Role of Emotion Recognition in Computive Assistive Learning for Autistic Person

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Abstract

Objectives: Computer Assisted Learning (CAL) methods are extensively used to provide assistance to individual's suffering from Autism Spectrum Disorder (ASD). Computer assisted technology has proved to be one of the powerful support tools to aid person suffering from cognitive disabilities to improve their daily life conditions. However, the individual's suffering from Autism lack the ability to interpret emotions and hence are unable to respond to other person's emotion. CAL techniquescan assist these individuals in improving their social behaviour. **Method/Statistical Analysis:** The statistical analysis has been performed that showsincrease in the count of individuals suffering from autism in recent years. To enhance the condition of such individual's several CAL techniques have been implemented. This paper describes the analysis of varied CAL techniques implemented to improve the daily life conditions of such special people. **Finding:** The review combines the published documentation to explicate the benefits of implementing computer assisted learning (CAL) in the field of recognizing emotions and educating such special people about skills essential to perform daily life activities. **Applications/Improvements:** CAL techniques comprise of varied applications that emphasize on enhancing the communication, behavioural and social skills of such special children. However, person suffering from autism is unable to recognize emotions due to lack of social skills. Therefore, there is quintessential need of developing an efficient emotion recognition system for such special individuals.

Keywords: Autism, Autism Spectrum Disorder(ASD), Computer Assisted Learning(CAL), Emotion Recognition

1. Introduction

Autism is a biotic brain disorder that symbolically prevails the capability to interact, communicate and deduce people actions and events. The extent and diversity of symptoms differ in each individual. According to Diagnostic and Statistical Manual of Mental Disorders(DSM-5)¹, Autism is compound neurological disorder in which an individual suffering from it is lacks ability to conduct normal activities such as communication, social and behavioural skills.

The measure of Intelligent Quotient for a normal person is 100. However, if Intelligent Quotient is below 70 then the child is considered to be intellectually disabled². If the Intelligent Quotient is in range from 55 to 70 then the child suffers from mild cognitive disability and if the Intelligent Quotient is below 30 then the child suffers from severe cognitive disability. A child with serious cognitive disability requires assistance for daily life activities. However, child with mild or minor intellectual disability may perform activities as though the disability even exist.

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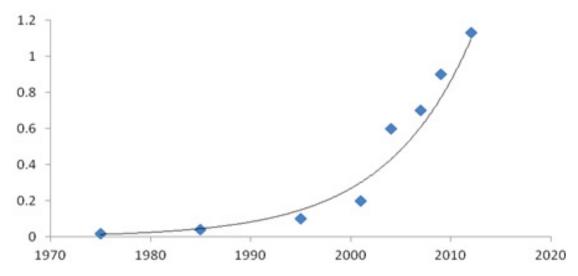


Figure 1. Prevelanve of ASD in 50 years (Data from autism speaks and CDC, USA).

Autism spectrum disorder is also termed as Pervasive Developmental Disorder. This disability is explicated as a spectrum for the reason that severity of this disorder in an individual can vary from mild to severe depending upon the syndrome. However the legitimate cause of autism is so far not known by the researchers, nevertheless conferred to the recent exploration there are plentiful reasons of developing autism spectrum disorder inclusive of neurological aspect, discrete form of infections and one of the reason is complication at the time of child's birth. Despite there is no consent about pervasiveness of ASD as there is diverse autism associated syndrome confer to clinical norms³. Moreover, the studies depict an increase in number of Autism casesthat illustrate that 1 individual in 150 is suffering from ASD4. The Figure 1 depicts raise in prevalence of ASD.

The latest analysis conducted by Centres for disease control and prevention shows that 1 in 68 was diagnosed with ASD in USA. It is estimated that in India 5-10% of children (approx. 3crores) are suffering from autism spectrum disorder², and the count can be much higher due to lack of awareness about cognitive disabilities among people. Sometimes the parents are unaware about the

presence of autism symptoms in their child, though the child might possess mild disorder. Recent research depict an increase in ASD and certain studies have accredit it to preeminent attention³, detection and realization of the disorder. Due to escalation in recognized instance of ASD, several software and hardware applications to aid person suffering from autism have been developed. Such technology that aid an individual suffering from ASD to enhance their skills is referred as Computer Assistive Learning⁵. Computer assistive technology have facilitate person suffering from distinct disorders in every aspect of life and have provided favourable circumstances for autistic person to develop into an effective comrade of society. Emotion recognition is the measure to determine an individual's emotion usually by facial interpretation. Emotions are considered to be developed by their robust virtue of dealing with basic daily life activities. Every emotion consist of distinct characteristic. Each emotion may have common feature in contrast to other emotion like impetuous instance, shortened stretch and consistency in reaction. All the characteristics of emotions are the outcome of our evolvement. There are six fundamen-

