Facial Expression Recognition System for Autistic Children in Virtual Reality Environment

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Abstract- Autism Spectrum Disorder (ASD) may be viewed as a neuro developmental disability that can affect social interaction, language (or) behavioral skills of children. Most autistic children show symptoms of withdrawal from social interaction and a lack of emotional empathy towards others. The underlying causes of ASD are still not well understood but an alarming number of children are diagnosed and also suffered from this disorder. Among the fundamental social impairments in the ASD are challenges appropriately recognizing and responding to nonverbal cues and communication. Several existing assistive devices mostly serve as remedial tool that provides a learning environment for autistic children to learn about the norms and difficulties of social behavior. However this tool lacks the capability to operate in conjunction with real world scenarios. So we proposed a new intervention paradigm that act as a portable system called facial expression recognition system that recognizes virtual reality (VR) based facial expressions in a synchronous manner and also to break the dependency of an autistic child by enhancing expression based accessing and controlling process in this modern environment.

Index Terms- autism spectrum disorder,nonverbal communication,facial expression,virtual reality

I. INTRODUCTION

Autism Spectrum Disorders (ASD) is characterized by atypical patterns of behaviors and impairments in social communication [1]. Studies have found that children with ASD in a controlled environment were able to perform basic facial recognition tasks as well as their control peers, but they are often failed in identifying more complex expressions as well as required more prompts and more time to respond to facial emotional expression understanding tasks. In general, children with ASD have shown significant impairment in processing and understanding complex and dynamically displayed facial expressions of emotion .The human face is an important human body part which plays an extraordinary role in the human to human or human to machine communications. As such, it is essential to design robust emotion detection system for real world applications like human decision making and effective human computer interaction [2]. Our paper mainly focuses on human computer interaction via facial expressions. Social Interaction is the use of non-verbal or verbal communication to engage in interaction with people. This may involve speech, body postures, gestures, eye gaze and facial expressions used to initiate and respond to interaction with other. Autistic children face tremendous difficulties in understanding social cues and conventions; they are unable to properly express non-verbal communication and body language. These inabilities hinder them from understanding verbal and non-verbal communications, as well as reading human facial expressions effectively. The ability to identify and determine one's emotions can serve as an empowerment for the field of artificial intelligence and give rise to smarter, more powerful machines that understands the intention of users. An intelligent machine with emotional awareness can achieve the shortcomings of autistic children. With that emotional awareness, the machine is capable of teaching and guiding autistic child on how to respond appropriately when the person that he or she is communicating with is expressing various emotions [1]. Such machine has the potential to bridge the communication chasm between the society and those diagnosed with autism.

II. SOCIAL COMMUNICATION

Children with ASD usually have difficulties to interacting or communicating with other people. Conversation relies on two peoples listening to each other and taking their turns to speak. For children with autism, this is a particular problem. Children who have ASD are attempted to address several difficulties. Some important early communication characteristics of this group are

- Limitation in speech, even not responding to their name itself
- Reduced communication rates
- Deficits in skills including coordinating attention between objects and people, following the gaze and gestures of others, shifting gaze between objects (or) people for the purpose of directing another's attention and also for sharing experiences.
- Deficits in symbolic languages and also in imitation of vocal and other behaviors.
- Limitation in the range of communicative intentions like requests and protests

Communication problem in children with autism are differentiated in many ways based on the problem type and severity. Some children have severe communication problems even they do not speak at all while other children have delayed, unusual speech that makes it difficult to communicate with others and also have trouble to express their own needs itself [12] . A smaller group of children's have better speech but they have some problems regarding how to use language to communicate

with others. Based on the problem type and severity children with ASD are categorized as

A. Verbal Children

Some children with autism acquire functional speech .they will begin to speak (or) acquire speech more slowly and unevenly [12]. Some children use words but the words are not effectively used to communicate. Verbal children acquire two major problems

1) Receptive Language (or) Comprehension Problems

- Difficult in understanding the meaning of what others say
- Literal usage and interpretation of what others say, e.g. "put your socks properly"
- Difficult in understanding a sequence of conditions/instructions
- Lack of understanding the metaphor, e.g. "shake a hand"

2) Expressive Language Problems

- Development of speech may occur very slowly and also previously learned words may disappear
- The same word is repeated over and over
- Speech may come delayed or unusual, sentences may be spoken out of blue
- Echolalia (repeated words or phrases) may be present in any forms
- Pronouns are often confused and reversed
- Tone, modulation and pitch may be too loud (or) too soft.

