The Role of Information and Innovative Technology for Rehabilitation of Children with Autism: A Systematic Literature Review

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***Abstract*—This paper presents a literature review of roles played by information and innovative technologies for helping children suffering from Autism Spectrum Disease (ASD). ASD is a pervasive developmental disorder having issues [1]with social communication, interests, coordination, attention, and health. People with autism are very sensitive and cannot afford a minor change in their surrounding environment. They do not know how to react according to the situation. The information technology is very helpful to resolve their issues. The best solution for autistic children is to educate them. The education in younger age is considered as more helpful for autistic people. The method of education for autistic people through computers is very promising nowadays with advanced information and communication technologies. Computers represent a considerable and valuable part in educational techniques of autism. Many software's can be used to help children with autism. A detailed comparison of different games and applications which are helpful for kids with autism is described. Information and Computer Technologies are very helpful to predict facial expression, speaking and writing skills. Virtual Reality based frameworks are very helpful to estimate a different kind of fears faced by autistic people.**

Keywords; Autism Spectrum Disease; Children; Innovative and Information technologies; Rehabilitation;

I. INTRODUCTION

Autism refers to some physical or mental disturbance found in human beings which prevent their normal activities. Autism does not mean that one cannot do even a single thing by himself. It all depends on the will of disabling human whether he wants to show the ability to do things and act like normal humans. A disabled person is one who cannot see, walk, hear and speak properly. They do not have hand working properly but have a proper mind to percept the environment and want to be a part of it. Many disable children have a common interest in education and many of them are serving after completing their academics. On the way of their struggle, they have to face many barriers. In literature, different authors tried to explain the problems of ASD and autism with their solutions.

These disorders are described by different troubles in the social association, verbal or nonverbal communication and repetitive behavior. ASD is a type of neural disorder in which a person has difficulties in social interactions and other communication problems related to interests and behavior. Children with autism have lacked in social communication with others. If someone is trying to communicate with these children, they do not make an eye contact with that person and the Person who is doing this at very first time may think of a rude reaction. These children are very sensitive and cannot afford a minor change in their surrounding environment. These children and people around them face challenging problems because these children do not know how to react according to the situation. Sometimes it becomes a very difficult task to handle these children because if the environment changes to their surrounding they may show aggression or run away. Within autism population, 25–61% of children have a total absence of verbal communication [1]. Many researchers have concentrated on enhancing communication abilities of kids with ASD [2]. Innovation in computer technology over the most recent two decades has expanded which results in cost reduction. Computers are now commonly used in schools and homes [3]. Recently, computers are frequently utilized as instructional devices for different learning purposes [4]. Leo Kanner an American psychiatrist narrated that ASD happens due to brain disorder which happens between two or three years of childhood. ASD has three main aspects of impairments which are social cognition, imagination, and communication. Children affected with ASD usually behave, act and look like abnormal children's unless or until through training and teaching their behavior, social interaction and communication skills improves to look the world in another way [5].

Virtual environments attracted much attention for the education of autistic people. In virtual environment autistic people can be educated through emotional faces (avatars) [6]. Emotions can motivate and encourage the autistic people to achieve things as the face plays a complex role in human communications. Upgraded personal computer interfaces and virtual environments are especially interesting platforms for increasing social abilities of ASD [6-8]. In a few recent years, virtual

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reality (VR) is being considered as the best method to monitor ASD intervention through virtual reality based human computer everyday tasks [9]. VR technology possesses various qualities like flexibility, controllability, dependability, modifiable tactile incitement, the capacity to individualize intervention methodologies and support systems [10]. As indicated by the literature, autistic people and kids with autism, appreciate communicating with the computers because they feel "safe" with computers [11]. Gaze-sensitive versatile reaction technology can consistently coordinate VR-based function with eye-tracking methods to intelligently encourage engagement in function. VR-based Interactive framework with Gaze-sensitive versatile reaction technology increases social relational abilities. This is divided into two parts; firstly, a virtual reality based engagement-sensitive system with a reaction technology is presented. This system depends on the composite impact of one's viewing way, eye motion, and execution metric which can be utilized to social correspondence undertaking for kids with ASD. Secondly, the consequences of a study intended to examine the contrast between the ES and another framework that is based on a person's performance alone [12]. Children affected with Autism are growing day by day [13]. There are many ways to diagnose affected person but progress is very slow. In most of the cases, children cannot live independently after growing [14-16].

II. AIMS AND OBJECTIVES

We present a detailed study on children with autism, problems that they have faced in their daily life and how education is important for them to improve their skills. We will discuss the important role of information technology in improving their behavioral, communication and Social Skills.

III. RESEARCH METHODOLOGY

In order to fulfill the goal of the study, we will collect data through Research papers and Systematic Literature Review for the formulation of QAs.

A. Relevant Evaluation Questions

To examine the effectiveness of information technology for children having a formal diagnosis of autism and engage in problems like behaviors, social and communication we addressed the following questions:
The following questions:
RQ1. Different Technologies which are useful for handling issues in autistic children?
RQ2. Autistic children problems and their solution through technology?
RQ3. Does developments of different autism games useful in rehabilitation of autistic children?

B. Search Strategy

This review was based on a systematic search of published research and unpublished dissertation studies available till April 2016. The target population was children or adults diagnosed with ASD.

1) Search Terms Identification

This process is utilized for the development of search terms.
a) Derive major terms from research questions;
b) Find synonyms for these major terms;
c) Check relevant paper and verify the keywords;
d) Boolean Operation uses for conjunction, use 'OR' operator for the concatenation of synonyms whereas 'AND' for the concatenation of major terms.

