

Computer as Therapy : in role of alternative and augmentative communication

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Abstract :

This paper continues in research of “computer as therapy” in which we have previously proposed the framework for the design, development, and use of new ways of interacting with computers for mentally challenged individuals. In this paper we continue in “computer as therapy” research aims with focus on design, development and use of application for alternative and augmentative on tablet computers for therapy purpose.

Keywords : *human computer interaction, e-learning, computer as therapy, tablet computers, mentally challenged*

I. INTRODUCTION

In last times we could be witnesses of boom of new touch devices (smart phones and tablet computers) which have found huge application in many fields including the field of primary/secondary school education and special education for mentally challenged individuals [1, 2]. Thus, rightfully the application of tablet computers in special education for mentally challenged was called “the revolution of special pedagogy” [1]. Based on these successes we have put several following research questions:

- Why previous technologies (e.g. PCs, notebooks, special keyboards, one-purpose assistive/special computers, and translators) were not able to find their way to mentally challenged?
- Why are tablet computers such successful in special education? What we can learn from its design?
- Is the application of tablet computers for mentally challenged strictly limited only on usage in school environment?
- How we can transfer the advantages of tablet computers for mentally challenged from the school environment to social, daily, natural living (creating therapy-like program plugged into their daily plans)?
- What other human computer interaction (HCI) factors we should also consider to make this therapy-like program more efficient, usable, and accessible?

As reply on these questions we have previously proposed the framework called “computer as therapy” [3]. This framework describes how the design, development, and use of IT should be done to obtain such HCI for mentally challenged which works as the daily therapy. In other words “computer as therapy” framework prescribes set up of HCI factors to receive maximal impact in the therapy with mentally challenged individuals. In this paper we focus on design, development, use and study of specific application for alternative and augmentative communication which was completely created according to “computer as therapy” framework. Consequently this application was tested in real environment of mentally challenged and processed into several use case studies. By this work we would like to

highlight the benefits of presented design, development and use in terms of HCI. But before we can move further to our application for alternative and augmentative communication let us first recall basic background of “computer as therapy” framework.

II. COMPUTER AS THERAPY BACKGROUND

A. General definitions

Therapy : by therapy we understand common meaning known from medical science which means application of the set of methods, techniques which are directly applied to reduce or compensate impact of negative deficiency or to minimize its causality on human [5]. For purpose of shorter naming we abbreviate “computer as therapy” as *iCT*, where *i* letter denotes intelligent and intuitive touch device like iPad and *CT* stands for Computer as Therapy.

Human computer interaction metrics (e.g. usability, usefulness) : here we understand the terms of human computer interaction (HCI) as defined by Nielson, see [6, 7].

AAC : alternative and augmentative communication is form of communication developed for mentally challenged with speech disability. In most cases it operates with paper cards with easy pictograms or photos which substitute some real objects. Since boom of touch devices (e.g. tablet computers) these AAC cardboards have been moved into AAC applications (software - SW) on tablet computers [4].

B. Computer as therapy general hypothesis

“By the proper synthesis of present demands and resources of IT, special education and social-health care (according to iCT framework, see [3]), the developed IT product is more useful – with stress on efficiency, memorability, satisfaction and accessibility.

Thus consequently, the developed IT product with better usefulness used according to methodological criteria of computer as therapy framework leads subsequently to higher therapeutic impact (i.e. therapy is sustainable as long term in natural social environment) in cases of intellectually disabled individuals.”

C. Computer therapy as research & therapy

In introduction we have noted the fundamental questions which led to proposal of “computer as therapy” framework (*iCT*). These questions led us to several areas – multidisciplinary approach, not clearly pedagogical, social-health care or clearly IT approach. As we can read in the hypothesis above, computer as therapy is area of HCI research where multidisciplinary area comes from special pedagogy, social/health care and information technology. As user is always in the centre of HCI research in *iCT* we also have to deal with the whole life cycle of each user (to be able to reflect user daily needs, demands). Thus in *iCT* we have handled 13 basic factors of HCI which are reflected as prescribed in *iCT* framework. These factors are divided into two main categories based on its origin demands, thus we finally distinguish computer science factors and human factors (covered by special education, social/health care demands). For illustration these factors includes e.g. criteria for accessibility (open source, freeware, multi-platform, native support) or usability (individual user account, administrator support, restrictions of functionality on application and operating system – OS levels). Overall we should note that “computer as therapy” is not just a theoretic conception.

Since 2013 “computer as therapy” have been implemented by author and personally performed, led by author as daily therapy program in home for mentally disabled in Czech Republic. As part of this practical therapy long term usability study was conducted. More than 30 mentally challenged individuals have been participated in this therapy program and the study. Some of observed the positive results, particularly confirming the *iCT* hypothesis have already been published in [3] and further results are currently being prepared for upcoming journal publication.

