

A proposal for e-learning software for children with cerebral palsy

¹Muhammad Adeel Ghafoor, ²Zeeshan Tufail

^{1,2}Army Public College of Management and Sciences, Rawalpindi, Pakistan

Email: adeelghafoor48@yahoo.com, shanitufail2@gmail.com,

ABSTRACT

Cerebral palsy (CP) is a disorder of physical body movement and posture caused by a lesion or injury of the immature brain. Many children with CP frequently develop learning disabilities. A child with learning disability has an average or above average level of intelligence. Other than that, the brain damage that leads to CP can also lead to other health issues, including vision, hearing and speak problems, and learning disabilities. As a result, the system or applications that must be developed for children with CP must focus on their limitations and requirements, which can give the user a useful way of learning process. This research papers focuses on an e-learning software system that enhances the learning capabilities of children with CP.

Keywords: e-learning software; software engineering; cerebral palsy; software applications; software development;

1. INTRODUCTION

Cerebral palsy (CP) is a disorder of physical body movement and posture caused by a lesion or injury of the immature brain. CP is a condition caused by injury to the parts of the brain that control our ability to use our muscles and bodies. Cerebral means having to do with the brain. Palsy means weaknesses or problems with using the muscles. Often the injury happens before birth, sometimes during delivery, or soon after being born. Physical symptoms typically appear in the first few years of life. Infants with CP are frequently slow to reach developmental milestones such as learning to roll over, sit, crawl, smile, or walk. Other than that, the brain damage that leads to CP can also lead to other health issues, including vision, hearing and speech problems, and learning disabilities. As the result, the systems or applications that are required to develop for children with CP must focus on their limitations and requirements, which can give the user a useful way of learning process [1]. CP is one of the three most common lifelong development disabilities, with prevalence rates ranging from 1.5 to 3 per 1000 live births [8]. CP is the leading cause of childhood deformity and the second leading cause of severe mental retardation [9]. Children with CP have an increased prevalence of associated comorbidities, including intellectual disability (52%), epilepsy (45%), speech/language deficits (38%), vision impairment (28%), and hearing impairment (12%) [10].

2. LITERATURE REVIEW

CP is the disease which attack on cerebrum of children because of these attacks children suffer from learning disabilities. This disease is the cause of physical body movement, injury of immature brain and pre-mature birth. Often the injury happens before birth, sometimes during delivery, or soon after being born. These disabilities have different kinds and to compete with these disabilities we develop application which help the children in their education career and enhance their learning level with different kinds of concepts.

Education system is the most important basic need of every country. Education is the backbone of a country roots. Education systems vary society to society. In every social system education play important role to take that nation on glance. Thus, the biggest purpose of every developed nation is to provide better schooling and best education system. A country with good educational system must be with good cultural values in education and is the strength of a country roots. Education systems differ from one society to another society. In every social system, education plays an important role to take that nation on glance.

Physical symptoms of CP typically appear in the first few years of life. Infants with CP are frequently slow to reach developmental milestones such as learning to roll over, sit, crawl, smile, or walk. CP occurs in 1 in every 300 children (Source: Center for Disease Control). CP can be mild, moderate, or severe. Mild CP may mean a child is clumsy. Moderate CP may mean the child walks with a limp. He or she may need a special leg brace or a cane. More severe CP can affect all parts of a child's physical abilities. A child with moderate or severe CP may have to use a wheelchair and other special equipment.

Children who have a learning disability like autism then that is very thoughtful impairment in emotional, societal and communication skills and that need a high degree of personalization in using the learning software development for victim of CP. There are different methods that are adopted to build the application like Block Based method, the purpose of this method is to allow the end users like the parents/guardians or instructors to develop the application or software that fulfills the different needs of an autistic child.