2) Trial Search

The trail search is conducted by using the following search string in Google scholar, Science Direct, IEEE Xplore, Springer Link and ACM digital library.
("Autism" OR "Autism Spectrum Disorder" OR "children with autism" OR "Asperger" OR "Behavioral Disorder" OR "Children with autism" OR "neurobehavioral disorder" OR "developmental disability")
AND
("Information Technology" OR "Innovative Technology" OR "Computer Based system" OR "Virtual Reality" OR "Factors" OR "Signs" OR "Challenges" OR "Language problems" OR "Social Communication problems" OR "Games" OR "Computer Based software" OR "Computer Based system")
By using these strings, we get different research papers which are presented in Table 1. We use these papers for our guideline and the advancement of current knowledge.

TABLE I. TRAIL SEARCH RESULTS

S.No	Digital library	Search	Conduction Date
1	IEEE Explore	125	5 April 2016
2	ACM Digital Library	118	10 April 2016
3	Google Scholar	115	15 May 2016
4	Science Direct	95	20 May 2016
5	Site Seer Digital Library	75	25 June 2016
6	Springer link	60	30 July 2016

C. Study Selection Criteria

By using above search strategies, we search an enormous amount of research papers from different electronic databases. This search was limited to English-language and peer-reviewed studies. Inclusion criteria are used to determine the relevant literature which is collected by trail search.

3) Included Criteria

Only those studies are considered which are written in English. All retrieved abstracts were scanned and only full papers/ thesis/books meeting the search terms were obtained. Studies that describes theoretical concepts in the context of the role of information technology in autism. Studies that describe autism, or part of computer base software in the recovery of different problems of autism. Studies that directly answer one of the research questions.

4) Excluded Criteria

Any study that did not link Autism or ASD to these latter terms was excluded. Literature reviews and articles that did not include original data were also excluded. Studies that describe the autism without the scope of information technology and computer-based software's, such as manufacturing tools which are used by autistic people, Studies that are part of a book, Studies that describe medical treatment.

D. *Electronic Data Sources Used*

We search the following electronic sources

- scholar.google.com.pk
- ieeexplore.ieee.org
- acm.org
- sciencedirect.com
- citeseer.ist.psu.edu
- springerlink.com

Following Figure 1 shows complete study process in a flow chart which is followed during research. It shows how much paper are included and excluded from the study and what are the reasons behind them.

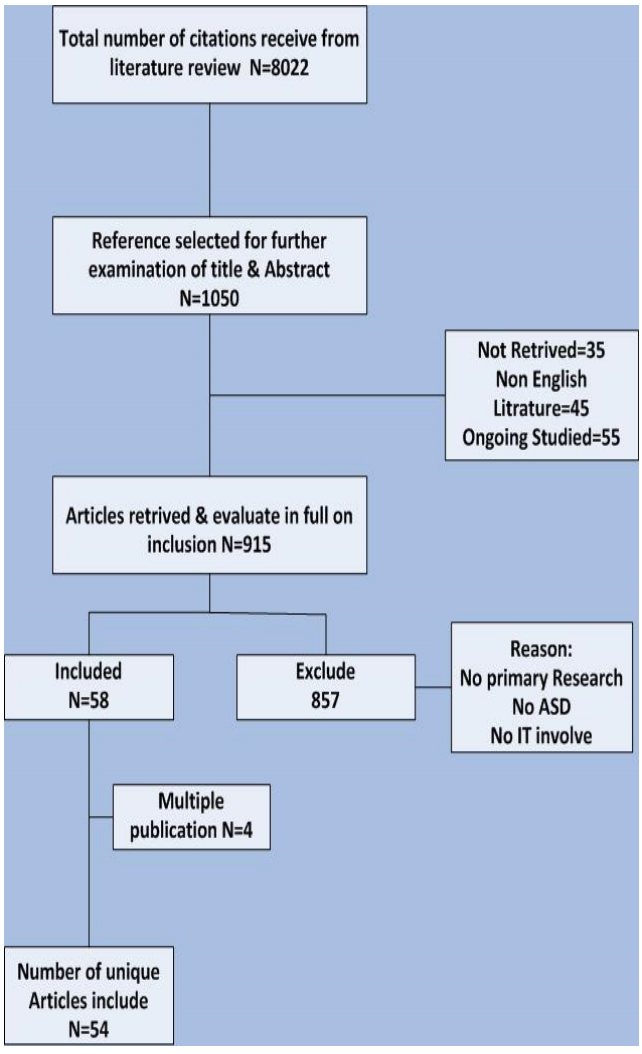

Fig. 1. Study Process in a Flow Chart

IV. EXISTING RESEARCH SUMMARIES AND RELATED WORK

E. *Pre-Birth Factors That May Cause To Autism*

Following are pre-birth factors that may cause to autism

Taking antidepressants during pregnancy: Particularly in the initial 3 months

Nutritional insufficiency in pregnancy: Especially not getting enough folic corrosive

Age of the mother: Kids destined to older mothers also have a higher danger of a mental imbalance

Complexities at or soon after birth: Containing low birth weight and neonatal iron deficiency

Maternal diseases in pregnancy: Any maternal diseases in pregnancy can cause autism.