B. Non-Verbal Children

Some children with autism have non-functional speech. They express their feelings and share their ideas without use of words. Messages can be communicated through gestures, eye contact, body postures and facial expression. Children who are non-verbal must be able to convey their needs to others in some way because they have strong underlying social deficits and problem with joint attention [12]. It is important to assess how the non-verbal child expresses his/her needs and get his/her message across to others. Now days there are several augmented communication systems were developed for improving non-verbal communication.

Augmentative communication helps children who don't have speech so they communicate by using other system. These systems are called "augmentative" because they increase the strength of the child power to communicate. Some augmented systems are signing, pictographs, photographs and objects, picture exchange communication system (PECS)

1) Signing

Signing was first alternate system used for non-verbal children with autism. Signs are very portable and do not require the children to carry around equipment. Signs are simple, concrete and do not require difficult finger spelling. Many of the first signs use only one hand. For example, the sign for "drink" uses one hand in the shape of a cup that is lifted to the mouth and titled as if the child were having a drink.

2) Pictographs (line drawings)

Children who have low cognitive skills (or) otherwise called as low functioning people with autism can generally use a picture system to communicate more effectively. When children are familiar with picture system, they can be put into books that the child carries with him/her and also used to indicate their own needs.

3) Photographs and objects

One advantage of photographs and objects is that the child can attend to them for as long as he/she needs and return to them to refresh their memory. This system is mostly useful for low functioning children. Use of photographs usually requires that the child first learn to match an actual object with an exact photograph of the object.

4) Picture Exchange Communication System (PECS)

PECS is widely used to teach children how to initiate communication. An advantage of this system is that it does not require complex (or) expensive materials and can be used in a variety of settings by parents, caretakers and teachers. Picture based system to help improve the Childs communications will depend upon his/her level of cognitive and language ability and mainly developmental profile of strengths and weakness.

This paper was mainly focusing on non-verbal children interaction (or) communication with the help of another real-time an emerging system called facial expression recognition system was developed to break the manual intervention and dependency of an autistic child.

III. EARLY INTERVENTION SYSTEM

Non-verbal child expresses his/her needs and communicate with others using several augmented system. This system must need manual intervention to train an autistic child. Early augmented system like signing has major disadvantage that it might understood only with in their communities but outside the circle of those child who can sign with him/ her may not always be well understood. Signing also requires person for teaching the signs to the autistic child. Pictographs and PECS are useful only for low cognitive functioning child because they are completely non-verbal and even do not communicate with the closest of the family members. Before the usage of PECS system, speech language pathologist (SLP) should provide a comprehensive assessment for evaluating the autistic child. Testing tools are used to gather data include standardized assessment, qualitative measures, screeners, observation and records review. This system required manual intervention called SLP as well as it can useful only for mild autistic child with good IQ .ultimately , the choice of system to improve autistic child communication will depend on language ability , cognitive ability and developmental profile of strengths/weakness . PECS requires more assessment efforts to teach children how to initiate communication. Later innovative VR-based facial emotional recognition system was developed

that allows monitoring of physiological signals and eye gaze of an autistic child for emotion identification. However, VR systems applied in the context of autism therapy focus on explicit user feedback as primary means of evaluation so it lacks adaptability. This intervention system was not accessible to the vast majority of child with ASD due to lack of trained therapists and intervention costs. VR-based system uses head mounted display (HMD) as VR tool that can be rated as heavy and discomfort. The main problem found in existing system was classification based on one emotional label per input utterance if the expression cannot be well captured by single emotional label then multiple algorithms are needed for finding the emotion . Innovative technology promises alternative therapeutic system called facial expression recognition system based on desktop VR tool with comfort and reduced intervention cost as well as decreasing assessment efforts, promoting intervention and ultimately skill generalization. We believe that such ability will provide insight to the emotion recognition process of children with ASD and eventually help in designing new intervention paradigms to address the emotion recognition vulnerabilities.

IV. DIAGNOISING TOOL: CHILDHOOD AUTISM RATING SCALE (CARS)

A. History of Autism Diagnostic Tool

In 1828, Itard has made first attempt to differentiate children with “intellectual mutism” from mentally retarded children. Itard has described some key symptoms for intellectual mutism are language disabilities , preoccupation with their own needs , deficits in memory as well as poor sense of imitation . Finally, Itard considered intellectual mutism is totally differ from a psychological state [11].

In 1911, Blueler coined the term “autism” while studying schizophrenia. Autism has considered as a central symptom for schizophrenia (Minkowski, 1927). He defined the key features of autism as a lack of social-relation system and also social withdrawal.