The term learning disability defines the comprehensive group of developmental disorder and shortfall in learning in more than one domain which can include reading, writing and mathematics [2]. Everyone may be identified having learning disabilities like dyslexia, dysgraphia, dyscalculia, or attention deficit disorder or genetic growth disabilities like autism, down syndrome, Congenital birth complexity like fetal alcohol syndrome, or many of other type of ill-health affecting intellect [3]. Children with CP may have difficulty in reading, spelling, reasoning, recalling and organizing information. Parents can help their children who have such disabilities to get the success by knowing their strength, knowing their weaknesses, awareness of the educational system of special children, working with experts and learning about strategies with specific difficulties. For the social behavior education computer software is being used. Children find different kinds of scenario in which involve character problems in social struggle. Researchers are used to animated characters that simulate to describe the interactive behavior or human communication like speech, facial expression and gesture.

Computer applications or software are more helpful and play an important role in the education of the children that are the victim of autism. However, there is no software that customizes the need of the different autism's end-users. The victim children of autism require a high customization and personalization in the studied base software. The one of the approach in block based that is component based. The component based techniques define the modules of available interfaces of software which provide different related services. In component based techniques every component is in ready to use form. The major crises in recent software are defective products, missed schedules and exceeded budget. Component based software development is a hopeful solution for the software crises and gets the considerable attention in software industry [2]. According to Nierstrasz and Dami [4], the aim of this technique is to get element from a group of reusable components such as component on the shelf and make the software by plugging the component together. Its purpose is to develop high qualities software in time effectively by adopting a cost effective development cycle. Through this technique the product requirement can be changed easily. In this technique following important facts are given due considerations.

- There are many blocks that will be available for the problem domain.
- Every block supports a specific task and function.
- Users can change block and develop the application by adjusting it to their needs.
- Any application can be developed by combining these blocks.

There is another approach named as framework technique and is being used when system product requirements change rapidly and also in the incremental development by applying the guidance and later upgrading the application. This technique is more useful for the software that is built by 3D or 2D animation. There are many problems in framework technique but the main problem is documentation. Newcomers should look at visible issue in the existing software and this is not solution of all the problems. If using framework, then study and verify the document if there is authentic explanation of good quality. Programmer should observe the software that is being developed and expensive spent on the developmental process.

Parent involvement in children's learning process is directly linked with children higher academic achievement in school. This research focuses on framework which outlines an integrated parent information system (SMIB) to mediate the parents and their children's academic achievement plus school activities information. According to the framework, the components include the parents, teachers and school administrator module and they can communicate with each other at the same time. Functionally, SMIB's main focus is to provide comprehensive tutorial and notes. These knowledge resources aid the parents in guiding their children throughout the learning process effectively especially in homework.

Initially, PIBG act as the main medium for the schools in Malaysia to sustain relationship with the parents as well as supporting their involvement. PIBG is a compulsory event employed at every school in Malaysia. The main agenda in PIBG is an annual meeting attended by parents and teachers. Via the meeting, parents and teachers discuss on school issues, event and performance throughout the year. Alternatively, a meeting between parents and teachers is

set up by schools at every end of terms examination. During the meeting, teachers will explain about the children's result and discuss with the parents about the children's weaknesses and how to overcome the problem. The problem arises when both of the PIBG and end term examination meetings still could not optimize the parent's involvement. Both of the meetings require the parents to physically present at school. Besides, the meeting is usually conducted during working days. Due to the hectic lifestyle especially at the online homework activities require a big shift from the traditional homework method to a new online homework method which will involve changing of policy, standard and implementation. The needs of parents in educational environment must be addressed carefully. Time, method of implementation, effectiveness and efficiency must be taken into account. Basically, the children's academic information is successfully disseminated to parents. A report writing software is a special purpose software used to inform parents about their children's academic information. The software helps the teachers to prepare end of year report effectively and at the meantime provide the parents with standard and reliable report.

A survey is being conducted and it is found out that 80% of respondent always help in their children's learning at home, 20% help sometimes and none of them never help the children's learning at home. Most of the parents are still practicing traditional ways to get information concerning their children in school. 40% of the parents present at school to meet the teachers, 32% via PIBG, 12% schools contact the parents through letters or telephone, 10% contact teacher using telephone and 6% through the school's website. On the other hand, 52% of the parents face difficulties in helping their children at home. The survey identified that 43% of the parents are lacking of knowledge on a particular subject, 23% are lacking of reference resources, 17% are lacking of self-confidence, 10% are facing difficulties in understanding reference resources and 7% have none reference resources. Based on that, the parents are asked whether they agreed if a parent information system could solve their problem. 56% strongly agree, 43% agree and 2% disagree. Music therapy is one of the ways to help out the children with CP and victim of autism. Due to this therapy they are able to do different kinds of tasks because due the music therapy children with CP and autism not only enjoy they learn in a meaningful way.