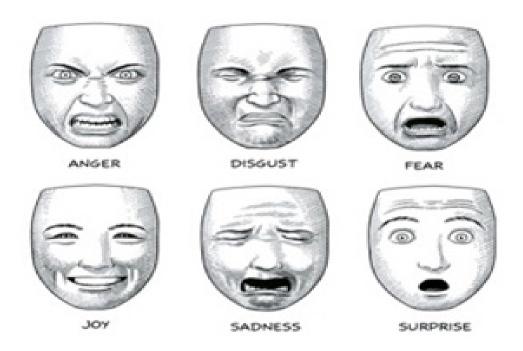


Figure 2. Ekman. Six basic emotions.

tal emotions: happy, sad, surprise, fear, disgust and anger⁶. Figure 2 represents the basic emotions.

People suffering from Autism Spectrum Disorder (ASD) bear problem in interpreting, determining, and reacting to the facial expression of other individuals. Therefore, problem in interpreting the sentiments and intellectual conditions of others plays a vital part in affecting the social and communication skills of individuals suffering from autism spectrum disorder (ASD)^Z. The emotion recognition problems are related to transformed consciousness, intuitive, intellectual and neurological measures. Person having Autism Spectrum Disorder (ASD) measures the facial interpretation abnormally and display lessened attentiveness towards facial interpretation⁸.

The paper is further divided into three sections: Section 2 describes about the role of computer assistive technology for people suffering from Autism Spectrum Disorder (ASD), Section 3 illustrates recognizing emotions with help of computer assistive techniques, and Section 4 presents discussion and future scope.

2. Role of Computer Assistive Learning (CAL) for Autism Spectrum Disorder (ASD)

Computer Assisted Learning (CAL) is a technique which has been implemented extensively to aid and provide support to people suffering from ASD. It is a technique that utilizes computing device such as mobiles, iPhone, iPad to assist individual's suffering from Autism. Autism Spectrum Disorder comprises of distinct disorders that makes difficult for the person suffering from ASD to conduct everyday activities². It is essential to understand the requirements of people with Autism. Technology can aid autistic people to enhance their skills in different aspects like behavioural, social and communication. Recent

standardized survey¹⁰ signifies that computer assisted learning (CAL) can act as supporting tool for people with ASD to represent their emotions and feelings. Several computer assisted applications are developed especially for individuals suffering from ASD to improve their living conditions. Assistive technology plays a vital role in life of person suffering from Autism Spectrum Disorder(ASD). Various computer assisted application have been developed targeting the individuals suffering from Autism. Whenever an individual is affirmed with autism, there is an essential need of clinical therapies which is followed by consistent tutoring. Moreover, the treatment and therapies can be costly and may be time consuming thus affecting the individual's family. The advantage of utilizing these computer assisted technology is that it will produce a consistent aid to person suffering from autism. Moreover it will also lessen the strain on family of Autistic Children.

2.1 How Computer Assisted Learning (CAL) can Help Autistic People

With the evolution of technology it is feasible to build systematic and absolute virtual environment and can be utilized effectively as a support tool in various aspects of life. Usually people suffering from intellectual disorders have problems with decision making abilities, logical reasoning, language, learning, and memory related problems. However, CAL technologies lay emphasize on enhancing intellect, social and behavioural skills. Assistive technology that include virtual environment provide an opportunity for autistic person to improve their learning skills. Assistive technology can be diversified ranging from basic techniques to advanced computing technologies. Ideally these assistive technologies can be categorized as low, medium and high technology. The low technology includes basic medium of cards and papers which act as pictorial expertise for communication. These pictorial cards include the daily routine activities, break cards, choice cards, and stories. Medium technology includes visual presentation system such as Voice Output Communication Aids, Talk Pad, Language Master. High technology includes virtual learning environment that includes mobile devices, iPads, and robots.

Several researches have shown that children suffering from autism have a tendency to interpret visual expertise easily in contrast to audio expertise. In particular, the pictorial expertise are proved to be highly effective, this is the reason that low technology method includes a basic mode of paper and cardboards. Many of the autistic children sometimes get very confused about their daily habits and routines, thus a sequence of tasks or scheduling is required. Therefore, visual schedules are applied to provide autistic children a scenario about what is currently going on, what is to be done, and what is already done. Pictorial information act as a guide to special children.

