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Digital Visual Schedule and Training System for Centre of Autistic Children

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Abstract: Research indicated that there is no proven cure for autism sufferers. Usually, implementing the appropriate treatment and education can eventually help the autism person to be integrated into their community. However, the conventional visual schedule and training system that depending on physical tool and toy bringing the difficulty on changing or update the picture, text and current using tool. Therefore, Digital Visual Schedule and Training System (DVST System) is developed as a user- friendly, interactive and flexibility system for children with autism. The inconveniency of traditional training program that depending on physical tool or multiple application software is improved by DVST system that provides a complete set of features and functions for the therapist and autistic children to carry out the administration work (for therapist-Server) as well as training program (for autistic children-Client) in a single application.

Key words: Autism, digital visual schedule, education, training, picture exchange communication system

INTRODUCTION

Autism is a brain development disorder that is present from infancy or childhood in development that affects essential human behaviors such as social interaction, the ability to communicate ideas and feelings, imagination and the establishment of relationships with others (Committee on Educational Interventions for Children with Autism, 2001). The main obstacle in the learning process of autisms children are impairment in social interaction and communication skill. Research has shown that children with autism are more capable of interpreting visually than verbally. Therefore, most of the treatments for children with autism are conducted through pictorial representation such as Visual Schedules, Picture Exchange Communication System (PECS) and Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) (Hermelin and O'Connor, 1970).

Autistic children are much harder to concentrate than normal children. In the traditional treatment, usually multiple software are required or still depending on physical tool and toy to carry out the entire task from visual schedule to evaluation. This non relevant activity will cause the autistic children lose their attention and affect their learning progress. Besides, the traditional treatments are not user friendly enough and have their own drawbacks in term of convenience and efficiency, complex process (capture/search, edit, print and cut the

image) that involve in the traditional training that depending on physical tool and toy bringing the difficulty (not flexible) on changing or update the picture, text and current using tool and are difficult to use especially for those autistic children with fine motor problem such as unable to hold a pen or mouse properly.

Development of computing power enables to convert most of the conventional method to the digital method. This tool is important to help people in improving the quality of life, especially for individuals with developmental disabilities. By shifting the conventional means to digital, it able to reduce the cost, time and workload required. This DVST system develops the required system and software to integrate visual schedule and training in order to provide the children with autism and their therapists a more efficient way to proceed with the therapy. It is of utmost importance that the beneficiaries from technological development be the society, not solely for financial gains.

DESCRIPTION OF AUTISM AND TOOLS

Autism: In general, autism is a developmental disability that comes from a neurological disorder that affects the normal functioning of the brain which is characterized by the abnormal development of verbal and non-verbal communication and social interaction. The disorder makes it hard for them to communicate with others and adversely affects educational performance. The lifelong condition

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affects one in 150 children born today and typically manifests in the first three years of life (LEE, 2009). Kanner captured the three core features of what later came to be called Autism Spectrum Disorders (ASDs): Disturbances of social relationships, limited use of language to communicate and fixed repetitive interests and routines (Kanner, 1943).

Several outdated theories about the cause of autism have been proven to been thoroughly refuted. The poor parenting can affect upbringing in any child, including autistic children as well as non-autistic children, however autism is not caused by bad parenting. Furthermore, no known psychological factors in the development of the child have been shown to cause autism. Most researchers agree that the causes are likely to be genetic factor. (Merry and Tamara, 2008). There is compelling evidence for multiple interacting genetic factors; several candidate genes have been located, with over twenty gene clusters under examination. Research has shown that among identical twins, if one child has autism, then the other will be affected about 75% of the time. Among non-identical twins, if one child has autism, then the other has it about 3% of the time.

Treatment for autism is divided into Behavior and communication therapy, Medical and dietary therapy and Complementary therapy (Web, 2009). In communication type (communication therapy) of treatment required close coordination between parents, teachers, special education professionals and mental health professionals. That is because the primary treatment for autism includes programs that address several key areas. Those areas are behavior, communication, sensory integration and social skill development. Picture Exchange Communication System (PECS) and Visual Schedule (VS) are the common type of education programs that structured focus on aid and helping autistic children. The other two treatments are also helpful in treating some symptoms of autism in some children. Unfortunately, until today there still do not have any solution to prevent autism.

