decision making process issues still remains to be resolved [5].

For this reason, cognitive user interfaces should be designed for the development of healthcare systems and medical devices. Major cognitive components include visual and spatial skill (to recognize symbol and layout), abstract and structure skills (to form mental model and reasoning) as well as memory [6]. This study provides a comprehensive picture about the usability and interface design problems of healthcare systems. The objective is to understand how to improve the performance of healthcare systems.

This study can help to better recognize how developers of interactive healthcare systems and medical devices not develop a cognitive perspective into their development procedures [7]. The study discusses that healthcare quality and performance can be improved by developing cognitive user interfaces.

This study also illustrates about the importance of user interface designs in healthcare. The users of this domain are Doctors, clinicians, attendants, patients, healthcare providers, insurers, decision makers, pharmacist, engineers, and teachers. The cognitive load of the users of healthcare systems should be minimized to increase the usability of the system [8]. This can be achieved by avoiding visual clutter, redundant links, irrelevant images, and meaningless typography flourishes [9]. Meaningful links, images, and typography are valuable design elements. However, these can impair usability when overused [10].

This study can become an aid not only for the medical profession but also for the entire society. The rest of the paper is organized as follows: Next section discusses related work on designing healthcare systems and medical applications based on HCI principles. Section 3 describes the methodology used for this work. The results are presented in section 4. Finally, the outcomes are concluded in section 5.

2. Related Work

The fast development of technology allows people in emerging countries to catch up with the other world, because technology is flattering more and more affordable [11]. However, due to the inability to read, so understand the technical interface, some of which are still faced with difficulties in the technical interaction [12].

Katre investigated the proficiency of illiterates and literacy skills, thereby influencing their ability to understand the interface of computers and communication technologies [13]. Cognitive engineering methods possibly can also be a useful complement when evaluating the usability of medical equipment in a buying condition, i.e., earlier the equipment is occupied into use [14].

Dominic et al., discussed that the medical devices are becoming more interrelated and difficult and are increasingly supported by fragmented organizational systems, e.g. through different processes, committees, supporting staff and training regimes. Distributed Cognition has been proposed as a framework for understanding the design and use of medical devices [15]. Distributed cognition (DCog) is an approach that was developed in reaction to classical forms of cognitive science that focus on what goes on in the head of the individual [15].

Brunner et al., investigated that a high measure of data cannot be completely communicated in a client focused plan. The study group directed an intellectual meeting and a pilot test to guarantee reliable understanding of the overview questions; be that as it may, as with all reviews, respondents clarified that a portion of the adjustments in the issue may hold on and prompt estimation blunders. This study distinguished four client focus configuration hones at the US Veterans Affairs (VA) essential care center and assessed the accessible utility of clinical choice help for these facilities. Assess the connection between client focus configuration rehearse and the accessible utility of clinical choice help [16].

The result of study gives a quantitative help to subjective work in various settings and features the benefit of connecting CDS to quality objectives and execution enhancements. The affiliation does not really imply that the VA medicinal focus that examines the effect of CDS on execution change ought to be more successive or more extensive; we can't evaluate the "measurement reaction" relationship [16].

Constance et al., illustrate the redesigning of the healthcare interfaces using a user centered framework, in the current information age, health care workers has been challenged by more and more information, and therefore need to use technology to effectively manage this information. To enhance the nature of healthcare and decrease mistakes, analysts and framework engineers must cooperate to incorporate client driven outline information into the plan of new frameworks [17].

Ahamed et al., discussed the pervasive computing. It is a concept that integrates computing in our functioning and existing environment in such a method that the contact between humans and computers becomes enormously natural, and the user can get many types of data in a totally apparent manner. The goal of universal health care is to provide medical services for everyone at any time, overcoming the limitations of doctors, nurses, and residents' places, time, and availability. The vision provided by this study is a heterogeneous communication approach to bridge the gap between current fixed infrastructure and wireless methods [18].

3. Methodology

This study is divided into two different phases: the first phase identifies the issues in the current healthcare systems user interface designs, and the second phase discusses the improvement from the implementation of the cognition based interface design for healthcare systems.