Exposure to chemical pollutants: For example, metals and pesticides, while pregnant

F. *Symptoms Of Autism in children*

Signs of autism commonly show up during initial three years of life. In few kids, symptoms are appeared from birth and for others it grows up till the age of 18 to 36 months. In any case, it is presently perceived that a few people may not demonstrate indications of a communication disorder until the requests from the environment overreach their capacities. A mental imbalance is four times more regular in young boys than girls. It knows no racial, ethnic, or social limits. Family wage, way of life and educational levels do not infect a child's chance of being autistic.

G. *Signs Of ASD In Older Children*

As children come to have older, the warnings for extreme autism become more severe. There have more warning signs. They normally spin around weakened social abilities, speech or language troubles, non-verbal communication troubles and inflexible behavior. Older children and teenagers with ASD have a problem in two fundamental territories. The first is social communication, and the second is behavior signs [19-20].

Following Table 2 consists of social communication signs and behavioral signs of older children and teenagers with ASD.

TABLE II. SIGNS OF OLDER CHILDREN AND TEENAGERS WITH ASD

Social communication signs	**Behavioral signs**
Problem in conversations.	Have uncontrollable behaviors.
Worried by language take things literally.	Get disturb easily
Unexpected tone of voice.	Unexpected attachment to objects
Difficult to follow a set of instructions.	Worried by change.
Problem in reading non-verbal clues	Repeat body movements.
Use eye contact in a strange way.	Make repetitive noise.
Can't read facial expressions.	Seek sensory stimulation.
Have few or no real friends	Very sensitive.
Like spend time with them.	Strange interests or obsessions.

H. *Types Of Autism Spectrum Disorders*

Following are types of autism spectrum disorders [21-22]

Autistic disorder: It consists of issues with social connections, communication and creative play in kids younger than three years.

Asperger's syndrome: These kids do not have an issue with language, they tend to score in the normal or above-normal range on knowledge tests. However, they have the same social issues and restricted the scope of interests as kids with autistic disorder [23].

Pervasive developmental disorder or atypical autism: This is a type of cover-all group for kids who have some mentally unbalanced practices but do not fit into other groups.

Rett syndrome: Kids with Rett syndrome, essentially young girls, start growing regularly but then start losing their communication and social abilities. Starting from 1 to 4 years' age, repetitive hand movements replace purposeful utilization of the hands. Kids with Rett syndrome are normally felt trouble in remembering, learning new things, concentrating and making decisions.

Childhood disintegrative disorder: These kids grow regularly for at least two years then they lose their communication and social abilities. This is not a common issue. Its presence as a different condition is a hot topic which was discussed by many mental health experts. These disorders are analyzed either a social communication issue or autism spectrum disorder in view of the essential disabilities.

I. *Autism Spectrum Disorder Children Problems* [24, 25]

- Face difficulty in learning and understanding the meaning of word
- Perform the same action again and again. For example, saying the same word
- Certain movement of arms or body
- When a change occurs, they have a problem to adjust with it. (like try new foods, having a substitute teacher)
- Early indications of a mental imbalance in children
- Cannot build eye contact
- Cannot smile when someone smiles at them
- Cannot react by calling name or by hearing sound of a well-known voice
- Cannot follow objects visually
- Cannot use different signals to convey like wave hand for saying goodbye
- Cannot point out things
- Does not make noises when other people notice them
- Does not start or react to snuggling
- Cannot follow a model or facial expressions
- Does not play with other
- Cannot request a help or make other essential requests

J. Adapting The Curriculum For Kids With Autism

Kids with autism will require initialing steps for learning education from the age of three to the end of reception year.

In any case, kids with autism have variation in their mental health. They might have issues in learning what the other normal kids learn naturally. Basically, a kid needs to develop 'learning to learn' capability keeping in mind that the end goal to get an educational program is looking, listening, consideration, focus, happiness and basic self-improvement abilities, e.g. toileting. Education is considered as a perfect answer for the issue of autism [7].Children with autism give a better feeling when programs include cartoons instead of photographs of real faces. Kids with autism spend more time for looking at cartoons instead of real faces [26].

5) Social and Emotional Development

What a kid in autism realizes the early years, it is essential to improve his social ability. Particular social collaboration skills should be taught by utilizing real social circumstances.

6) Communication and Literacy Development

Kids might have trouble in understanding the communication which may be verbal or non-verbal. It is needed to develop these skills.

7) Mathematical Development

This might be the best zone of learning. Mathematical knowledge should be taught to the kids with autism.

8) Information and Understanding the World

The kids may not be actually curious and this should be cultivated but, they might have amazing interest for specific things. They will be expected to understand the past, present and future occasions.

9) Physical Development

Watch the kids whose physically condition is not strong. They feel danger in environment outstrips. It is necessary to understand their sense of danger and provide clear safety rules for them.

10) Innovative Development

Offer the kid some assistance which reflects in past experience and learning. It is needed to offer some assistance for them which make associations between past and present learning.

K. Some Organizations Which Work for Kid With Autism

11) The Itaalk Autism Foundation

The iTaalk Autism Foundation's central goal is to teach families, instructors and administration suppliers on the essential uses of the interactive technological products like iPad, iPod, and Android for people having developmental disabilities. They supply intelligent technological items to people (birth to 22) with a Medical ASD determination.

12) Autism Speaks' Innovative Technology for Autism Initiative

The essential focus of Autism Speaks' Innovative Technology for Autism Initiative is to adjust and advance the utilization of accessible technologies and support the improvement of new

technologies in an interdisciplinary and inventive approach. It encourages applied research that straightforwardly effects the developing needs of those who suffered from autism.

