Development of Software for Users with Specific Disorders

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Abstract: *The paper deals with possibilities of information technologies when improving communicative skills of children with specific disorders, such as autistic spectrum disorders, Down syndrome, mental retardation, etc. The development of an application stemming from the communication system PECS (The Picture Exchange Communication System) and its Czech variant VOKS is the base of this paper to show specificity of the development and verification of software for the given group of handicapped users.*
Key words: *Application, autism, Down syndrome, mental retardation, PECS, VOKS, testing*

INTRODUCTION

Use of information and communication technologies has reached massive expansion recently. Computer users are to be found in every social and professional group. Computers simplify a lot of work tasks, make methods of communication easier and more accessible, intermediate new information, etc. These modern technologies can play a role of important supporting and compensational means for a group of users with specific needs. It is mainly people with some mental and health problems who face difficulties with communication, and common means of communication are usually unusable for them. Computers can act as a positive agent in such cases. However, hardware and software must be adjusted to the specific needs and it is not possible to implement experience gained and applied with common groups of users.

There is a potential group of users with specific disorders who could make use of the development of communication skills. E.g. people with autistic spectrum disorders, Down syndrome, forms of mental retardation and other development defects which cause problems to learn and use spoken language, written text, and other commonly used means of communication. Various methodics bringing interesting results have been worked out to develop communication skills of people with the above mentioned disorders. For instance, such methodics is the system PECS (The Picture Exchange Communication System) and its Czech variation VOKS. The base is a use of pictures representing particular concepts, things, activities. The user gradually becomes familiar with new concepts – pictures, which are then incorporated in their list. Choosing pictures and placing them on a sentence strip helps them learn to create even simple sentences. [3]

In 1998, the Department of informatics and computers, the University of Ostrava, decided to help interested people with a health handicap. The first stage was to support the study of people with hearing impairment; the department introduced a distant form of studies in the bachelor programme Applied Informatics. The distant form of studies enabled the deaf applicants to join the study. The distant form and study fields proved to be interesting even for applicants without health handicaps and currently there is a great concern over both distant and combined form. The university support of the study for applicants with health impairments is still being developed, e.g. in the area of projects focused on support of health handicapped students, special educational courses, development of accessible web, and recently in cooperation with special schools in the development of communication software for children with specific disorders.

METODICS FOR LEARNING

Based on the requirements from special school, we are developing an application which should facilitate communication with a child with specific disorders such as autism, Down syndrome, mental retardation and others. Autism is a mental handicap which demonstrates in worsened communication skills. Speech formation of people with

an autistic spectrum disorder is delayed and some of them do not speak all their life or they use only limited number of words, frequently corrupted. Several methodics to improve their communication skills have been developed. [10]

One of them is the PECS methodics created in 1985. It is an alternative education and communication method for communication between an adult and a child handicapped by autism, mental retardation, and other specific disorders. [11] The fundamental principle is an exchange of a picture representing a particular thing for a real one. Continuous practice leads the child to learn how to use concepts correctly and improve its communication skills. The whole process is emphasised by stimulation. For instance, the child gets a chocolate if it brings the correct picture. Follow-up education leads not only to knowledge of pictures – concepts, but also to composing a short sentence from the pictures. The last phase of education encourages the children to comment independently the action around them and to answer direct questions. The system also helps some pre-school children to develop speech. An elaborate methodics of work with a system provides six training phases with examples, manuals, and advice [1] [2].

The Czech system VOKS mainly stems from the methodics and principles of PECS. However, it brings some improvements and it tries to adjust to particularities of the Czech language. Unlike PECS, it emphasises visual support of speech of both communicating partners. Thus there are changes to basic situations in all lessons. The methodics is divided into two basic parts. The first contains important information concerning teachers of the VOKS system and training environment. In addition, it describes preparation of individual tools for communication and the way of reward choice before the whole training of the communication begins. The second part contains educative lessons, which form the backbone of the education. The client learns to ask spontaneously for a favourite thing in exchange for a picture, to go on his own to the symbol container to get a picture and then to hand it in subsequently to the partner. They learn to ask different people about anything in an unfamiliar environment, to choose appropriate symbol from several pictures, to complete correctly a simple sentence on a sentence strip using pictures and then to ask by help of the sentence strip. Finally, they learn to react to various questions and to comment on the environment around them. The supplementary lessons then develop picture inventory and syntax [6].

Experience with this system proves that the children evidently improved their communication skills, as well as those who did not have any communication skills before application of the VOKS system. A number of children faced other problem, though. The users started to handle more concepts – pictures. Their container – book, where the pictures are attached by velcro, became very bulky and physical manipulation got difficult for the children. With respect to this fact, there was a requirement defined to develop a software application in order to solve these problems. There are several programmes for the PECS system, e.g. Boardmaker [12]. Yet, this does not meet the chosen methodics, moreover its cost (300$ up) is high. Another similar application is Overboard. Applications usually contain several thousands of colour or black-and-white pictures, which can be chosen from various categories. However, the education progress and work with the programme is not focused a particular methodics and thus there is a higher need of teacher's technique [8].