Visual Schedule (VS): A visual schedule is a set of pictures, with or without accompanying text that communicates a series of activities or the steps of a specific activity. Visual schedules are meant to help children understand and manage the daily events in their lives (Web, 2009). Usually, the VSs are created by using photographs, pictures, written words, or physical objects. Ideally, they communicate clear expectations for the child and decrease the need for constant adult involvement in the activity (Kimball, 2003). Most VSs are introduced with adult guidance that gradually decreases with time. Samples of the morning schedule for the children with autism are shown on Fig. 1.

Fig. 1: Visual schedule sample

Fig. 2: Centre of putra special community (ASPEC)

There are several types of visual schedules, it including: Visual sequencing of tasks, visual calendars, written schedules and written/drawn notification of change. In the autistic children case, visual sequencing of tasks and written schedules are more likely to be used compare with the visual calendars and written/draw notification of change. The written/draw notification of change type are not suitable for the children with autism due to its complexity and required better language understanding.

For this project, the samples of VS have been taken from Centre of Putra Special Community (ASPEC) that is located at Bandar Baru Bangi, Selangor. The visual is the list of tasks for individual children which are difference to each other depending on their level. The project started from July 2009 until April 2009. Figure 2 shows the Study Place at ASPEC.

The importance of visual schedules: Autistic children tend to have strengths in rote memory and the ability to understand visual information; usually they understand seeing rather than more hearing. Although students with ASD may have difficulty attending to and processing lengthy verbal requests, such as directives on where to go in the classroom or when an activity will begin, research has shown that students are able to attend to visual information more successfully (Kara, 2009).

Vss enhance receptive language and assist in providing meaning to students and allow children with autism to better predict and plan within their environment by it efficiently communicating information. This is important on reducing anxiety in children with autism. A visual schedule provides a clear external structure for the school day and may be physiologically calming for students which may feel anxious in unpredictable routines and expectations are not understood (Threshold, 2009). VSs facilitate communication and therefore may minimize behavioral problems.

Vss also help children with autism become independent of adult prompts and cues (Kara, 2009). Recent research confirms that shifting from verbal prompts to visual prompts can increase student independence and engagement, as well as decrease the need for adult supports (Kara, 2009).

Visual schedule vs. PECS: Visual schedules are often confused with PECS. In general, PECS is a method of communication used by parents, therapists and educators. The individual with autism communicate use the picture to help them on expressing what their wants and needs through this communication system. Visual schedules use images like PECS, the only different between them is visual schedules are not primarily used as a communications tool.

DESIGN METHODOLOGY

This system comprises two parts which are server part for the therapists and client part for the students. The main required characteristics of the system are : the list of VS activities for individual, the list of students, integration of the activities in the VS and their training program and the report of the students performance. Top-down approach is applied during the development of this project to ensure the successful of the application produce. There are 5 main phases that involve in the project development process. The first phase is the conceptual design planning which including the software selection. Analysis phase which include analyze of data from literature review, conceptual design and related information. The whole idea for DVST System then will be

generated based on the analysis done to the data and the tools and requirement specifications of this project will be determined. The third step is design where the flow chart, algorithm and block diagram is generated for the application. Meanwhile, bottom up implementation will be done in the fourth phase. The final phase is maintenance which modification, error debug and testing.

Conceptual design: Conceptual design is the thought process of generating and implementing the fundamental ideas that characterize a product novelty, performance, robustness, development time, value and cost (Ehud *et al.*, 2001). In this project, conceptual design is the explicit construction of the ideas or concepts that a user needs to learn such as it features, function as well as how it is intended to be used. Conceptual design is done from the user's point of view where the user for this project will be the therapists and the children with autism. Throughout the project design phase, Unified Modeling Language (UML) user case is developed to describe the overview of the relation links between the users and the application. Figure 3 presents the graphical overview of the functionality provided by a system in terms of actors (user), their goals and any dependencies between those use cases. Role of the actors in the system can be depicted. For children with autism, the DVST System will be useful to view VS and conduct training whereas therapists will have extra access in modifying the data and able to view the training evaluation report of the autistic children.

Block diagram of DVST system: The design of DVST System begins with the UML diagram. The UML is used to specify, visualize, modify, construct and document the artifacts of an object-oriented software intensive system under development. Figure 4 shows the higher lever block diagram of the whole system. It shows the main components that exist in the system ideally which is including the local file storage, server application, client application and local network connection (LAN or WLAN).