One of the best research that was conducted by the Av. Prof. Ascendino Reis, 724 Vila Clementino - 04027-000 - São Paulo - SP – Brasil. In this research colored cards with graphic symbols are being used and these colored cards replace the music keyboard for better understanding for the children with CP. Disparately the keyboard composed of unchangeable and the fix key. Every card represents different note. Every card has a specific symbol and detected by the system and related to a sound and specific pitch that help the patient for understanding. Patient can play different types of sound with the help of graphics cards like violin, flute, guitar and trumpet. Virtual cube is attached to every card and the potential of the software in rehabilitation process. According to the American Music Therapy Association [5], the main purpose of the musical therapy is not to teach the music to children with CP and no previous instrumental skills are necessary. The purpose of the music is to able the patient and give him a chance to communicate with the others with confidence [6]. Many children face many difficulties for example some face difficulty to open hands, mobility, and to play piano etc. some are little in mobility in arms and legs and able to play piano [7].

3. SOFTWARE AND EDUCATION

The use of computer software in the education department and training dated back in the early 1940s. When American scholars developed flight simulators which used analog computers to produce simulated on board instrument data. One such system was the type 19 synthetic radar trainer, built in 1943. From these early attempts in the WWII era through the mid-1970s, educational software was directly tied to the hardware, usually mainframe computers, on which it ran. Pioneering educational computer systems in this era included the PLATO system (1960), developed at the University of Illinois, and TICCIT (1969). In 1963, IBM had established a partnership with Stanford University's Institute for Mathematical Studies in the Social Sciences (IMSSS), directed by Patrick Suppers, to develop the first comprehensive CAI elementary school curriculum which was implemented on a large scale in schools in both California and Mississippi. In 1967 Computer Curriculum Corporation (CCC, now Pearson Education Technologies was formed to market to schools the materials developed through the IBM partnership. Early terminals that ran educational systems cost over \$10,000, putting them out of reach of most of the institutions. Some programming languages from this period, particularly BASIC (1963), and LOGO (1967) can also be considered educational, as they were specifically targeted to students and novice computer users. The PLATO IV system, released in 1972, supported many features which later became standard in educational software running on home computers. Its features included bitmap graphics, primitive sound generation, and support for non-keyboard input devices, including the touch screen.

The arrival of the personal computer, with the Altair 8800 in 1975, changed the field of software in general, with specific implications for educational software. Whereas users prior to 1975 depended upon university or government owned mainframe computers with timesharing, users after this shift could create and use software for computers in homes and schools, computers available for less than \$2000. By the early 1980s, the availability of personal computers including the Apple II (1977), Commodore PET (1977), Commodore VIC-20 (1980), and Commodore 64 (1982) allowed for the creation of companies and nonprofits which specialized in educational software. Broderbund and The Learning Company are key companies from this period, and MECC, the Minnesota Educational Computing Consortium, a key non-profit software developer. These and other companies designed a range of titles for personal computers, with the bulk of the software initially developed for the Apple II.

Major developments in educational software in the early and mid-1990s were made possible by advances in computer hardware. Multimedia graphics and sound were increasingly used in educational programs. CD-ROMs became the preferred method for content delivery with several digital encyclopedias released as Multimedia application CD-ROMs. With the spread of the internet in the second half of the 1990s, new methods of educational software delivery appeared. In the history of virtual learning environments, the 1990s were a time of growth for educational software systems, primarily due to the advent of the affordable computer and of the Internet. Today Higher Education institutions use virtual learning environments like Blackboard Inc. to provide greater accessibility to learners.