There are total 151 adults which were participated in this study. There were 88 Doctors and 22 IT professionals and remaining were from 8 other occupations which also participated in this study. The participants belong to different hospitals and different organisations.

Likert-type scales are mostly used in medical education and healthcare related research work. To analyse the survey results we use the likert scale analysis. A likert scale is the summation of replies to numerous likert items.

4. Results and Discussion

The results of this study show that the users of healthcare systems feel that the system must provide effective solutions to improve the quality of medical activities. We also found that healthcare professionals have a positive intention to use a cognitive-based user interface design to positively influence the actual use of the system.

Respondents reported that the current healthcare systems are not supportive for the decision-making process and its

response time is very low. Over 80% of respondents were agreed that the cognition based user interface design for healthcare systems and medical devices will improve the performance of healthcare systems and doctors, attendants or other users for healthcare systems can easily interact with the system and can perform their tasks more

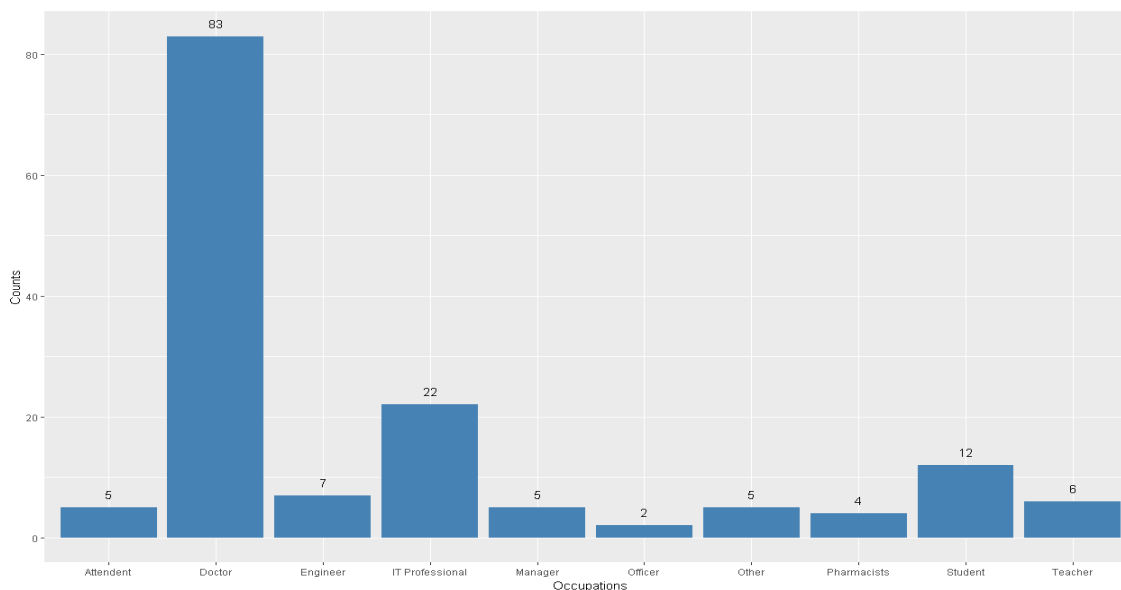efficiently because of less cognitive load on the user interface design.

Fig. 1 Survey participant's occupation bar chart.

Targeted group of participants also agree that appropriate information is needed to help non-specialist doctors or users of healthcare system to interpret the test results of the patients. The responses of the participants indicate that the material in the current system is unsatisfactory and that the link with exterior information resources will make it helpful for them in decision making process. Participants also prefer to provide a cognitive-based user interface design idea for healthcare and medical devices.