The *iCT* framework implementation and verification process is divided into two phases. In 1st phase we operate with modified today, available IT devices (hardware - HW) and SW which are modified as much as possible to fit the *iCT* framework. This phase was already mostly preformed as part “computer as therapy” practically implemented in Czech home for mentally disabled individuals, see [3]. In 2nd phase we try to overcome the lacking (limitations of today market available designs) observed during the 1st phase. Thus in 2nd phase we overcome limitations of today market available designs and operate with our own designs, development (HW or SW) fitting the *iCT* framework as much as possible. The 2nd phase as part of *iCT* framework implementation and verification process has also been particularly conducted. In this 2nd phase we have already indentified specific limitations of applications for communication for mentally challenged which are also in contrast with HCI factors expected by *iCT* framework. Thus we have consequently identified and proposed set of three applications for communication which should be designed first. These applications were implemented by faculty students BUT FIT (Brno University of Technology, Faculty of IT) as bachelor or master thesis in previous academic year 2013/2014. These students’ projects were led by author as expert supervisor and by academic supervisor too. One of these developed applications is the application for alternative and augmentative communication (AAC) which is main subject of this paper.

III. COMPUTER AS THERAPY IN ROLE OF ALTERNATIVE AND AUGMENTATIVE COMMUNICATION

A. AAC in general

The intellectual disability is often followed by combined defects including sense and motor defects. One of these common defects is also the speech disability. This defect is often observed at moderate and hard intellectual disability. Even if mentally challenged individual is able to understand natural speech he may not able to produce the natural speech by his own capabilities. In all these cases we need to overcome this disability by tools and methods of AAC, which is much simpler than sign language (too complex for mentally challenged). Until recently AAC tools were made as paper/cardboard cards with pictograms or photos specifically designed for each mentally challenged individual. By boom of touch devices (e.g. tablet computer) these AAC cardboards are often replaced by an AAC application (SW) which can be easily modified, renewed to fit individual AAC needs [4] including specific educational needs (SEN).

B. AAC applications from point of HCI factors

If we go through the set of today market available AAC applications for tablet computers we can identify some critical HCI issues which should be solved and may be solved by *iCT* framework redesign. In table I. we compare

important functionality of AAC representative applications from point of related HCI factors. Our designed and developed AAC application (according to *ICT* framework) is called **Easy-Talk**, see below for detail.

TABLE I. AAC APPLICATION HCI FUNCTIONALITY COMPARISON

AAC application	Important AAC application functionality related to HCI factors								
	<i>Admin. support</i>	<i>User accounts</i>	<i>Multiplatform, native</i>	<i>Editor</i>	<i>Sentence history</i>	<i>Drawing canvas</i>	<i>Text input</i>	<i>Price</i>	<i>Open source</i>
Easy-Talk	YES	YES	YES	YES	YES	YES	YES	0	YES
Klabosil	NO	NO	NO	YES	YES	NO	NO	0	NO
Niki Talk	NO	NO	YES	YES	NO	YES	YES	1	NO
C.P.A.	YES	YES	YES	YES	NO	NO	NO	0	NO
Grid Player	NO	NO	NO	YES	NO	NO	NO	1	NO

- a. Admin. support: protection of setting from unwanted changes caused by mentally challenged individual
- b. User accounts: app. may use multiple users, individual setting should be supported for each user
- c. Multi-platform and native: application can support usage on different platforms (e.g. iOS, Android, Windows 8), application runs natively on device without internet connection (not web based app.).
- d. Editor: application should allow to edit the pictograms and pictogram categories
- e. Sentence history: enable user to recall and apply previously used sentence
- f. Drawing canvas: enable user to draw own pictogram if is not available in any category
- g. Text input: enable user to type text if appropriate pictogram is not available in any category
- h. Price: denotes whether AAC app. (within an editor) is completely free or not (0: YES, 1: NO)
- i. Open source: denotes whether the AAC application is distributed as open source or not

As we can see in the table I. each AAC application supports some of HCI key factors which are important for usability or accessibility issues. We claim that all of these listed factors are fundamental (fundamental for interaction with mentally challenged individuals) that is why all of these factors are also handled by mentioned *ICT* framework. But unfortunately none of today market available AAC applications handle all of these listed factors as expected. Hence based on *ICT* framework requirements we proposed such AAC application which supports all of these key issues. Consequently, needed AAC application, called **Easy-Talk** was designed developed and finally tested as part of student's master thesis (under author's expert supervision).

C. *Easy Talk in role of AAC application for tablet computers*

Here we describe the functionality of our AAC *Easy-Talk* application to be able to highlight its benefits for interaction with mentally disabled consequently. For detail functionality description of *Easy-Talk* application see student's paper [8]. The composition of *Easy-Talk* application working desktop is shown on Fig. 1.