Studies¹¹⁻¹⁵ depict that interactive computing games can aid people with disorders to improve their social and behavioural skills. In one of the study the author has proposed an interactive gaming desktop application for children who are suffering from autism spectrum disorder to improve their speech proficiency and fluency with help of technological application. They developed three main segments of game, in the initial segment two desktops were remotely connected to each other with the help of socket technology available in Java programming language. The next segment of the game consisted of front end application and the third segment consist of maintaining database for amendment of images and results. The approach followed was that the child will be on one side of desktop and on another side there will be instructor. The images will appear on the screen and the child sitting on the front end will have to recognize the images and utter the names of images forming a sentence, if the child utters the sentence correctly then the child win. However, the limitation of the performed research work is that the child is first trained to enhance his/her vocabulary skills before playing the game thus making the research work not substantial. In another study¹² the author proposed gaming application for children who are suffering from Asperger's syndrome. Asperger syndrome comes under the category of Autism Spectrum Disorder (ASD), in which is an intellectual disorder and the child suffers some of the physical and intelligence disorders. Such children are not eugenically interactive and some of the children might be nonverbal. Even in some of the situations the child is intelligent enough to frame sentences in

his/her mind but they find it difficult to utter a word and might not be able to produce articulatory sounds. Thus, the author have proposed a web application for such children to enhance their social and communicational skills. The game application consists of connecting of two game applications run on desktops, one for puzzle game while another is Picture Exchange Communication System application and these two desktop application were linked with web application with help of bridge present between the two functions to interact with each other. It also includes speech recognition synthesis performed with help of utilizing an interactive speech functional interface developed by Microsoft. The child can play any of the game application, the purpose of the research work is to improve the daily life conditions of such special children.

Another research work¹³ proposed a gaming desktop functionality for child suffering from intellectual disability to enhance their behavioural and learning skills. The proposed game comprise of two sections; one for management of data and results and another section for playing game. The gaming approach followed by the authors in the study performed was that in the basic level of game a set of certain images will appear on the screen and the child will recognize the name of the image visible on the screen, once the image is recognized by the child then he/she will pronounce the names of the image and the speech of the child will be converted to text with the help of using a speech recognition model developed with help of Sphinx4. The text will appear on the top of the screen. While in the foremost level of the game an object image will appear on the screen and if the child pronounces the name of the object correctly then the image will be coloured with a specific colour thus making the game interactive. The results of the games are analysed on the basis of whether the child has spoken the word correctly or not. In14 the author has developed a mobile gaming application known as "Go Go Games", to help the children undergoing intellectual disorder to develop the understanding of managing multiform jobs. The mobile application has been developed for the iPhone devices that consist of iOS platform. The purpose of conducting the research work by the authors was to make child learn about to manage simultaneous occurrence of different application while taking the device therapeutic -'sittings. The application subsist three types of distinct games and the child was given the mobile and the teachers were not let to help the child with running the device applications instead they were allotted a job of observing the behaviour of child while using the mobile application. It was concluded that initially the child showed no interest in playing the games but after sometime the child developed its interest in the game.

Study¹⁵ proposed a unique methodology of educating the children with intellectual disorders about the concept of money. Teaching such special children about the concept of money is also essential, so that no person can misuse the learning disability of such special children. Children suffering from learning disability lack cultural, behavioural and communication skills required to perform daily life activities. The research work targeted the children with group of age ranging from 9 to 14 years and the main aim of conducting this research work is to make children teach about the concept of money such as recognizing rupees, how to purchase individual or manifold stuff from shop, understanding transaction of money, what kind of behaviour is required while purchasing items from a shop, and also to interpret and recognition of various money combinations. A digital story telling application have been developed to teach intellectually disabled children about the concept of money. The application comprises of various levels starting from initial level in which the child was made to learn about how to purchase individual item from shop to advanced level where the child was allowed to purchase manifold item with certain amount of available budget. Various items to be purchased were displayed on the screen along with sequence of money, the child would buy the items and generate combination of money to purchase it from shopkeeper. However, intellectual disorder cannot be cured, but such device therapies can aid such children to improve some of their daily life skills. Another study discussed about how assistive technology can aid individuals having intellectual disability. The author discussed about the need of developing technology for children with autism and also provides an overview of almost all of the cognitive disorders.