Respondents were also agreed that cognition based user interface design will be effective to deal with emergency cases easily because they have less cognitive barriers in healthcare systems and medical devices. This will increase the overall performance of the healthcare systems and medical devices. Figure 1 shows a bar chart of all participants of the targeted group for the survey conducted during this study and next are the figures which show the analysis of participant's response about the current healthcare system issues.
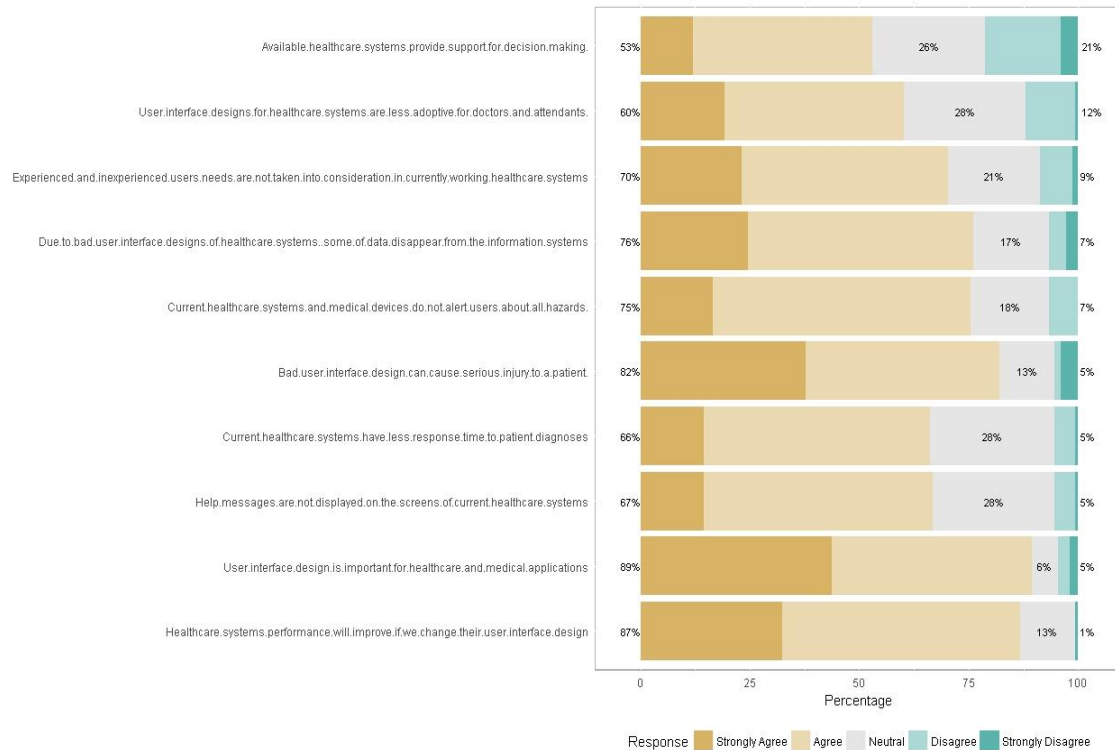
Fig. 2 The likert scale analysis of currently working healthcare system from all participants responses.