When developing and implementing for users with specific disorders, it is usually necessary to use other procedures and methods than with common applications. The target group requires totally different approach taking into consideration their health or mental handicap.

The most striking difference is in the programme control. Embedded standards and procedures are often inappropriate or unusable. Users with specific disorders often cannot use common control mechanisms which are being used in applications of

contemporary operating systems. Their creators try to build up work area of a specific application as large as possible, but control features (close, minimize and maximize, menu offer, etc.) are as small as possible.

APPLICATION VOKS

When designing a new application environment, it was necessary to get rid of all control features which were not directly related to the main use of the programme, and which could lead to early closing, new configuration, initialisation of new actions, etc. A lot of children find difficult to concentrate on realizing the needed performance. They frequently unwillingly click the mouse or wander the cursor round the screen. Thus it is highly important that children could not consciously or by mistake initiate functions indirectly related to the course of the programme.

The application control must not be demanding, unclear, or complicated at all. Generally common activities (such as double-click on a mouse) are almost impossible for numerous users with specific disorders. The control features of the programme must be conveniently large and their start-up and control as easy as possible. An ideal case would be if the application, having been opened, took up the whole screen of the desktop, being maximized all the time with no possibility of any change. The use of the mentioned software counts with the use of special hardware to control the computer. Users with motor handicap are e.g. supplied with IntegraSwitch, which works as an aspiration-expiration switch. Classical mice and keyboards are replaced by alternative positioning devices and keyboards, such as BickTrack, KidTrack, Roller Joyistick, BigKeys, IntelliKeys, various sensor buttons, and others. The main advantages are larger control features and more robust construction. On the other hand, the disadvantage is usually the price which exceeds several times the price of commonly used hardware. Purchase of such special devices can become unaffordable for many families with handicapped children. The solution could be use of touch screens, e.g. in new types of computers generally called nettops. It is a kind of cheaper computers containing all parts in one case together with a touch screen. The user can control the applications directly on the touch screen, which seems to be more convenient especially for children with specific disorders than using mouse or other positioning devices. Some children have motor problems when using mouse, moreover they have problems with moving the mouse while concentrating on another place - on the screen. Nevertheless, despite all of the above mentioned special hardware tools, it is convenient to create the developed software in a way to be usable even on common desktops, or notebooks with their usual peripherals.

An application for children with specific disorders requires two basic parts. The first one – a functional part designed for children. The second serves to their parents or health workers for configuration and setting. With respect to diverse requirements of the target users, it is necessary to enable clear, but sufficiently complex and extensive setting offers. Unlike common applications, requirements on functionality and look of an application for particular individuals are often very distinct and influenced by health or mental problems of the child.

With respect to the fact that the programme VOKS and similar teach the user to communicate, they act as a learning software in the first phase. The application tries to use the VOKS methodics and it contains several levels and phases of usage fully corresponding to the chosen methodics.

- Level one – the user learns to choose the picture by clicking. The desktop shows only empty fields and one picture which has been randomly chosen from a pre-defined group of pictures – concepts. The child's task is to click on the picture. The programme monitors all clicks in the empty fields and the information is saved in an XML file. During the development and verification of the application, we have

found out that it is not convenient to use classical way of control and distinguish clicks by left or right button. Children with certain disorders find work with mouse itself motorically very demanding, so the button distinction was rejected. Adding sound to the picture proved to be an advantage, though. Support of other sensation makes the process of learning easier.

- Level two – the user sees two pictures. One represents positive, pleasant emotions and feelings, the other negative. The child learns to choose the picture connected with positive emotions.
- Level three – having mastered the two previous levels, the vocabulary of the users expands and individual concepts – pictures are classed in categories, which differ in colour. The child learns to choose concepts from the categories and places the pictures onto a sentence strip.
- Level four – serves for independent communication and the users composes short sentences and sequences using concepts from different categories. At first, the sentence strip enables the child to form simple sentences such as "I want a chocolate", etc.
- Level five – increases communication level and enables to create a picture, description of events and situations.