In 1943, Kanner was the first to distinguish between autism and childhood schizophrenia. He described a group of children identified as “infantile autism”. Kanner regarded a lack of need for other and preference for aloneness as major symptoms of infantile autism. Kanner was unclear and confused by the fact to regard some of the criteria as non- essential such as good cognitive potentialities and physically essentially normal [11].

In 1956, Kanner and Eisenberg named five distinct features of autism (i) failure to use language for the purpose of communication (ii) good cognitive potential (iii) fascination for objects which are handled (iv) Extreme detachment from human relationship (v) limitation in the variety of spontaneous activity.

In 1960, Creak has published nine criteria for the diagnosis of autism were (i) sustained impairment of emotional relationship with people (ii) abnormal behavior toward self (iii) pathological preoccupation with particular objects (iv)abnormal perceptual experience (v) distortion in patterns like locking , spinning , hyperkinesias (vi) excessive and acute illogical anxiety (vii) lack of development in speech (viii) background of serious mental retardation (ix) sustained resistance and striving maintain.

In 1967, O’Gorman offered an alternative model based on Creak’s group criteria. He concluded only one criterion as particular symptom for autism i.e “withdrawal from people”. He published six important features of autism are (i) failure to involved with reality (ii) failure to acquire speech (or) improve on speech already learned (iii) exceptional intellectual function (iv) pathological resistance to change like severe anger (or) terror , excitement , attachment to objects (v) abnormal response to one (or) more types of sensory stimulus (vi) peculiarities of movement.

In 1977, Autism Society of America described autism as a developmental disorder (Ritvo & Freeman , 1977) . They defined autism as severely lifelong developmental disability that appeared during 3 years of age. The four criteria were (i) abnormal responses to sensations (ii) abnormal ways of relating to people, objects and events (iii) disturbance in the rate of appearance of social, physical and language skills (iv)delayed speech and language. He suggested that social problems and communication were central symptoms of autism.

In 1978, Rutter suggested that there are four essential for the diagnosis for autism: (i) diagnose before 30 months of age (ii) impaired development of communication (or) abnormal language (iii) social impairment that do not reflect mental retardation (iv) Stereotypical behaviors.

In 1980, the two prior edition of DSM (edition I and II) has excluded the autism. Autism was first included in the third edition of Diagnostic and Statistical Manual of Mental Disorder (DSM-III). Adoption of the term pervasive developmental disorder emphasized the developmental aspects or abnormalities that occur during childhood developmental process itself. Four criteria of autism were included (i) Age of onset under 30 months (ii) communication deficits (iii) perseverative behavior (iv) lack of relatedness.

In 1987, American Psychiatric Association published DSM-III-R and listed in one of three major categories: (i) qualitative impairment in reciprocal social interaction (ii) qualitative impairments of verbal and nonverbal communication skills and activities of imagination (iii) markedly restricted repertoire of activities and interests.

In 1994, DSM-IV/ ICD-10 characterize autism by deficits in three areas (i) social interaction (ii) communication and (iii) patterns of behavior, interests and activities. A total of six or more criteria from three areas with at least two from social interaction and one each from communication and patterns of behavior, interests and activities must be present in order for a child to receive a diagnosis of autism.

B. Childhood Autism Rating Scale

The CARS was first utilized by diagnosticians for observing the autistic children which is done by qualified professionals. They conduct physiological and behavioral evaluations such as clinical observation, psychological testing, parental report of developmental and health histories, speech and language assessment. Goldfischer in 2002 said that the CARS is considered the “Gold Standard” for assessing autism. His results provided additional support for the utility of new factor based scoring of the CARS.

The CARS was first called as Childhood Psychosis Rating Scale .it was developed mainly for TEACCH (Treatment and Education of Autistic and related Communication Handicapped Children).the CARS consist of 15-item behavioral rating scale which is utilized by trained diagnosticians, professionals,

caregivers or parents for observation about their child. The main purpose is to identify children with autism and to distinguish them from developmentally delayed children .it is especially effective in discriminating between children with autism and those who are mentally retarded and also able to distinguish among children from mild to moderate and moderate to severe autism [11].

When a child is being observed by professionals, brief discussions and notes are made on the form and ratings are completed only when all data have been collected then the child behavior is compared with normative children of same age finally peculiarity, frequency, intensity and duration of behaviors are noted [11]. Behavioral assessments are: Relating to People, Imitation, Emotional Response, Body Use, Object Use, Adaption to Change, Visual Response, Listening Response, Taste, Smell, and Touch Response and Use, Fear or Nervousness, Verbal Communication, Nonverbal Communication, Activity Level, Level and Consistency of Intellectual Response, General Impressions.