The likert scale analysis of the survey about the issues in current healthcare systems is shown in figures 2 to 5 indicate that those respondents who are doctor by occupation most of them agree that the current user interface design for healthcare system and medical devices is not efficient and helpful for users it must be change. The overall performance of healthcare system will be increased and the healthcare systems will become more flexible to be used by the literate or illiterate users.
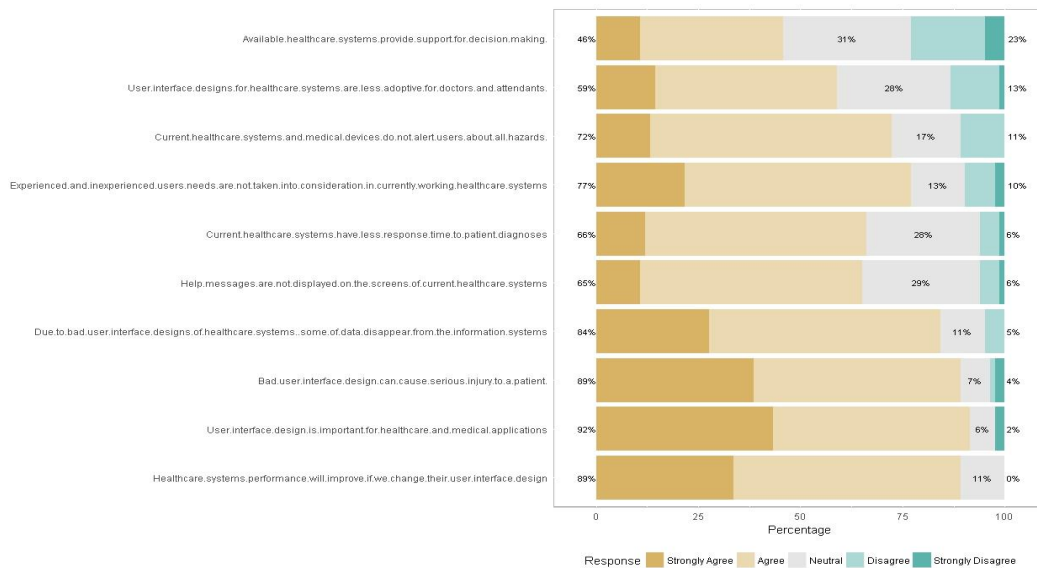

Fig. 3 The likert scale analysis of currently working healthcare system from all doctors responses.
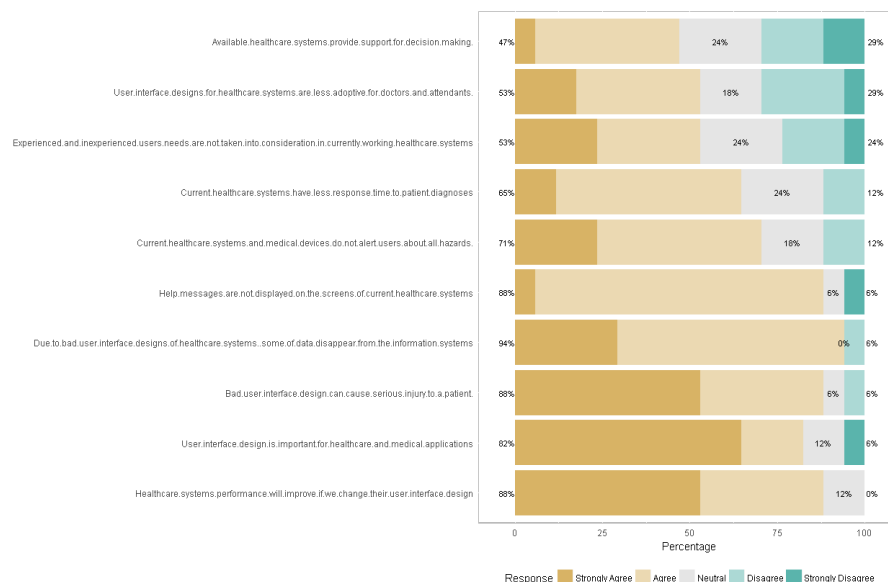
Fig. 4 The likert scale analysis of currently working healthcare system from all male doctors responses.
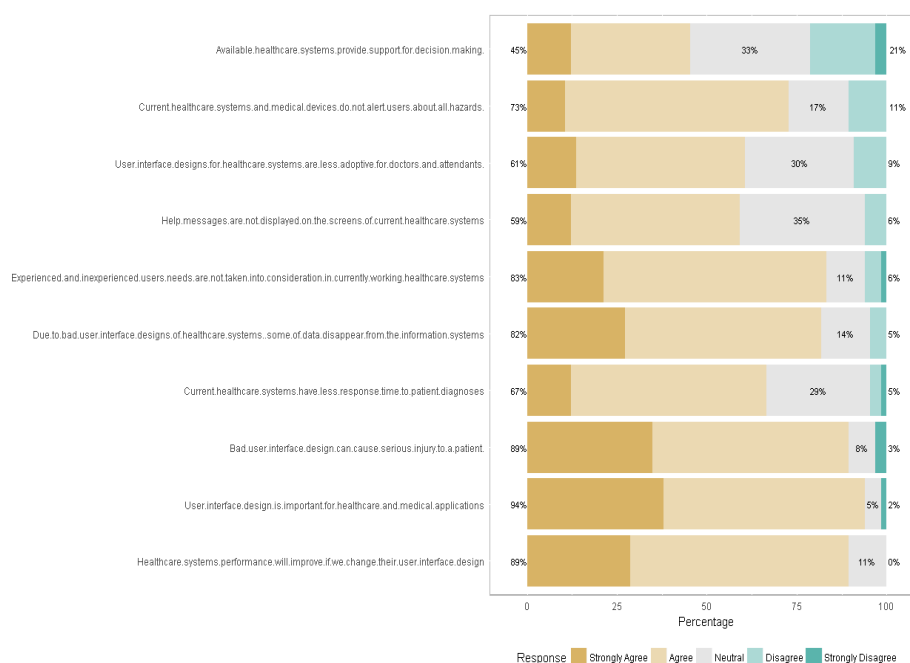