The first three phases of programme usage primarily serve to learn how to control the programme and to get acquainted with the pictures and their content. It is highly important to observe activities of the user. This happens on two levels. The first is observation of the parent, tutor, or health worker who teaches the child how to use the programme. The second is built-in monitoring in the programme itself. Each activity is stored in the XML data file format. Subsequently, it is possible to retrieve information about which pictures are difficult for the user to be understood, which are not mastered so well by the users, which position on the screen is problematic to reach, etc. This information can serve not only to the tutors, but also to the creators of the programme for eventual improvements.
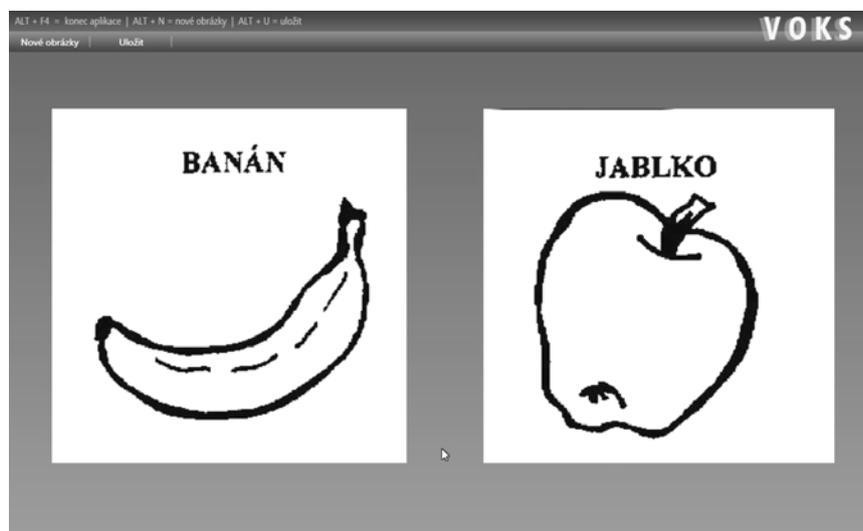
Image 1 – Interface of application

When developing an application, the creators must primarily cooperate with the health workers and professionals in the given methodics. For example, the VOKS methodics of the developed programme is so specific and demanding that it is important to understand and master it. Failing this, the programme might not meet its purpose. Creators of a programme must free of common stereotypes and familiar processes, which are mostly unusable with this specific group of users. It proved right when the VOKS application was being developed. It was often necessary to consult the staff of

special school and to adjust the interface and functionality of the application. The need to monitor children in their usual activity showed to be essential. Such experience gained by monitoring of the children was important for the creators of the programme. When developing an application for handicapped users, the creators cannot fully rely on their previous experience. Due to the fact that application developers do not have a direct contact with children with autistic spectrum disorders, Down syndrome, mental disorders, and other very specific disorders, it is important to get familiar with practical reactions and behaviour of such children.

The situation is then complicated by individual ways of behaviour, which relates to the extent and level of the disorder.

PROGRAMME TESTING

Hand in hand with an increase in requirements and properties of software tools, there is a need of appropriate and profound testing. Despite the fact that the above described programme does not include any complicated functional structures or algorithms, and work of complicated and expensive devices is independent of its activity, it is necessary to secure its high reliability. Children suffering from e.g. autism find difficult to get used to a new environment and unfamiliar things. The time needed for the child to accept the programme and learn to work with it is usually very long. In case of serious disorders, there is a danger that the child will decline it or refuse to work with it. During testing of an application by children, there should not be any fundamental adjustments of the graphical interface and its control. Apart from classical procedures of testing of the programme functionality, it is important to observe how the child masters the application. It is not enough to use only usual static and dynamic testing means, analysis of the source code, monitoring by testing programme, special tests on memory usage or load, etc. [6]

Thus the application incorporates internal mechanisms which monitor user's activities. Monitoring data about manipulation with programme objects are stored in XML files. The application contains an interface designed purely for parents and health workers which enables to evaluate both child's skills to work with the programme and its functionality. The output data then acts as a feedback for the creators of the programme as well as for parents and health workers, who can adjust the process of education more effectively. Another way to verify the programme functionality is methods used in quality oriented pedagogical research. It primarily concerns the method of observation [4]. The children use the application together with the parents or health workers. The adults act both as a pedagogue, who teaches the child to use and communicate with the programme, and an observer, who check for reactions and skills of the child. The observation results are very important not only for the educational process, but also for the development of the programme.

Unlike commonly used software, there are specific problems when testing:

- The target group of users is not large enough.
- The target group of users is very diverse and the level of the disorder considerably influences ability to work with the programme. It is necessary to take into consideration individual needs of the users and to enable more possibilities of setting and adjustment.
- The phase of learning how to use the programme is very time consuming. This results in longer period of testing than with usual applications. Children with higher level of disorder can take months to pass from one phase of the programme to another.
- It is important to largely cooperate with parents and health workers because the children find difficult to get used to changes in environment and unknown people.

CONCLUSION

Concerning the fact that the target group of users of the described software is not very large, forming a relatively small sample, it is advisable to offer it a quality solution. People with specific disorders are mostly dependent on supporting tools and means. It appears that information and communication technologies offer a way to improve their life standard. They enable to create tools which were not possible when using common approaches or they were very difficult to realize. When creating software for children with specific disorders such as autistic spectrum disorders, Down syndrome, mental retardation, etc., it is necessary to cooperate with doctors, psychologists, and health workers. It is the area of programme control where the creators of programmes must apply totally different criteria and processes than with common applications. Testing of the developed software is more complicated, time consuming, and apart from common code testing processes and application functionality, it also requires observation of its users.

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