4. EXISTING SYSTEM

Our system is localized based system. Such kind of system or application did not exist in Pakistan, if any then that is so expensive and unaffordable for the institute that works for the rehabilitation of children with CP. Previous education system was very costly and unbearable and complex and the instructors' involvement is continuous with the victim child. The control of existing systems, for children with CP, is difficult and complex. Moreover, the existing solutions are highly costly, more specific and are not viable for institutes of Pakistan. Parent involvement in children's learning process is directly linked with children higher academic achievement in school. This research focuses on framework which outlines an integrated parent information system (SMIB) to mediate the parents and their children's academic achievement plus school activities information. According to the framework, the components include the parents, teachers and school administrator module and they can communicate with each other at the same time. Functionally, SMIB's main focus is to provide comprehensive tutorials and notes. These knowledge resources aid the parents in guiding their children throughout the learning process effectively especially in homework.

4.1 Criticism on existing solutions

- Existing systems are complex and purely instructor based, no one can operate easily.
- Only usable for institutions
- More than one instructors require to operate
- More expensive

4.2 Weaknesses of existing systems

- Need three supervisor or therapist to control and conduct the game.
- The systems are often expensive making not impractical for the clinical and home setting.
- Some are Specific for only car games.
- The video was designed for upper limb rehabilitation robot for children with CP that cannot meet the targets.
- Music therapy session need a supervisor to control and guide.
- Some existing systems did not serve as a therapeutic

5. PROPOSED SOLUTION

The control of existing systems, for children with CP, is difficult and complex. Moreover, the existing solutions are highly costly, more specific and are not viable for institutes of Pakistan. Our proposed solution is part of an ongoing research of R & D Department to develop an indigenously developed low cost and comparatively simpler technology. Hence, the research statement in the context of software is as follow:

“To propose a cost effective e-learning software system to enhance the level of rehabilitation through learning”

In order to meet our research statement we basically focused on the following steps to develop an e-learning software system for the children with CP [11].

5.1 Concept Building

The aspects of repeat and stress are covered in the concept building phase. The repetition and stress on idea understanding is forced with repetition and stress on the word. Learning disabilities are the main issue in children's academic functioning, to understand something and for self-concept. It is not easy to exactly define the learning disabilities, most of the experts agree that children with learning disabilities have the following characteristics.

Disabled children face difficulty in reading, writing, and spell or perform mathematics. These academic weaknesses are due to dysfunction in underlying psychological processes such type of children need more interaction as compared to normal children. They require a lot of repetition. We want to repeat word or sentence again and again to develop the concept among the children with CP. Sometimes we need to stress the word sentence to make the concept building so that CP children learn easily

5.2 Identification

People who have CP can experience abnormal sensation and perception. Some children with CP have impaired ability to feel simple sensations like touch and pain. They may also have stereognosia, or difficulty in perceiving and identifying objects using the sense of touch. A child with stereognosia, for example, would have trouble in identifying a hard ball, sponge, or other objects placed in his hand without looking at the object. A child with CP may experience sensory integration dysfunction as a result of central nervous system damage. Sensory integration dysfunction is the inability of the brain to correctly process information brought in by the senses.

Visual and auditory integration problems are frequently noticed in children with CP. This is different from having a physical inability to see or hear things. When a child has a visual processing deficit, it means that they have a hard time in finding the words for objects they are viewing. Sometimes if they are asked to go and get an object, they might look right at it and then say they can't find it. This is because they are seeing it but their brains are not processing what it is that they are viewing. Auditory integration problems are the same, the child hears what you say but the brain does not process it in a way that is meaningful. It may take several minutes for what you have said to "click" with the child and make sense.

One helpful way of interacting with a child who suffers auditory integration problems is to break down instructions, giving them one thing at a time to do. Let them finish with the first task before you give them direction for the next step. Music therapy can also be helpful with treating auditory processing deficits.

5.3 Localization

Localization is the process of adapting a product or service to a particular language, culture, and desired local "look-and-feel". Every country or nation has its own culture, style and languages. In our project we only focus on our national culture, life style and customs. In our project we basically hit the culture of Pakistan because all the existing system belongs to their specific system and there is no such kind of system that basically represents the Pakistani culture.