Fig. 5 The Likert scale analysis of currently working healthcare system from all female doctors responses.

To increase the excellence of healthcare and decrease mistakes, scientists and system developers must work together to change the cognitive knowledge into the design of new systems. It is promising to focus on cognition based user interface design guidelines and to provide quality healthcare applications through appropriate efforts, so healthcare professional can focus on integrating the information gained from the use of these systems rather than the mechanisms of these systems.

Consistent monitoring of patient health standing allows the health professionals to deliver protective measures or emergency treatments when required. Next figures will show the analysis of the participant's response about the implementation of cognition based user interfaces for healthcare systems.

Figure 6 show the Likert scale analysis results of all doctors who participated in this research survey which show that mostly respondents are agreed for the implementation or change of current healthcare systems design with cognition based user interface design.

Figure 7 illustrates the Likert scale analysis results of the male doctors' participants who response to the research survey for cognition based user interface design for healthcare systems. It indicates that male doctors are also agree for the implementation of cognition based UI design which can increase the performance of operating suit devices and other medical device will become more flexible to use. To explain this concept with our findings, we can look at examples of gender and medical system use. Generally, women use the healthcare system more frequently than men, as seen in our study, which shows that the demographic characteristics (in this case, gender) can determine patterns of healthcare use.
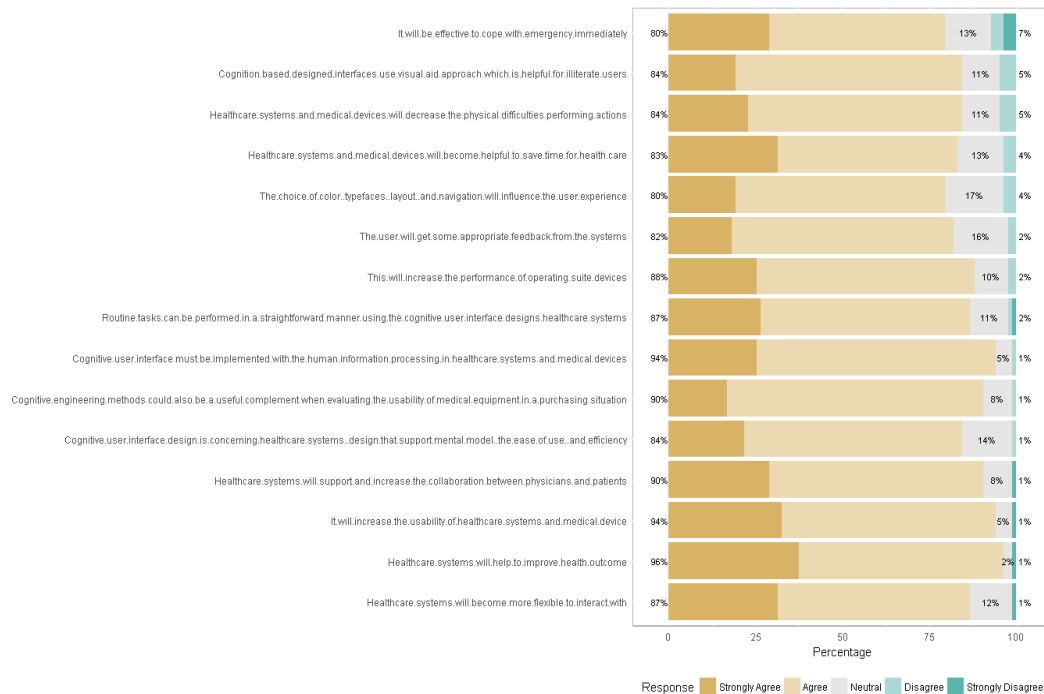

