Capability of Graphical User Interfaces for Occupational Therapy: A Comparative View

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Abstract

In this paper, capability of GUI is discussed for occupational therapeutical purposes from a comparative viewpoint. Within this context, software application peculiarities such as "type of operation system", "status of being open-source", "deployment method", "written/audio instructions", etc. of the related systems have been investigated from two standpoints of "generality" and "domain dependency". A tabular form showing the functionality of GUIs in association with corresponding peculiarities has been used in this regard. A hybrid strategy for designing GUIs with special capability in case of patients with mixed disorders was finally proposed as the result of comparing the existing approaches. Such a strategy is quite helpful since many patients in reality suffer from a variety of disorders together. In addition to this, designing GUIs with hybrid peculiarities has the potential to enhance caregivers' analysis ability regarding the patient's historical records.

1. Introduction

Graphical User Interfaces (GUIs) have been widely used in recent years in a wide range of Human Computer Interaction issues in the domains of education & research, decision-making, idea/art creation, medical diagnosis & treatment, movement/ posture control, etc. [1,2,3,4]. The point significant in all these cases is facilitating human computer interaction/ communication with the aim of guiding a computer and its peripheral systems in a direction compatible with the user's objectives. This means that, on the one side, computer should understand well what a user is intending, and on the other side, based on this understanding presents its decision to the user in terms of some messages or actions.

Among the issues calling for GUI, movement/ posture control in the disabled or patients with movement disorders is of particular significance. It is easily seen that, the message provided by GUI in this case, has the ability to give the patient an idea on how to select his/ her posture as well as control mental disorder. In this way, developing GUIs based on the features of disabilities or disorders, may achieve a fruitful role in minimizing patient's stress/ anxiety, and besides that increasing the efficiency of the related treatment [4, 5]. Due to significance of such a notion, in this paper, we decided to make a comparative study on a variety of GUIs already developed for treating movement disorders, to figure out what peculiarities should exist in a GUI to make it most fittable for certain pathological situations. It is to be noted that, due to the difference in cognitive/ affective preferences of different patients with different types of disorders, the corresponding GUIs should be benefited by different peculiarities [6,7]. That is the main point we are trying to crystallize in this paper.

2. Related Works

There has been a growing interest in using technology platforms and software applications for training purposes in physical or mental occupational therapy. In these assisting software packages, the component which has a significant role in attracting audiences is Graphical User Interface (GUI). Different perspectives may affect GUI design, such as: aesthetics, pedagogy, user-friendliness, cultural appropriateness, accessibility, effectiveness, engagement and innovation, etc. [8,9]. Beside the above-mentioned perspectives, in the case of Occupational Therapy, for those patients, their caregivers or therapists, who may not be able or familiar enough to apply those software packages, some other considerations may also be added. For instance, the GUI should be "simple", "user in control" and "consistent" to motivate the patient or his/her caregivers for continuous use.

Existing research activities in the domain of occupational therapy, reveals that mental-assisting software tools have a history longer than physical ones. The most feasible example of using such tools returns to supporting social and self-management skills in children with Autistic Spectrum Disorders (ASD), for which there is a burgeoning progress of designing assistant applications. Some of these applications focus on improving complete tasks, as well as transition within and between tasks [10]. While, the others present standardized measurement tools to estimate PDA's efficiency as cognitive assistants [11]. It is mentionable that, in addition to applications for patients, there also exist some applications for parents and instructors (ex. "HANDS") to train them how to assist the patients [12]. Also, in last years numerous mobile applications have been designed to help patients, suffering from autism including: "iOT session" [13], "Shelby's Quest" [14], "Brain Works" [15], "Autism Learning Games Camp Discovery" [16], and "Find me" [17], etc..

Another field of exploiting technology for mental therapy is assisting individuals with moderate-to-severe memory impairment, for which extensive fields of research have been done including: supporting memory function in individuals with milder memory impairment using mobile phones [18, 19], digital voice recorders [20] and PDAs and smart phones [21, 22]. In all these studies, the role of caregivers is crucial specifically in the cases where patients are unable to program the reminders, calendars and troubleshooting parts. Although, the first suggestion has been on structured training to make patients independent in using PDAs [23, 24, 25, 26], this suggestion is however not adequate for patient with severe memory impairment [26, 27]. Therefore a prosthetic memory protocol that teaches how to store and retrieve information in/ from a memory book, has been developed for patients with severe amnesia [28].