Figure 1. Easy-Talk application working desktop. Category and pictogram selection area is separated by different visual boarding.

Categories are separated from proper pictograms by yellow background (customisable). Control panel is sliding. Beside navigation control panel contains SETTING button, DRAWING CANVAS and TEXT INPUT buttons.

Easy-talk app. was designed and developed according to object-oriented paradigm by using Oracle development tools (jDeveloper) within the extension (plugin) called ADF mobile (currently renamed to Oracle MAF – Mobile Application Framework), see [9]. Oracle MAF is available as free and supports multi-platform application development (currently iOS and Android) based on MVC architecture which corresponds to *iCT* framework requirements. By multiple-platform support mentally challenged individuals are not fixed at one tablet computer manufacturer and can use their AAC application on different platforms. Thus individuals have an option to choose proper HW platform which is better fitting to their needs and which is currently available (at current time, place and price). As noted in table I. our Easy-talk app. is designed to support administrator account and multiple user accounts too. In practical interaction it means that each curator (e.g. parent, social care worker, teacher) can manage individual settings (visual theme, category and pictogram vocabulary) for each of his wards (mentally challenged individuals). Thus each individual user is protected from unwanted changes in setting (e.g. accidental deletion of all vocabulary) and in parallel each user can operate with own profile according to his SEN. By this way of design tablet computer within AAC app. can be also shared for multiple users. Fig. 2. shows option of expressing of pictogram by drawing canvas (on the left) and user account administration, each user has his own profile with his categories and pictograms (on the right). Next key HCI factor handled by *iCT* framework is distribution of app. as freeware. Hence Easy-Talk application is distributed as freeware and open-source in parallel. Even a common AAC application may not be very expensive (e.g. Niki Talk full version - 49 EUR) for many mentally challenged individuals such price makes AAC

application inaccessible. Further there is a factor of application sustainability, modification, extensions, and development. If the application is distributed as opensource we are not dependent only on the creator (company) of an application but we can try to modify, extend it by ourselves (if possible) or ask someone who may handle it for us. Thus there are more degrees of independence for achievement of user satisfaction. In result this again increases the accessibility of AAC application (e.g. there is independence in option of app. modification for aiming individual SEN).

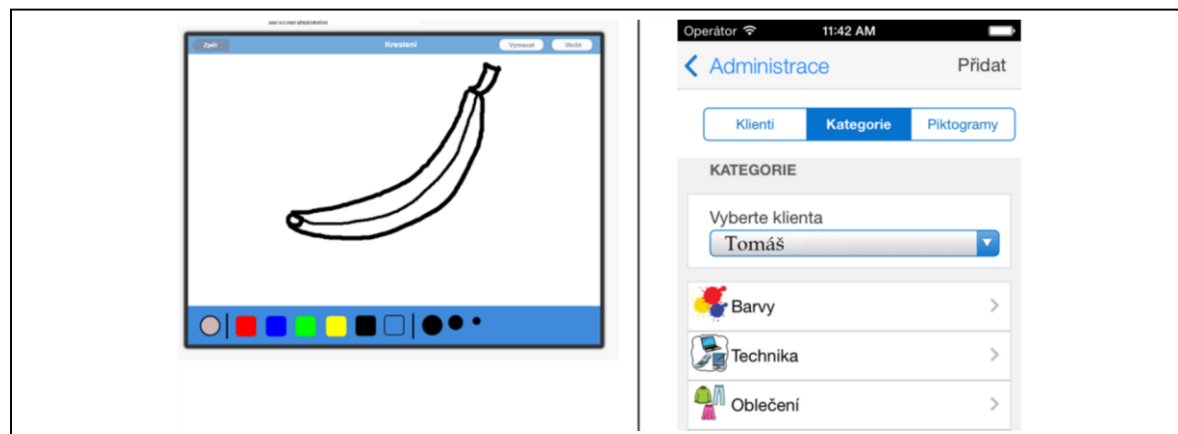


Figure 2. Expressing of pictogram by drawing canvas (on the left) and administration of user account (on the right). Each user has his own profile with his categories and pictograms. Here user account administration has Czech localisation but app. language is customisable too.

Finally, based on presented characteristic of *Easy-Talk* application with reference to *iCT* hypothesis we claim: **“If design and development of an AAC application is extended according the *iCT* framework as presented (with focus on HCI factors related to price, multi-platform, open-source, administration, user accounts support) the observed AAC application is consequently more accessible and usable.”**

Based on previous justification we consider this claim as true and obvious without need of proof. But to show how our real *Easy-Talk* application is more accessible and usable in detail we should present here the complete user study with independent groups using different AAC applications (within *Easy-Talk*) on the same prepared tasks. But because we cannot present such study in this short paper, we will just present *Easy-Talk* simple case study here (usability testing with small target group).