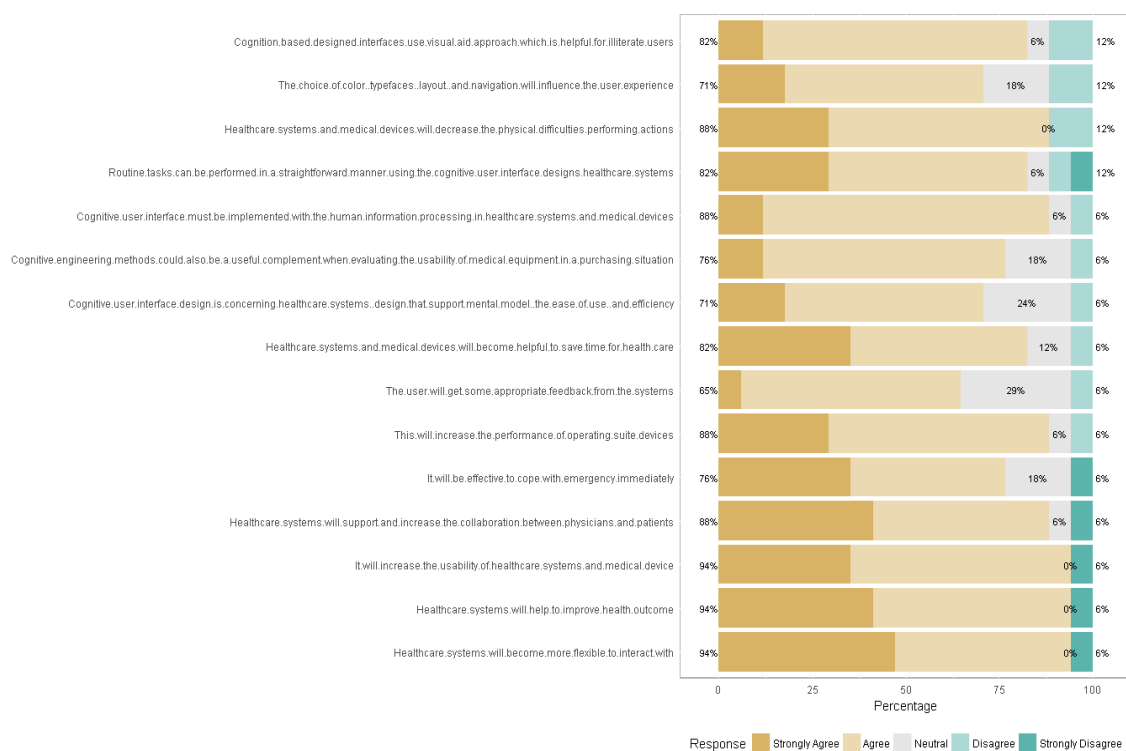Fig. 6 Cognition based healthcare system doctor's responses analysis.