13) Webinar

"PDA's, Smartphone's and Tablet PC's as cognitive behavioral aids for autism" from the Virginia Commonwealth University Autism Center for Excellence.

L. Influence of Information and computer technology (ICT) on children with ASD

People or children having ASD have a monotropism ("is a feature when an individual has restricted the range of interest") because these designed computers have many advantages over traditional design. Like highly accurate, no social interaction required long-term archive of date and multi-prompt choices etc. Children with ASD have a different set of habits due to their deficits in social skills and cognitive abilities. Furthermore, with the advantages mentioned above, ICT also has largely been used in long-period interventions, therapy or training sessions.

Storytelling is an important ability for the development of the children. This method can develop the children's. The Storytelling Listening System was introduced by the ICT. This system is developed to train ASD children through storytelling virtual peer to reach three different stages like control, build and interact [22]

14) Facial Expression Wonderland (FEW)

FEW is a prototype of the training program for the children having autism. This program is designed to enhance cognitive abilities for the children facing autism. The purpose of the FEW is to train children with autism for facial expression recognition via game playing. The voice instruction to each game level can listen via pressing the button, so they can manipulate with the game [22].

M. Modular playware as a playful diagnosis tool for autistic children

Children suffering from syndrome face a lot of issues such as Communicating with people and expressing their emotions. Some children have diseases which can't be diagnosed by the therapists. Some children lack creativity and they cannot even play. But if we provide those kids opportunity to play with some instruments or machine, there is a chance that they will start understanding and playing. Different tools which are easy to play and can be played by people of all ages. Could be a game, a puzzle or a quiz etc. By involving children in such activities, we can judge that how the child is interacting with the activity, which steps he had taken and how powerful is his/her decision taking ability etc. Previously, many robotic systems are created for the special children for example Billard developed Robot Doll, which copies the movements of a child and use for rehabilitation of children with complex developmental disabilities [27]. Modular playware is also used same type of approach. Modular playware is develop using robotic tiles which will be a source of diagnosing disease of a child having physical disorders. It has following different modules [18].

15) Modular robotic tiles

The main concept is to build a playware which can be easily handled by a special kid. It would be flexible, and easy to play. The playware will be composed of modular tiles and have four sided. It should use the infrared signals and the magnets between the tiles to join them together. The tiles can be arranged horizontal or vertical in both ways. Tiles could make a group and could communicate via radio signals [28]. On the basis of its design, a lot of activities could be developed for the special kids. Such as game, puzzle's or quizzes etc.

N. Facial Emotions Recognition System for Autism

Facial expressions use to express our feelings as well as to provide different clues in social communications. Autistic people have different expressions which cannot be understandable. To handle such type of problem, we use image processing technique. These are steps to process any type of digital input image for recognizing emotional expressions.

Image acquisition: Includes set of input images of a human with different face expressions.

Image preprocessing: Process of increasing features that will make image easy to observe for the subject

Image post processing: To gather interesting parts that can be observed later.

Feature extraction: This is done using Weber's law descriptor. Its purpose is to show the image as a histogram and remove the noise in the image.

Classification: The feature classification is done by Fuzzy C-means (FCM) classifier. It is used to identify things like eyes (left or right), nose etc.

Edge detection: Is used to detect edges using a sobel filter and to find the magnitude of all point in gray scale image.

Database training: Used to train database using C 4.5 algorithm along with Naive Bayesian Classifiers.

Emotion Detection: Various kinds of emotions of human beings are detected in the input image.

Image processing technique plays an essential part in the identification of the human facial feelings. Virtual Reality (VR)-based facial expression system is to be built up that can get eye tracking and peripheral psychophysiological data during the subjects are involved in emotion recognition tasks [29].

O. Serious Games for Autistic children

Children affected with autism are growing day by day. There are many ways to diagnose affected person but progress is very slow mostly children cannot live independently after growing [14-16]. Serious games are used to diagnose patients affected by Autism. Serious games can be a combination of education as well as entertainment.

The video game which depends on the interaction or actual use of user and players experience of playing the game with

perception are categorized as serious games [30]. Serious games purpose is to use new gaming technologies for educational or training purposes. It explores the educational and social effect of computerized games that are built with or without learning outcomes in mind [31]. Treatment of autistic children is possible with the help of serious games which include two different methods, education and therapy [32].

16) Tool and technologies use in Serious Games

Tools and technologies which are used in development of serious games are following

Computer Games: Different researcher used computer technologies for the development of serious games for autistic children [33-35]. In computer games a user can interact by using headphone, mouse, keyboard, microphone speakers and joystick.

Virtual Reality: It is created by using the 3D artificial software. The user can interact and manipulate activities and objects using virtual reality.

Mobile devices: First aid education mobile game for autistic children using android introduced [36], Mobile devices can be of many types which include, IOS, Android, Windows Phone and others mostly Java is used as game development for mobile devices.

Touch Screen Computer and Table Top: Touch Screen Computer based Collaborative Puzzle Game is developed for improving collaboration in children with autism [37]. The user can interact without using a mouse, keyboard, and joystick.

Interaction: It mostly used platform now a day where the user plays computerized games on different online or social platforms. Nowadays, there are such interfaces which interact or read brain's electrical signal known as Electro Encephalon Grapey and turn it into movement in virtual environment [38]

P. Virtual Reality Based Adaptive Response design Technology for Children with Autism

ASD is such type of neural disorder in which a person has difficulties in social interactions and other communications problems related to interests and behavior. To overcome such problems, studies are underway to understand that why disordered people have fear of other people. In a few recent years, VR is being considered as the best method to monitor autistic children in everyday tasks [12]. This system consists of the following major three parts.