The local file storage are used to store all the required file such as picture, video, text file, evaluation report, the training program and other related file. Local Network is the communicator between the server and the client application running on the computer. DVST System Server application will perform the entire function interface such as View and Selection Data, Modify Data, Picture Upload, Drag and Drop and Networking. On the other hand, DVST System client application will perform the entire function interface like View and Selection Data, Log in, View Training and Networking. The whole system then is developed by using this higher level block diagram.
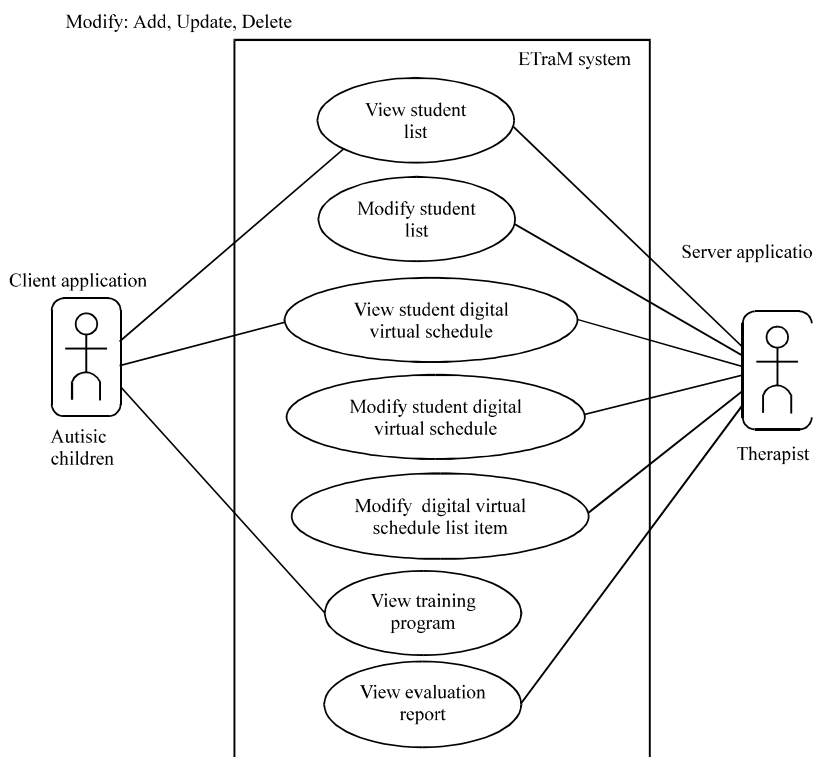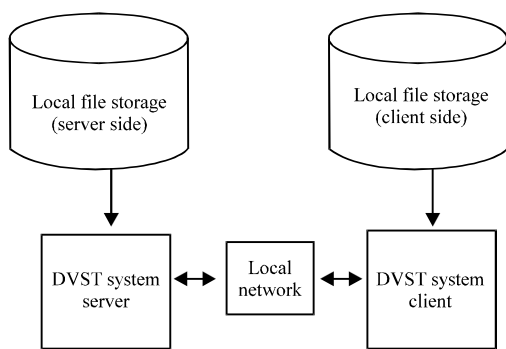
Fig. 3: Use case diagram for DVST system

Fig. 4: Higher level block diagram of DVST system

RESULTS AND DISCUSSION

DVST system can also be regarded as a revolutionary concept of evaluation, training and management tool for children with autism to replace the traditional binder and it is divided into two components, which are DVST Server and DVST Client.

DVST server: DVST system-server (Fig. 5) is designed for therapists where it allow the therapist to carry out several administration tasks such as update, edit or changing the existing data by using DVST Server.

Graphic User Interface (GUI) is implemented in this system to provide a user friendly environment; where the networking functions are added to enable the communicating, sharing and exchanging data within the system. In this project, Transmission Control Protocol (TCP) is implemented to ensure the DVST server and DVST client able to communicate to each other. It enables DVST Client to update its local storage data by downloading the latest data from the DVST Server and also enables DVST Server to download the student training report from the DVST Client.