IV. EASY-TALK APPLICATION IN CASE STUDY ON USABILITY

A. Case study description

In this case study 3 different mentally challenged individuals from Czech home were participated. All of these participants have an experience with tablet computers. Briefly participants can be described as following:

- **Maria:** moderate mental disability, Down syndrome, poor articulation, unintelligible speech, Maria has already participated in computer as therapy program with focus on AAC application (Klabosil).
- **Paul:** moderate mental disability, unintelligible speech, Paul has already participated in computer as therapy program but with focus on reading training. Paul has no experience in using of AAC application.
- **Thomas:** moderate mental disability, poor articulation, strong diopter, Thomas has already participated in computer as therapy program but with focus on reading training. Thomas has no experience in using of AAC application.

Scenario: each participant is asked by set of prepared questions (representing normal dialog common for participants) and each participant is asked to give a reply through *Easy-Talk* AAC application. *Easy-Talk* app. is preinstalled on „Samsung Galaxy Note” tablet computer with 10.1-inch touch screen. Given questions and participant’s success rate is described in table II.

TABLE II. CASE STUDY ON EASY-TALK AAC APPLICATION USABILITY TESTING

Given questions	Participants and their success rate		
	<i>Maria</i>	<i>Paul</i>	<i>Thomas</i>
1. How do you feel?	0	1	2
2. What do you wear?	1	1	2
3. What is your favourite color?	1	2	2
4. What is your favourite food?	2	2	2
5. What is your favourite drink?	2	2	2
6. What is this? Pointing on phone.	1	2	2
7. What is this? Pointing on DVD.	1	2	2
8. What is this? Pointing on radio.	1	2	2
9. What is this? Pointing on tablet computer.	1	2	2
10. What is this? Pointing on PC.	1	2	2
11. What is this? Pointing on camera.	1	2	2

- First 5 questions are formulated to represent normal dialog, common for mentally disabled participants.
- In cases of “What is this?” questions we test whether the participants are able to map recognized realworld (pointed) object to AAC abstraction substituted by pictogram in specific category.
- Coding: 0 denotes no reply, 1 denotes reply with help (giving a hint in which category the pictogram should be located), 2 denotes full reply without help.

B. Case study findings

As we can see in the table II, Thomas was able to manage all questions alone even without AAC app. experience. Paul has demonstrated almost the same success rate as Thomas (also without any previous experience in AAC application).

Maria was able to manage given of questions but almost with help (pointing at category containing the target pictogram). She was not able to concentrate as Paul and Thomas were. Nevertheless Maria was able to manage the most known questions (“food and drink”) completely alone too, see Fig. 3 for detail. At this simple case study we have shown that even non-AAC educated mentally challenged (moderate) participants were able to access and use presented *Easy-Talk* app. as AAC app. for communication. Participants were able to understand application usability which was accessible on tablet computer.

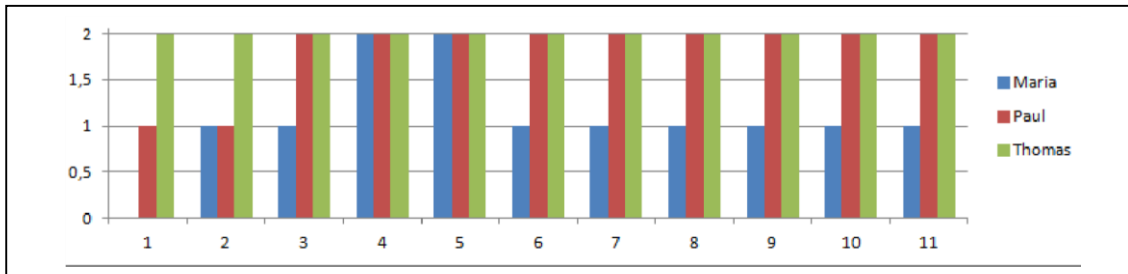


Figure 3. Graphical expression of participant’s success rate. Numbers 1 to 11 denotes no. of questions according to table II.

V. CONCLUSION

In this paper we have continued in previously proposed research on “computer as therapy” topic. In this contribution we specifically focused on design, development and use of ways of interaction for mentally challenged in AAC on tablet computers. From point of HCI with reference to *iCT* framework we have indentified key factors which we identified as fundamental and thus should be reflected, handled in “every good” design of AAC application for mentally challenged individuals. We have also justified the advantages of such design from point of HCI metrics (usability and accessibility).

To show the real contribution of such design and development we have also presented real implementation and usage of AAC application called *Easy-Talk*. Finally, for purpose of this short paper we have presented simple case study to show practical usability aspects in real environment of mentally challenged users. Beside the usage in special education (e.g. learning, educational too) we expect that our proposed AAC application can be used in daily common program of mentally disabled as therapy tool too.

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