17) VR-Based Social Communication Task Module

In this module, desktop based Virtual Reality based applications used for easily accessible, moderate and minimalize possible sensual problems for autistic children. Vizard, a virtual Reality design, used to build up the virtual situations. It is further divided in sub-modules, one is task presentation module and second is a bi-directional conversation module.

18) Real-Time Eye-Gaze Monitoring Module

This module deals with the data collected by the eye of observer which interact with avatars by using eye tracker glasses. Eye tracker glasses extracts specific characters for example raw pupil diameter and aspect ratio for offline investigation. View point vizard handshake unit provide link among eye tracker and the virtual reality coding platform.

19) Individualized Adaptive Response Module

This module further divides into two parts

Performance-Sensitive System (PS): This module represents a task modification technique which is based on one's performance metric alone and implementation of the dynamic task switching by a finite state machine representation. This module has three levels of difficulty which are Easy, Medium and High.

Engagement-Sensitive System: The purpose of engagement sensitive system is that switching between tasks knowing that how many participants were involved in the task. Involvement of participants in virtual reality based social task was predicted based on objective metrics. Engagement sensitive system provides information of the looking pattern of the participant and by analyzing this data the system gave us an extra feedback.

V. APPLICATIONS FOR KID HAVING AUTISM

Recently, many computer-based educational methods for persons with autism which can change their abnormal behavior [39]. There are many learning and educational tools which are created for the restoration of kids with autism. The majority of them depend on the computer by the method of software programming teaching platforms [40-41]. Software programming teaching platforms are used for entertaining kids with autism to learn educational things in order to present knowledge in a nice-looking way. By giving photographs of the real thing, software platforms facilitate people with autism to recognize objects based on their size, color, and type. Also, this type of interactive learning platform inspires the kids to correspond the things with sounds and words. For attractiveness, platforms make utilization of animated pictures. Moreover, robotic systems are included in the interactive environments [42]. Many handheld devices like mobile phone and tablet are very useful devices for addressing and overcoming several issues of autism. These devices are flexible, portables and lightweight therefore easily used by autistic people. The touch screen and user interfaces provide an easy learning environment for people with autism. Sliding and tapping have less effort than writing [43]. Following applications with description are listed below.

Anecdotal: No any related scientific studies for this kind of application.

Research: Related experimental and scientific studies available, however, no immediate research support for this kind of application.

Evidence: Strong or particular scientific evidence available for this kind of application or technology.

Table 3 contains a detailed comparison of different games and application for autistic peoples. This table contains the name, category, platform, age and supporting research. This data is collected from different research papers, Google play, Apple store and Microsoft app store

TABLE III. TABLE OF DIFFERENT GAMES COMPARISON FOR KID WITH AUTISM

Name of Game or Application	**Type**	**Platform**	**Targeted Age**	**Supportive Research**
Sight Words by Teach Speech Apps[2]	Language Improvement	iPad and iPhone	Preschool children (2-5) and Children (6-12)	NO Data
1 on 1: Communicate Easy[3]	Accessibility Behavioral Involvement Language Improvement Communication	iPad only	For all ages	Anecdotal
4 Forms[4]	Math Skills Development Recreation	iTouch, iPad and iPhone	NO Data	Anecdotal
4 kidcal	Functional Aids	iPhone, iPad and iTouch	Preschool children (2-5) and Children (6-12)	Anecdotal
:prose[5]	Communication	iTouch, iPhone and iPad	All Ages	NO Data
A BuZoo Story[6]	Social Skills Development Recreation	Android	All Ages	Anecdotal
AAC Autism Talk Now[7]	Accessibility Behavioral Intervention Social Skills Development Language Improvement	Android	All Ages	NO Data
aacorn[8]	Language Enhancement Communication	iPad	All Ages	Research
ABA Find It![9]	Recreation Behavioral Intervention	iPad, iPhone iTouch	NO Data	Research
Aiko&Egor:Animation for Autism	Recreation Social Skills Behavioral Intervention	iPad	Preschool children (2-5) and Children (6-12)	Research
Alpha Writer[10]	Communication Language	iTouch, iPad and iPhone	NO Data	Evidence
Autism Language Learning[11]	Language	iPad	Children (6-12)	Research
Autism emotion [44]	Social Skills Improvement	iTouch, iPad and iPhone	NO Data	Research
Autism Learning Games: CampDiscovery	Language Improvement Accessibility Communication	iPad only	Children (6-12)	Evidence
Avaz for Autism	Language Improvement Communication Creative Arts Skills	iPad only	All ages	Anecdotal
Birdhouse for Autism	Organizer	iPhone, iTouch	All Ages	Anecdotal

[2] http://www.teachspeechapps.com/sight-words.html
[3] http://autismappszone.com/1-on-1-communicate-easy/
[4] https://itunes.apple.com/us/app/4-forms/id623735791?mt=8
[5] https://itunes.apple.com/us/app/prose/id945122730?mt=8
[6] https://play.google.com/store/apps/details?id=com.shailah.BuZooStoryPaid
[7] https://play.google.com/store/apps/details?id=appinventor.ai_smartsanjaykumar.AAC_Autism_TalkNow
[8] https://itunes.apple.com/us/app/aacorn-intelligent-aac-solution/id732419715?mt=8
[9] https://itunes.apple.com/us/app/aba-find-it!/id605672015?mt=8
[10] http://montessorium.com/alphawriter
[11] http://www.autismlanguagelearning.net/main_page.html