Beside the above-mentioned applications, there exist some software applications for other mental disturbances such as: depression, insomnia and anxiety. Some of the well-known related applications are: "Operation Reach Out" [29], "BellyBio" [30], "Optimism" [31], "iSleep Easy" [32], etc.

Moreover, physical disabilities have also been assisted by software applications in the present decade. For different types of pathological disorders, specific applications have been developed. For instance, "PT and OT helper"[33] and "Dexteria VPP"[34] are useful for fingers and hand exercises, while, "Occupational therapy" [35], "Therapy Boss" [36], "Physical Therapy Home exercises" [37] and "Physical Therapy for kids" [38], cover various parts of body exercise even for daily activities.

Taking the above points into account, the application and its graphical user interface should be designed using a variety of parameters (Fig.1), such as context, method, purpose, user and type to provide a wide range of facilities and potentials for conveying different types of context, accessibility, safety, diversity, and digestibility for all kinds of users with different mental or physical disorders.

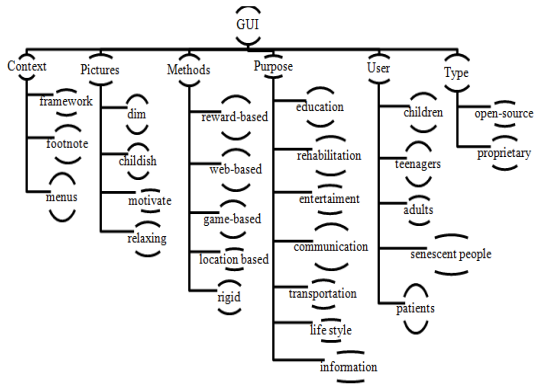

Figure 1. Some of the significant parameters in developing GUI

Role of different kinds of learning methodologies such as micro learning [39], game-based learning [40], location-based learning [41], and ICT-based learning [42] in reinforcing the patients to overcome their barriers, should not be disregarded in this respect. In addition to the above-mentioned parameters, there also exit some software and GUI peculiarities which play a significant role in designing appropriate assisting applications in this domain. These may not only attract users, but also facilitate their exercises. In this paper, we would like to have a comparative study on these parameters within the existing applications.

3. GUI and Software Significant Peculiarities

Graphical User Interface (GUI) achieves a high role in facilitating communication between the system on the one side and the therapist or the patient on the other side. GUIs should therefore be designed in a way that such goals can be achieved most plausibly. To approach understanding what certain protocols should be considered in designing an optimal GUI, it should first be studied how the existing GUIs holding certain software peculiarities have in practice behaved toward the corresponding pathological disorders, and how these peculiarities can in turn be responsible for achieving the related success or failure. It should then be analyzed, based on the existing learning theories, how these considerations can be justified from epistemological viewpoint. What we have done in our approach, is to conduct such a study.

To conduct our comparison, we first need some significant peculiarities both for "software" and "GUI", based on which such entities can be characterized. To specify such peculiarities we first referred to some existing resources (including both accreditation websites and research papers) discussing the capabilities of the entities, and then out of the peculiarities mentioned for them, we selected those items which were believed to be of high significance for the area of Occupational Therapy through Mobile Applications [3, 4, 9, 13, 14, 15, 16, 17, 30, 31, 32, 33, 34, 35, 36, 37, 38, 43]. Within the process of selection, we paid mostly attention to those peculiarities which of least correlation in a thematic sense. We finally ended up with those elaborated in Table 1.

Since GUI's peculiarities are hardly understandable, below we give a brief definition of them:

- User in Control: This master key has an undeniable role in the GUI efficiency, which mentions that users should have the authority of controlling the software behavior (for instance asking for users' confirmation for every vital command like "Quit", "Delete", and so on), as well as altering parts of interface in order to customize the GUI based on their own needs,

skills, and habits.