Besides, DVST Server also provides other functions to assist the therapists in their administration work. Those functions allow the therapists to:

Register new student: The therapist is able to view the entire student names with their pictures as shown in Fig. 6 with mark ① and ② in the figure is the section that uses to add the new student to the existing student list. The "Browse" button allows the user to assign the picture to the particular student, where the "Add" button is used to execute the adding process. Default picture will be used if there is no picture assigned to the student. A notification message will be displayed once the adding process complete and new user is successfully added. Furthermore, other sub-functions such as Delete user,
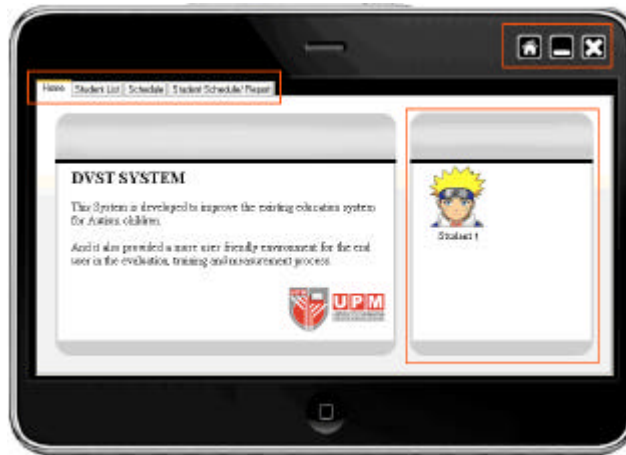
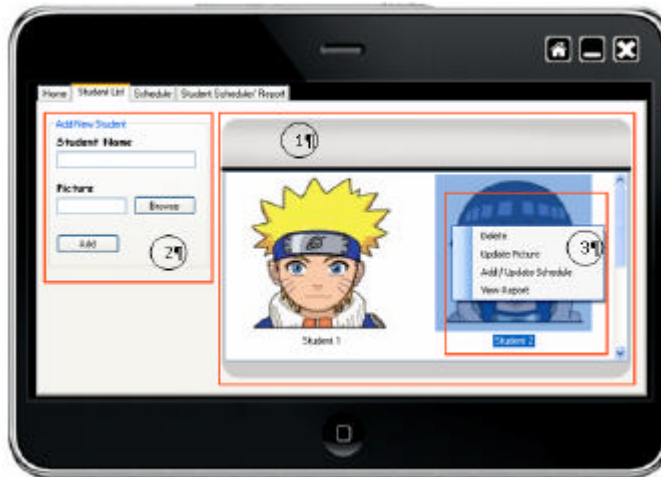Fig. 5: DVST system (Server)

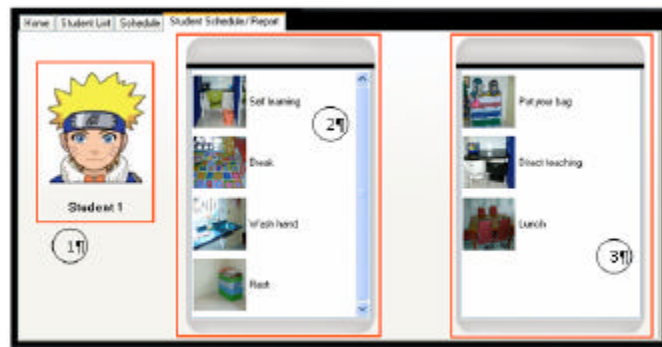Fig. 6: Student list page (Server)

Fig. 7: Student schedule page (Server)

Update User Picture, Add/Update Student Schedule and View Student Report are provided in this page as well ③.

Add or Update student visual schedule: To assign the Visual Schedule for a particular student in tradition
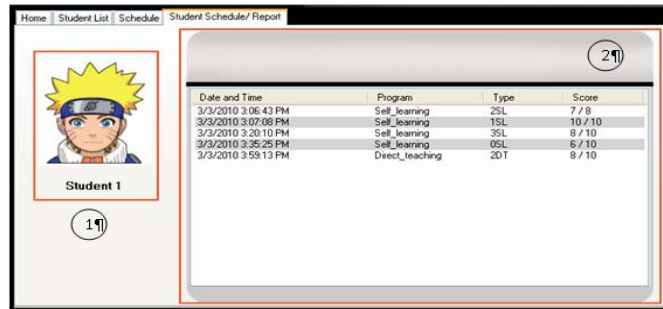
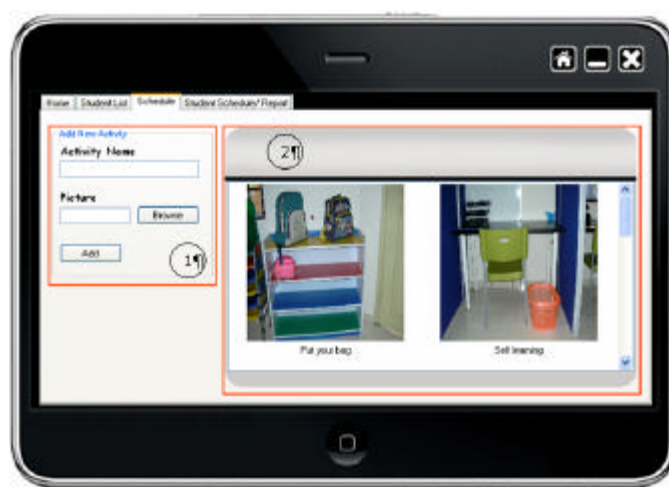Fig. 8: Student training report page (Server)