Conversation Coach [44]	Communication	iPad	NO Data	Evidence
Dance Party Zoo by FizzBrain	Recreation	iPad	NO Data	Anecdotal
Everyday Skills: Pocket Edition [45]	Functional Assistances	iPhone, iPad and iTouch	NO Data	Evidence
Feelings with Milo	Behavioral Intervention Social Skills Communication Functional Skills	iPad, iPhone iTouch	NO Data	NO Data
GreenDay	Behavioral Intervention	Android	NO Data	Anecdotal
HerbiWriteAbout	Language	Windows 8 Windows Phone	Preschool children (2-5) and Children (6-12)	Anecdotal
iMix- Scramble Words: A Creative Game for Kids[46]	Recreation Language	iPad iPhone iTouch	No data	Evidence
iPrompts [47]	Functional Skills Social Skills Behavioral Intervention Communication	Android iPad iPhone iTouch	No data	Research
Learn to Talk [48]	Language	iPad iPhone iTouch	No data	Research
Meet Heckerty [48]	Recreation Social Skills Communication Language	Android iPad iPhone iTouch	All Ages	Research
My Visual Timetable [49]	Recreation Communication	iPad iPhone iTouch	NO Data	Research
Picture Scheduler [47]	Organizer	iPad iPhone iTouch	NO Data	Research
Zody's World: The Clock Catastrophe	Social Skills Enhancement	iPad only	Children (6-12) and Adolescents (13-17)	NO Data

VI. Results and Conclusion

This paper describes how to handle the issues of autistic children in their education and daily life. There had been a lot of work done for autistic children by whom they can have easy access to e-learning resources at anywhere and anytime in such a way that they haven't experienced before. Most of the e-learning systems are not designed to fulfill needs of disable students as they have varying needs. Two autism persons with same disability will have different problems and needs in e-learning system, so while designing the system it has to be considered that the created system should handle the common problems. It also includes that how disabled people are neglected in the society due to discrimination. As the part of the society, they also have equal rights to get a proper education by assistive tools and technologies which provide eases in their education. Different mobile based game improve autistic children communication language, behavioral innervation, recreation, math skills, functional skills, social skills, accessibility and creative arts skills.

ASD is a pervasive developmental disorder. The child in this disease have decreased social communication and restricted interests [50]. ASD is related to mental disability in which children face some difficulties in coordination, attention and physical health issues such as sleep and stomach disturbances. Some people with ASD perform exceptionally well in visual skills, music, mathematics, and arts [51]. A man on the range may follow huge numbers of these behaviors or just a few, or many others besides. The determination of extreme autism spectrum disorder issue is fundamentally connected in view of examination of all practices and their seriousness.

A mental imbalance seems to have its roots in an early mental health problem. Side effects must be available in early two years old [50]. It impacts on the conduct of a man in verbally correspondence and comprehension. Kids with autism have difficulty in communication. They experience difficulties in understanding of other person thinking and feeling. This makes hard for them to convey the words, through motions, facial appearances, and touch. A kid with a mental imbalance might be enormously stressful, hurt or troubled by sounds, touches, smells and sights that appear to be ordinary for others. Social collaboration is also a generic trouble with an autistic person. They also have a problem to share their emotions [15, 52].

The solution for these problems is ICT. They can perform many tasks simultaneously, quickly and efficiently using ICT. Meanwhile, it is common to use ICT in healthcare delivery and management. ICT can be your ears, mouth or mind. Many Brain Computer Interface are developed to assist people with disabilities. In order to overcome such problems, studies have been in progress to understand that why disordered people have fears of facing people. In recent times, VR is being considered as the best method to monitor ASD intervention through VR-based human–computer everyday tasks. VR technology possesses various qualities like malleability, controllability, reliability, modifiable sensory stimulation, an ability to individualize intervention approaches and reinforcement strategies.

VII. Future Work

For future work, we will include tangible user interfaces. The user interacts with the digital environment with real world object in natural ways. We will develop synthesis algorithms and classification method for facial emotion analysis[53]. Special magnifiers are designed to increase the size of contents displayed. Further research on magnifiers and visual theory is also under processes. Text to speech software is also used by blind people. Thus, the system also needs to be flexible for providing users permission to change their looks and feel to suit their disabilities. The capacity for an e-learning system framework to change audio and video into text would be an invited expansion for the advantage of students with hearing impairments [54]. In future, we will do more researches on human and human emotion. Here, we have discussed only four of them. We will make a mobile application for such peoples with a problem of the face and emotion reorganization [29]. Serious games are the most effective and most used platform for the diagnosis of Autism, but there is a lot of work to be done in future because the progress in the diagnosis of the problem is very slow. Regardless of that, it provides a basic platform for future work as it proves to be very effective. In now a day, there are no serious games which focus on the stages of autism. We can develop or research on the game in which it will be possible to find the seriousness or the different stages of Autism which can be small, medium and large [32].

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References

[1] Weitz, C., Dexter, M., & Moore, J. (1997). C: with developmental language or speech disorders frequent-ly benefit from augmentative and alternative communication (AAC) strategies. These children have severe expressive or receptive communication disorders or. The Handbook of Augmentative and Alternative Communication, 395.

[2] Schlosser, R. W., & Wendt, O. (2008). Effects of augmentative and alternative communication intervention on speech production in children with autism: A systematic review. American Journal of Speech-Language Pathology, 17(3), 212-230.