3. Emotion Recognition Based Computer Assistive Learning Techniques

Emotion is compound involvement of understanding person's mental state of collaborating with innermost and outermost environment. An efficient human interaction involves knowledge of facial interpretation, body language, intonation, glare and hand movements¹⁷⁻¹⁸. A few days old toddler can interpret facial expressions and by the age of 3 a small child can utilize these fundamental emotions (happy, angry, sad, disgust, fear, surprise) in their communications. However, the individual's suffering from Autism are not efficient enough to interpret the emotions neither they are able to respond to other person's emotion. Emotions can be defined by two measures that is: high versus low and positive versus negative^{19,20}. Figure 3 depicts emotions based on these two measures.

Emotion recognition mechanisms commonly follows few basic steps. Figure 4 describes emotion recognition system²¹ in general. The first step is to acquire the signals which generally originates from brain (neurological aspect), which is followed by processing of signals that include feature selection and classification. Research in cognitive science affirms that interactive applications that include robots, and games can assist in developing emotional intelligence in person suffering from autism.

In Study²², the author have proposed a method for people suffering from Asperger's Disorder. They developed a wearable application that access facial expressions autonomously as people with Asperger syndrome confront problem in interpreting other person's emotion. The technique used for detecting emotion was Support vector Machine (SVM) algorithms. The system proposed by the author follow a procedure that manage an output device that looks like a glove. For distinct form of emo-

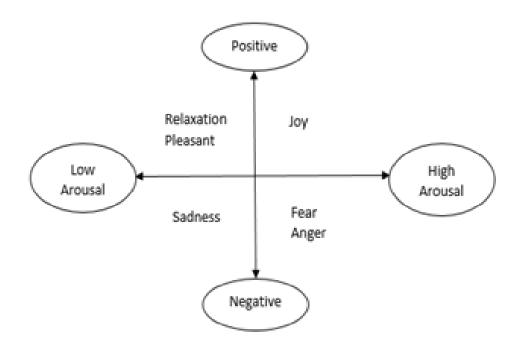


Figure 3. Emotions based on two dimensions.

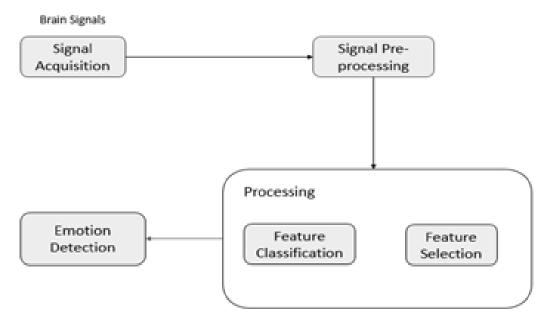


Figure 4. Emotion recognition system.

tions force was applied to different fingers. The magnitude of emotion was measured by the force applied on distinct fingers. In research work²⁰ the author developed an android application with name of "CaptureMy Emotion" that utilize wireless sensor device to detect emotions. The application enables the child to capture multiple videos and photos of their facial expressions. The photos are then trained with help of using OpenCV libraries. The algorithm compares the photos in real time with trained data set to display the result of facial expression. Thus the application can be considered beneficial for autistic person to make them learn about emotions. In research work23 the author have proposed a computer speech based therapy with help of using multimodal emotion recognition techniques. Author have laid emphasize on adopting refined technique to detect emotions of child as it play an important role in speech. In research paper²⁴ author have proposed unique method to improve the feature selection and accuracy of an image. Another research work²⁵ proposed a portative device, capable enough to aid people with autism in speech and communication in actual

time state. Such portative mechanism will reduce the gap between real time environment and Autism world.

4. Discussion and Future Scope

People suffering from autism ideally seems to be natural in when it comes to their appearance. However, they are uniquely identifiable from other normal mature individuals when it comes to their behaviour. They have are least interested in unfamiliar faces, sometimes they don't even show interest towards their parents. They possess stereotype behaviour and have habit of repeating an activity again and again without any purpose. Nevertheless some of the individuals having Autism disorder may be manifested by special talents in field of sports, music, mathematics although such kind of syndrome is rarely present. The major concern for such special individual is about teaching them emotions so that they can respond back to other person emotion and be able to express themselves. Looking forward in this context we are in the

process of developing an emotion recognition system for autistic person, in which an application will be developed through which the real time images will be acquired with help of wearable camera. The images will be analysed by the system and result will be displayed depicting other person's emotion. Therefore, every individual suffering from autism needs special care and help and there is an essential need of developing a system or technological tools that can help such special people to analyse emotions in real time.

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