Fig. 9: Schedule page (Server)

Fig. 10: DVST system (Client)

method is annoying, while the Add/Update Schedule sub-function solve the annoying and troublesome process by Drag and Drop feature. Once the Add/Update Schedule sub-function is activated, the user will lead to a Student

Schedule page as shown in Fig. 7. ① displays the name and the picture of the visual schedule owner. List ② shows the activities that are currently not included in the particular student schedule , where ③ list down all the
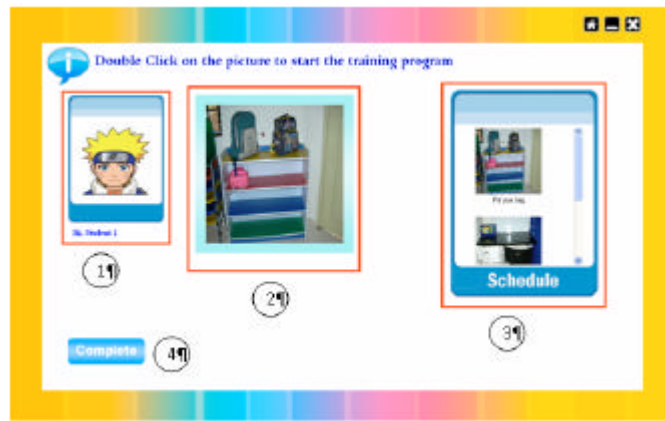
Fig. 11: Student visual schedule page (Client)

Fig. 12: Training Program menu page (Client)

activities that are currently assigned to the student and the student will follow this visual schedule to carry out their daily activity. Simply drag the activity from list ② and drop it into the list ③ to add the new activities into the student visual schedule. To remove the activity from the student list, drag the activity from list ③ and drop into list ②. Drag and drop the activity (up and down) within the same list to rearrange the activity sequence.

View student training report: Figure 8 shows the View Report sub-function. Section ① displays the name and the picture of the training report owner. Section ② displays all the previous training program report which includes the data and time of performing the training program, name, type of training program and the score. This report will keep on updating with the DVST Client application. Once the students have completed their training program, the new set of report will be sending to DVST server local storage.

Schedule Page is designed for the therapists to modify and update the existing visual schedule activity. The therapists able to view the entire schedule activities which are stored in the local storage as shown in ①. ② in

Fig. 9 above is used to add the new schedule activity to the existing schedule activity list. The "Browse" button allows the user to assign the picture to the particular activity, where the "Add" button is used to execute the adding process. Default picture will be used if there is no picture assigned to it. A notification message will be displayed once the adding process completed and new schedule activity is successfully added.

DVST client: DVST system-Client (Fig. 10) is designed for autistic children where this system is able to improve the autism children training progress by providing more suitable learning environment for them. When the student wishes to view their visual schedule and start their training program, simply log-in by Double Click on their picture, a new page with their personal visual schedule will be displayed.