[3] Barron, A. E., Harmes, J. C., & Kemker, K. J. (2006). Technology as a classroom tool: Learning with laptop computers. Handbook of research on literacy in technology at the K-12 level, 271-286.

[4] Inan, F. A., Lowther, D. L., Ross, S. M., & Strahl, D. (2010). Pattern of classroom activities during students' use of computers: Relations between instructional strategies and computer applications. Teaching and Teacher Education, 26(3), 540-546.

[5] Keen, D. V., Reid, F. D., & Arnone, D. (2010). Autism, ethnicity and maternal immigration. The British Journal of Psychiatry, 196(4), 274-281.

[6] Konstantinidis, E. I., Hitoglou-Antoniadou, M., Luneski, A., Bamidis, P. D., & Nikolaidou, M. M. (2009). Using affective avatars and rich multimedia content for education of children with autism. In Proceedings of the 2nd International Conference on PErvasive Technologies Related to Assistive Environments (p. 58).

[7] Mitchell, P., Parsons, S., & Leonard, A. (2007). Using virtual environments for teaching social understanding to 6 adolescents with autistic spectrum disorders. Journal of autism and developmental disorders, 37(3), 589-600.

[8] Lanyi, C. S., Geiszt, Z., Karolyi, P., Tilinger, Á., & Magyar, V. (2006). Virtual reality in special needs early education. The International Journal of Virtual Reality, 5(4), 55-68.

[9] Rutherford, M. D., & Towns, A. M. (2008). Scan path differences and similarities during emotion perception in those with and without autism spectrum disorders. Journal of autism and developmental disorders, 38(7), 1371-1381.

[10] Jones, W., Carr, K., & Klin, A. (2008). Absence of preferential looking to the eyes of approaching adults predicts level of social disability in 2-year-old toddlers with autism spectrum disorder. Archives of general psychiatry, 65(8), 946-954.

[11] Murray, D. (1997). Autism and information technology: therapy with computers. Autism and learning: a guide to good practice, 100-117.

[12] Lahiri, U., Bekele, E., Dohrmann, E., Warren, Z., & Sarkar, N. (2013). Design of a virtual reality based adaptive response technology for children with autism. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 21(1), 55-64.

[13] Center for Deases Control and Prevention. Autism Spectrum Disorder (ASD) [Online] Available from: http://www.cdc.gov/ncbddd/autism/index.html. 28 May 2016

[14] Billstedt, E., Gillberg, C., & Gillberg, C. (2005). Autism after adolescence: population-based 13-to 22-year follow-up study of 120 individuals with autism diagnosed in childhood. Journal of autism and developmental disorders, 35(3), 351-360.

[15] Eaves, L. C., & Ho, H. H. (2008). Young adult outcome of autism spectrum disorders. Journal of autism and developmental disorders, 38(4), 739-747.

[16] Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. Journal of Child Psychology and Psychiatry, 45(2), 212-229.

[17] Gal, E., Lamash, L., Bauminger-Zviely, N., Zancanaro, M., & Weiss, P. L. (2016). Using Multitouch Collaboration Technology to Enhance Social Interaction of Children with High-Functioning Autism. Physical & occupational therapy in pediatrics, 36(1), 46-58.

[18] Lund, H. H. (2009). Modular playware as a playful diagnosis tool for autistic children. In 2009 IEEE International Conference on Rehabilitation Robotics (pp. 899-904).

[19] Raising Children Network. Signs of autism spectrum disorder in older children and teenagers [Online] Available from: http://raisingchildren.net.au/articles/autism_spectrum_disorder_signs_teenagers.html. 25 May 2016

[20] Tantam, D. (2003). The challenge of adolescents and adults with Asperger syndrome. Child and adolescent psychiatric clinics of North America, 12(1), 143-163.

[21] Centre for Developmental Disability Health Victoria 2010, A.S.D. and V.M. [Online] Available from: http://www.cddh.monash.org/assets/fs-autis m.pdf. 16 May 2016

[22] Tseng, R. Y., & Yi-Luen, E. (2011). the role of Information and computer technology for children with Autism Spectrum disorder and the Facial expression Wonderland (FeW). International Journal of Computational Models and Algorithms in Medicine, 2(2), 23-41.

[23] Willemsen-Swinkels, S. H., & Buitelaar, J. K. (2002). The autistic spectrum: subgroups, boundaries, and treatment. Psychiatric Clinics, 25(4), 811-836.

[24] McGee, G. G., Feldman, R. S., & Morrier, M. J. (1997). Benchmarks of social treatment for children with autism. Journal of Autism and Developmental Disorders, 27(4), 353-364.

[25] Donnellan, A. M., Hill, D. A., & Leary, M. R. (2015). Rethinking autism: implications of sensory and movement differences for understanding and support. Autism: The Movement Perspective.

[26] Rosset, D. B., Rondan, C., Da Fonseca, D., Santos, A., Assouline, B., & Deruelle, C. (2008). Typical emotion processing for cartoon but not for real faces in children with autistic spectrum disorders. Journal of autism and developmental disorders, 38(5), 919-925.

[27] Billard, A., Robins, B., Nadel, J., & Dautenhahn, K. (2007). Building robota, a mini-humanoid robot for the rehabilitation of children with autism. Assistive Technology, 19(1), 37-49.

[28] Lund, H. H., & Marti, P. (2009). Design principles for modular playware. submitted to Interaction Design for Children (IDC'09).