- Directness: Users should be directed to their purpose through the shortest path, and by the minimal set of tasks in order to become able of retouching GUI objects in the most direct manner.(allowing users to make shortcuts is the most common example of directness).
- Consistency: A GUI should be well-known and predictable for all sorts of users, who have been adapted to other software products so far. Therefore all facets of the GUI including labels, layout, behavior,… should be compatible with other software products' GUI in order to reduce the learning process of the software, and makes agile its adoption (objects dragging function in all standard smart phones is the same, according to which users should hold their finger on the object and move the object to their favorable place without removing their finger).
- Forgiveness: This peculiarity leads developers to make users' actions reversible and recoverable. Therefore users do not have to start from the first step once a mistake has occurred in the processes of choosing, typing, deleting, or even closing a window. The purpose of forgiveness is to allow users to become familiar with the software, and learn how to use it gradually (Recycle bin, where deleted objects are able to be restored is an example of "Delete" function forgiveness).
- Feedback: This maxim has a close relevance to the user in control peculiarity as though users should be provided with immediate visual response to their actions, which allows them to understand which processes are being executed (If the user has deleted an object, he/she should then immediately feel that the object does not exist anymore).
- Aesthetics: is proved to be the most discernible aspect of GUIs' design, since it is the first layer which is presented to users. Aesthetics peculiarities are proportion, symmetry, color, lines, texture, balance, flow, …, which have a crucial role in attracting users, and can affect users' behavior and cognitive processes as well in visual facet; harmony is believed to depend on an appropriate arrangement of different fragments which leads finally to a pleasant perception by eyes (There have been lots of software products led to failure due to overlooking aesthetics aspects even though they have been rich in other aspects).
- Simplicity: A user interface should not be complicated to use and to learn either, because the more a GUI is designed simply and directly around what its users demand, the more success the system will gain. On the other hand, in order to optimize simplicity, developers should benefit from a type of prior knowledge about targeted users' level of education, age, gender, and purpose so as to provide the apt level of complexity (A comparison between Yahoo and Google represents the significance of simplicity in attracting users).

All kinds of mobile applications are somehow trying to teach a concept to the users. The concept can be even how to use the application. Therefore all of mobile applications should have been designed based on a learning theory. There are lots of learning theories which have been used in favor of different purposes, and in different styles such as "Behavioral Learning Theory", "Cognitive Learning Theory", "Information Processing Learning Theory" and "Constructive Learning Theory" [44, 45]. So learning theories should be elicited in order to be recognized in applications. Here are the characteristics of some widespread learning theories, based on which mobile applications make sense.

In addition to GUI peculiarities, some general and domain-dependant software peculiarities should be taken into considerations in designing occupational therapy applications. The software general peculiarities can be enumerated as "status of software as being open source or proprietary" and corresponding appropriate "operating system", which both have major role in selecting appropriate software's language for implementation. Beside that the type of "deployment" affects both the design as well as implementation of software.

Moreover, based upon the domain and context of the application, for instance occupational therapy in our case, some helpful peculiarities may be added to the software such as "written instructions", "audio instructions", "activity monitoring", "patient records", exercise management", "patient's location records", "reminders', etc. These peculiarities may not only help the patient, but also have added value for occupational therapist and caregivers to offer essential information for analyzing and following the treatment process as well as trend of recovery in patients. Figure 2 illustrates the major peculiarities for occupational therapy applications.

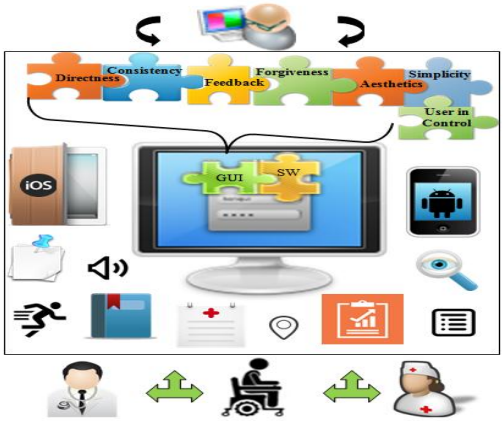

Figure 2. Major peculiarities for occupational therapy software applications

4. Main Points Extracted From Analyzing the Capability of the GUIs of Softwares

Looking at the content of Table 1, the following facts seem to be consistent:

- "Reminders" with both mental and physical applications, are useful for the patients, who may forget to use the application, or for therapists who probably have more than one patient. Therefore smart schedules (or in other words reminders) as well as "consistency" are mandatory in GUI peculiarities, because these sorts of applications have been designed for long term usages, in a way that all features should be consistent in order to optimize the rehabilitation process.
- "Patients location records" have manifested only in some applications, for mental therapy. As the patients may get lost, location records are thus believed to be extremely helpful in these cases.
- "Exercise management" has been presented chiefly in physical and occupational therapy applications due to the intense requirement of exercises stability. Here "Consistency" has a promising role, because sporadic and unorganized exercises are harmful for the patient in the sense of decelerating the rehabilitation process.
- "Patients records" has mostly appeared in those applications, that try to produce a report of the rehabilitation or treatment process. This is to help therapists and doctors to find out how much the patient is in trying mode, what strengths and weaknesses he/she has, and whether the application is helpful or not. Therefore the application should lead the patient as directly as possible in order to optimize this procedure. Due to this "Directness" has been considered effectively in GUI peculiarities.
- "Activity monitoring" is apparently similar to "Patient records", but the reason of separation lies in the variation of those activities done by the patients which cannot be considered as patient records. Particularly, in mental applications activity, monitoring is much more required than patient records, because in mental cases the treatment reports are usually produced implicitly when the patient is working with the application. The other point is that "Activity monitoring" is mandatory for applications that are based on "Constructive" learning theory, let say those which are game-based. These kinds of applications have mainly obtained a high grade of "Simplicity" in order to avoid any complication in the procedure of using the application for those patients who are not as intelligent as the normal people.
- "Audio instructions" and "Written instructions" have manifested mostly in physical and mental therapy applications in order to increase digestibility of instructions given by the application. In the meantime, with regard to some mental cases, they have been presented in a musical way in order to tranquilize the patient. In this way, "atheistic" has been shown to be very effective for this purpose.

Besides the above facts we also noticed some other points with regard to relations between GUI's peculiarities and types of disability as follows:

- GUIs used for patients with mental disorders, and those having disability in hand and fingers, is required to be more "simple" mainly because of limitation in their ability to interact mentally with the surrounding environment.
- For patients with mental problems like Autism, "Aesthetic Aspects" are believed to be more important simply because such patients may need more attention compared to other patients.
- For patients with mental disorders, who suffer from visual tracking and insomnia, "Feedback" and "Forgiveness" aspects are necessary to promote for continuous practice.
- GUIs used for patients with physical disorders, especially with disability in hand area, should be "Consistent". That is because patients have got used to some software's facets and we should facilitate their reactions with minimum learning efforts.
- For patients with mental problems, who need to concentrate on writing skill and visual tracking, "Directness" and "User in control" are two significant aspects which can navigate the patient directly and personalize software for easy use.
- The most important aspects for physical disorders are "Consistency" and "Simplicity" which have to be considered in GUI design.

From the point of learning theory considerations, it is mentionable that, majority of software applications listed in Table 1, are in charge of controlling the progress trend of patients, through observing their behaviors and actions. Thus, most of them have been constructed based on the considerations in Behaviorism (as a learning theory).

There however exist some applications mostly for mental problems which actually engage the patient with a process of writing a text or drawing a painting. In these cases, the applications are benefitted from Constructivism as a learning theory. The other kinds of learning theories have not been observed in the applications which have been investigated in Table 1.

Taking the above discussion into account, it is quite possible to look for different peculiarities

belonging to both different softwares and GUIs, in a blended way so that those patients who suffer from mixed disabilities can be benefitted by different software modules (to be adjusted by caregivers) under different learning theories to go through the process of therapy.

5. Conclusion

Capability of the existing GUIs for the patients with a variety of physical as well as mental disorders was analyzed from a comparative viewpoint. Ground for such an analysis is the peculiarities of GUIs and besides that the software used to make them effectively respond. In addition to these, type of disability and considerations within the scope of learning theory were taken into account as well. In order to show the functionalities of GUIs in association with the corresponding peculiarities a tabular form was employed. In case of mental disorders such as autism wherein patients are tremendously introvert, not being interested in interacting with their environment, it was seen that graphical user interfaces, which comply more with features such aesthetic sense as well as feedback and forgiveness, have more promising impact.

However in case of physical disorders with regard to abilities such as “writing skill’ and “visual tracking”, it was observed that GUIs, holding peculiarities such as “directness” and “user in control” show a better result. Based upon the above-mentioned facts, it can be concluded that, for the patients with mixed disorders, it would be most promising to make use of (employ) a hybrid strategy with regard to the process of GUI design. In addition to this, hybridizing the peculiarities of different GUIs of software in such a manner has the potential to enhance caregiver’s ability of analysis with respect to the historical records of the patients.

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