5.4 Similarization

Our project is only for the patient with CP because they face the difficulties to recognize the objects that are similar. For example, mango has different shapes, sizes and colors so this project is helpful for similar object recognition. This project will enable the children with CP to differentiate the similar object

5.5 Discrimination

Due to the problem with their cerebrum the patient with CP has a problem to recognize the objects that are different from each other so they can't differentiate the different objects easily. For example, train, airplane, wooden things, and it may be anything that are different form each other and all these objects have a different shape, size and color so this project will help the CP patients in object recognition. The children with CP will be able to differentiate the different objects and also able to talk with worldwide. Moreover, they can sort out the recognition problems.

6. CONCLUSION

Several e-learning software systems have been developed so far in order to cope with different academic issues that are related to normal and special children. However, the efforts that have been made so far in the domain of cerebral palsy are scarce and resulted tools are highly expensive and difficult to control. Moreover, it is difficult to operate them in different cultural conditions. Hence, in order to resolve the above-mentioned issues a proposal for e-learning software system has been presented in order to develop a cost effective and helpful e-learning software system for patients of CP. The system will be helpful in solving the different key problems being faced by children with CP and will not be very complex as compared to the contemporary e-learning systems. The e-learning software will be easily available in low cost for CP children and user friendly in its operations both for instructors and parents.

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REFERENCES

1. Ghazali, M. and M. Ashraf, *A Systematic Literature Review on Learning Software Application Design Framework for Children with Cerebral Palsy*. International Journal of Innovative Computing, 2013. **3**(2).
2. Ismail, A., N. Omar, and A.M. Zin. *Developing learning software for children with learning disabilities through Block-Based development approach*. in *Electrical Engineering and Informatics, 2009. ICEEI'09. International Conference on*. 2009. IEEE.
3. Bohman, P.R. and S. Anderson. *A conceptual framework for accessibility tools to benefit users with cognitive disabilities*. in *Proceedings of the 2005 International Cross-Disciplinary Workshop on Web Accessibility (W4A)*. 2005. ACM.
4. Nierstrasz, O. and L. Dami, *Component-oriented software technology*. Object-Oriented Software Composition, 1995. **1**: p. 3-28.
5. Corrêa, A.G.D., et al. *Computer assisted music therapy: A case study of an augmented reality musical system for children with cerebral palsy rehabilitation*. in *Advanced Learning Technologies, 2009. ICALT 2009. Ninth IEEE International Conference on*. 2009. IEEE.
6. Kwak, E.E., *Effect of rhythmic auditory stimulation on gait performance in children with spastic cerebral palsy*. Journal of music therapy, 2007. **44**(3): p. 198-216.
7. Lotan, M., *Assistive technology and supplementary treatment for individuals with Rett syndrome*. The Scientific World Journal, 2007. **7**: p. 903-948.
8. Sankar, C. and N. Mundkur, *Cerebral palsy-definition, classification, etiology and early diagnosis*. The Indian Journal of Pediatrics, 2005. **72**(10): p. 865-868.
9. Berker, N. and S. Yalçın, *The help guide to cerebral palsy*. 2010.
10. Ashwal, S., et al., *Practice Parameter: Diagnostic assessment of the child with cerebral palsy Report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society*. Neurology, 2004. **62**(6): p. 851-863.
11. Rosenbaum, P.L., *How do changes in body functions and structures, activity, and participation relate in children with cerebral palsy?* Developmental medicine and child neurology, 2008. **50**(4): p. 283.

AUTHOR PROFILE



Muhammad Adeel Ghafoor is currently an undergraduate student at Army Public College of Management and Sciences (APCOMS) in the Department of Computer Science, Rawalpindi, Pakistan. APCOMS is affiliated with University of Engineering and Technology Taxila, Pakistan. His research interests are in e-learning software applications development, software engineering, software requirements and software testing.



Zeeshan Tufail is currently an undergraduate student at Army Public College of Management and Sciences (APCOMS) in the Department of Computer Science, Rawalpindi, Pakistan. APCOMS is affiliated with University of Engineering and Technology Taxila, Pakistan. His research interests are in e-learning software applications development, software engineering, software requirements and software testing.