[29] Anjana, R & Lavanya, M. (2014). FACIAL EMOTIONS RECOGNITION SYSTEM FOR AUTISM. International Journal of Advanced Engineering Technology. Vol. V/Issue II: p. 40-43.

[30] Egenfeldt-Nielsen, S., Smith, J. H., & Tosca, S. P. (2016). Understanding video games: The essential introduction. Routledge.

[31] Felicia, P. (2009). Digital games in schools: Handbook for teachers.

[32] Noor, H. A. M., Shahbodin, F., & Pee, N. C. (2012). Serious game for autism children: review of literature. World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 6(4), 554-559.

[33] Hassan, A. Z., Zahed, B. T., Zohora, F. T., Moosa, J. M., Salam, T., Rahman, M. M., ... & Ahmed, S. I. (2011). Developing the concept of money by interactive computer games for autistic children. In Multimedia (ISM), 2011 IEEE International Symposium on (pp. 559-564).

[34] Barakova, E., Van Wanrooij, G., Van Limpt, R., & Menting, M. (2007). Using an emergent system concept in designing interactive games for autistic children. In Proceedings of the 6th international conference on Interaction design and children (pp. 73-76).

[35] Finkelstein, S. L., Nickel, A., Harrison, L., Suma, E. A., & Barnes, T. (2009). cMotion: A new game design to teach emotion recognition and programming logic to children using virtual humans. In 2009 IEEE Virtual Reality Conference (pp. 249-250).

[36] de Urturi, Z. S., Zorrilla, A. M., & Zapirain, B. G. (2011). Serious Game based on first aid education for individuals with Autism Spectrum Disorder (ASD) using android mobile devices. In Computer Games (CGAMES), 2011 16th International Conference on (pp. 223-227).

[37] Battocchi, A., Pianesi, F., Venuti, P., Ben-Sasson, A., Gal, E., & Weiss, P. L. (2009). Collaborative puzzle game: Fostering collaboration in children with autistic spectrum disorder (ASD) and with typical development. In 2009 Virtual Rehabilitation International Conference.

[38] Wang, Q., Sourina, O., & Nguyen, M. K. (2010). Eeg-based" serious" games design for medical applications. In Cyberworlds (cw), 2010 international conference on (pp. 270-276).

[39] Habash, M. A. (2005). Assistive Technology Utilization for Autism An Outline of Technology Awareness in Special Needs Therapy. In Second International Conference on Innovations in Information Technology.

[40] Luneski, A., Konstantinidis, E. I., Hitoglou-Antoniadou, M., & Bamidis, P. D. (2008). Affective computer-aided learning for autistic children. In WOCCI (p. 7).

[41] Marnik, J., & Szela, M. (2008). Multimedia program for teaching autistic children. In Information Technologies in Biomedicine (pp. 505-512). Springer Berlin Heidelberg.

[42] Robins, B., Dautenhahn, K., Te Boekhorst, R., & Billard, A. (2005). Robotic assistants in therapy and education of children with autism: can a small humanoid robot help encourage social interaction skills?. Universal Access in the Information Society, 4(2), 105-120.

[43] Lofland, KB. (2015). The Use of Technology in the Treatment of Autism, in Technology and the Treatment of Children with Autism Spectrum Disorder. Springer. p. 27-35.

[44] Parsons, S., Mitchell, P., & Leonard, A. (2004). The use and understanding of virtual environments by adolescents with autistic spectrum disorders. Journal of Autism and Developmental disorders, 34(4), 449-466.

[45] Mechling, L. C., Gast, D. L., & Seid, N. H. (2009). Using a personal digital assistant to increase independent task completion by students with autism spectrum disorder. Journal of autism and developmental disorders, 39(10), 1420-1434.

[46] Williams, C., Wright, B., Callaghan, G., & Coughlan, B. (2002). Do children with autism learn to read more readily by computer assisted instruction or traditional book methods? A pilot study. Autism, 6(1), 71-91.

[47] Gentry, T., Wallace, J., Kvarfordt, C., & Lynch, K. B. (2010). Personal digital assistants as cognitive aids for high school students with autism: Results of a community-based trial. Journal of Vocational Rehabilitation, 32(2), 101-107.

[48] Moore, M., & Calvert, S. (2000). Brief report: Vocabulary acquisition for children with autism: Teacher or computer instruction. Journal of autism and developmental disorders, 30(4), 359-362.

[49] Mohammedali, M., Phung, D., Adams, B., & Venkatesh, S. (2011). A context-sensitive device to help people with autism cope with anxiety. In CHI'11 Extended Abstracts on Human Factors in Computing Systems (pp. 1201-1206).

[50] Autism Society. What is Autism? [Online] Available From: http://www.autism-society.org/what-is/. 26 May 2016

[51] Olney, M. F. (2000). Working with autism and other social-communication disorders. Journal of Rehabilitation, 66(4), 51.

[52] Autism Spectrum Australia. W.i.A. [Online] Available from: https://www.autismspectrum.org.au/content/what-autism. 27 May 2016

[53] Konstantinidis, E. I., Luneski, A., Frantzidis, C. A., Costas, P., & Bamidis, P. D. (2009). A proposed framework of an interactive semi-virtual environment for enhanced education of children with autism spectrum disorders. In computer-based medical systems, 2009. CBMS 2009. 22nd IEEE international symposium on (pp. 1-6).

[54] Nganji, J. T. (2012). Designing disability-aware e-learning systems: disabled students' recommendations. International Journal of Advanced Science and Technology, 48(6), 1-70.