Fig. 7 Cognition based healthcare system male doctors responses analysis.
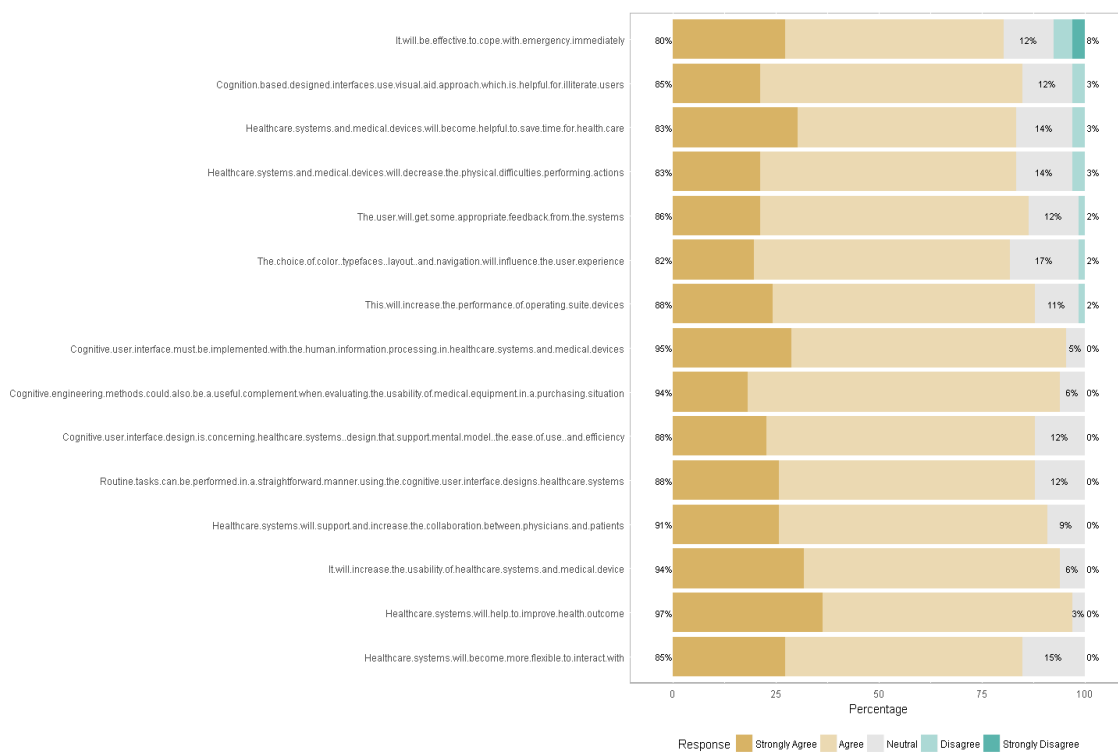

Fig. 8 Cognition based UI design healthcare system female doctor's responses analysis.

Figure 8 shows the response of the female doctors about the cognition based user interface design for healthcare systems and medical devices. These all respondents belong to different hospitals and having their specialization in different medical fields. These respondents interact with different types of healthcare systems and medical equipment's on daily bases. These respondents belong to different age groups and both male and female doctors are participated in this survey. Analysis results of the responses indicate that mostly participants agreed that new interface design should be used. It will make the healthcare system more flexible and more reliable for them. It will become easier for them to deal with emergency case. This study also shows that by modifying the existing healthcare system, access can be improved and utilization patterns can be changed. However, for an effective execution, it seems important that the end users experience a good usability of such systems.

5. Conclusion

The above study shows that the current user interface designs for healthcare systems are not much flexible for its users and it can cause some serious injuries to the patient if it is not being changed by the cognition based user interface designs. This study also shows that if we can decrease the cognitive load on the healthcare systems users it will increase the usability of the system. Usability is an important aspect for healthcare systems and medical devices. The results from this study show that cognition based interface designs can be developed for healthcare systems and medical devices. Cognitive exercise and usability testing must be used in the development and maintenance of medical systems and medical devices, and these test results can be organized to define the informal issues faced by users.

Most of the participants who respond to the survey were agree that the current user interface designs of healthcare system have many issues. They also agree that the cognition based user interface designs must be used for the healthcare systems and medical devices which will increase the performance of healthcare. This study therefore proposes that there is an increasing need to change the current healthcare system user interface and in parallel with this, replace or update the current interface designs to cognition based user interfaces.

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