Student visual schedule page: In the student visual schedule page (Fig. 11), ① displays the name and the picture of the visual schedule owner. ② displays the current activity that the student should execute, the students are required to Double Click on the picture to
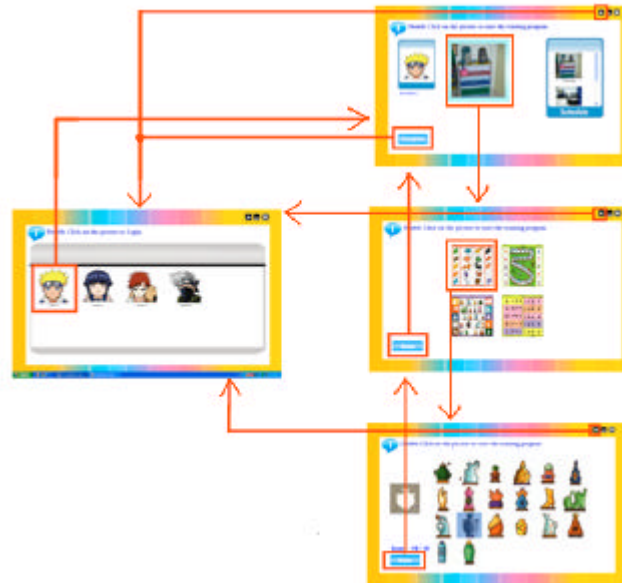
Fig. 13: Training program page (Client)

Fig. 14: DVST client flow diagram

start the activity or training program. The other activity that assigned to the student and haven't been executed are listed in the ③, it could also be defined as the waiting list of the training program for the student. Once the student has completed the activity or training programs it will be removed from the list ② and new activity will be displayed in the ③. In any circumstances the student could use the Complete button ④ to terminate the current page/logout and return to the home page.

Training program: This page (Fig. 12) displays the menu of training programs that under the same category in the system, the student can select any of the training programs from the list ① to carry out their training session. List ① only will display (maximum) 4 different type of training program in the list and the particular training program that completed by the student will be

removed from the list ①. Student could return to the Student Visual Schedule Page by simple clicking on Done button at ②. Once this button is clicked, it will force the system to terminate current page and assume that the student has completed the entire training program that assigned to him/her under this category.

Training program page: The training program page (Fig. 13) divided into 3 parts, at the beginning only ① and ② will be shown on the screen ③ only will be displayed once the student has completed the training program. ① is used to display the question of the training program, where ② is used to display the entire set of the answer for the training program. ③ shows the score of the student and together with the Done button, Done button is used to terminate the current training program and return to the menu of training program.

In general, DVST client is a platform that provides a training program for the children with autism (student). They can use the DVST client to view their personal visual schedule and then carry out their training program one by one according to their visual schedule.

Figure 14 shows the flow of using the DVST Client. First of all, the users have to log in by selecting the image from the list to view their personal visual schedule. Double click on the schedule activity to perform the activity; a training program menu will be displayed on the screen, select one of the training programs from the list to start the training program. The score of the particular training program as shown in Fig. 8 will be displayed once the users have completed the training program and the procedures will keep on repeating until the user logout or complete the entire training program and schedule activity.

Improvement of DVST system compared to traditional system: The DVST System improves the Traditional System with the help of the current technology, which is very much accurate, fast, can accomplish many tasks easily and can store huge amount of data in it. The traditional treatments are not user friendly enough and have it own drawbacks in term of convenience and efficiency. Hence, the DVST System emphasizes on user friendly environment, where it provides a better user interface that allow the user to carry out a lot of different task with the help of simple tool such as button (click and browse), ListView (drag and drop feature), PitureBox (display and select) and etc. This also resolves the complex process that involve in the traditional training which bringing the difficulty on changing or update the picture, text and training program using tool. Moreover, audio feature and animation are added into the DVST System. The sound and movement effect in the system will draw the student attention and help the student to be more concentrate during the training program. By doing this, it will able to improve the student learning progress. Furthermore, by using touch screen, DVST system able to help those autistic children with fine motor problem such as unable to hold a pen or mouse properly to carry out their training program in the easier and comfortable way.

CONCLUSION

All children need health care, especially for those who have health problem. If health problems are not identified and treated, they can affect a child's cognitive, physical, behavioral and emotional development. It is therefore essential to identify and treat health conditions early to prevent or minimize the impact on overall growth and development. As the numbers of children with autism increase, it is importance to pay attention on medical treatments and training for those who are affected. The treatment and training program are relevant importance since there is no prevention step available. As known that our children are our future, this project is not only helping the families that suffer from the autism, it also able to help the therapies and our country as well.

Finally, it would be interesting to extend this project formally to a larger number of autistic children in this country, to connect them to the modern information and communication technology so that they become part of the change that Malaysia and the world, needs.

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