Each of the 15 item is given as rating that should be done within 1-4 range (including midpoints).1: Normal Child, 2: Mildly Abnormal, 3: Moderately Abnormal, 4: Severely Abnormal. A total score is computed by summing the 15 individual ratings which can range from 15 to 60.the scores below 30 in children categorized as non autistic, 30-36.5 indicating mild to moderate autism, 37-above are categorized as severe autism. Finally

The children who received the diagnosis of autism using CARS are numbered as 25 from n=40 (5-10 age) children at the developmental disability center called Aadhuraa special school

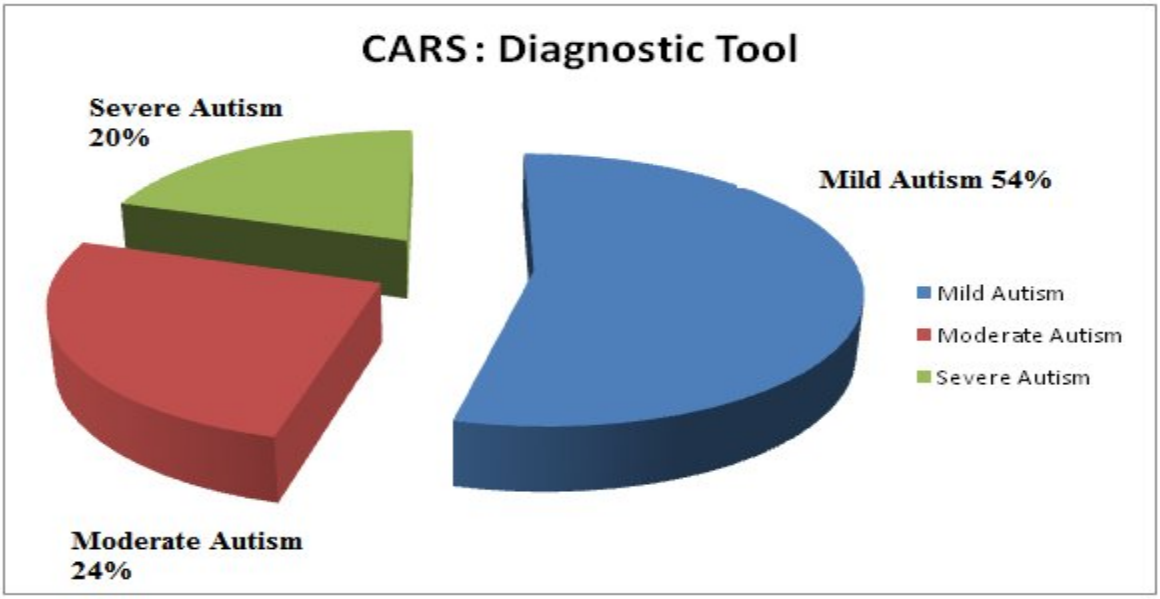


Figure 1 : Diagnostic Classification according to CARS (N=25 Autistic Disorder)

V. COMPARITIVE STUDY : NORMATIVE VS AUTISTIC CHILDREN

To analyze the communication of an autistic child first we have to recognize the normal children with 5 different kinds of emotions. The normative samples are collected from "Government Elementary School, vaiyavoor village, Kanchipuram". I analyzed 40 normal children under the age group of 5-9 .These children express their emotions in efficient manner and their communication is mostly verbal. Children learning capability differs in many ways. Some children are fast learners where as some children are slow so it is must not to compare one child's language development with another. A child communication was mostly depends on parent behavior. Parent has to talk in natural way so that he or she respond and listen to the sounds. Read stories together from an early age and also make communicating fun.

To identify whether the children is affected by autism or not, several evaluations has to be carried out to understand the characteristics of an autistic children. Speech Language Pathologist – "communication expert" plays an important role in team evaluation apart from others [psychologist, Educational Diagnostician, Occupational Therapist].SLP specializes in treatment of both language as well as communication skills. They identify the effectiveness and communicative intent of the autistic child and then maintain a review of records to classify the autistic children as mild, moderate and severe according to the CARS diagnostic tool.

In some cases, communication strengths and weakness are directly impacted by responses to the environment. Some of the testing tools used to gather data are standardized assessment, qualitive measures, screeners, observation and record review. Therefore assessment intervention is a lifelong necessity for children with ASD [13].

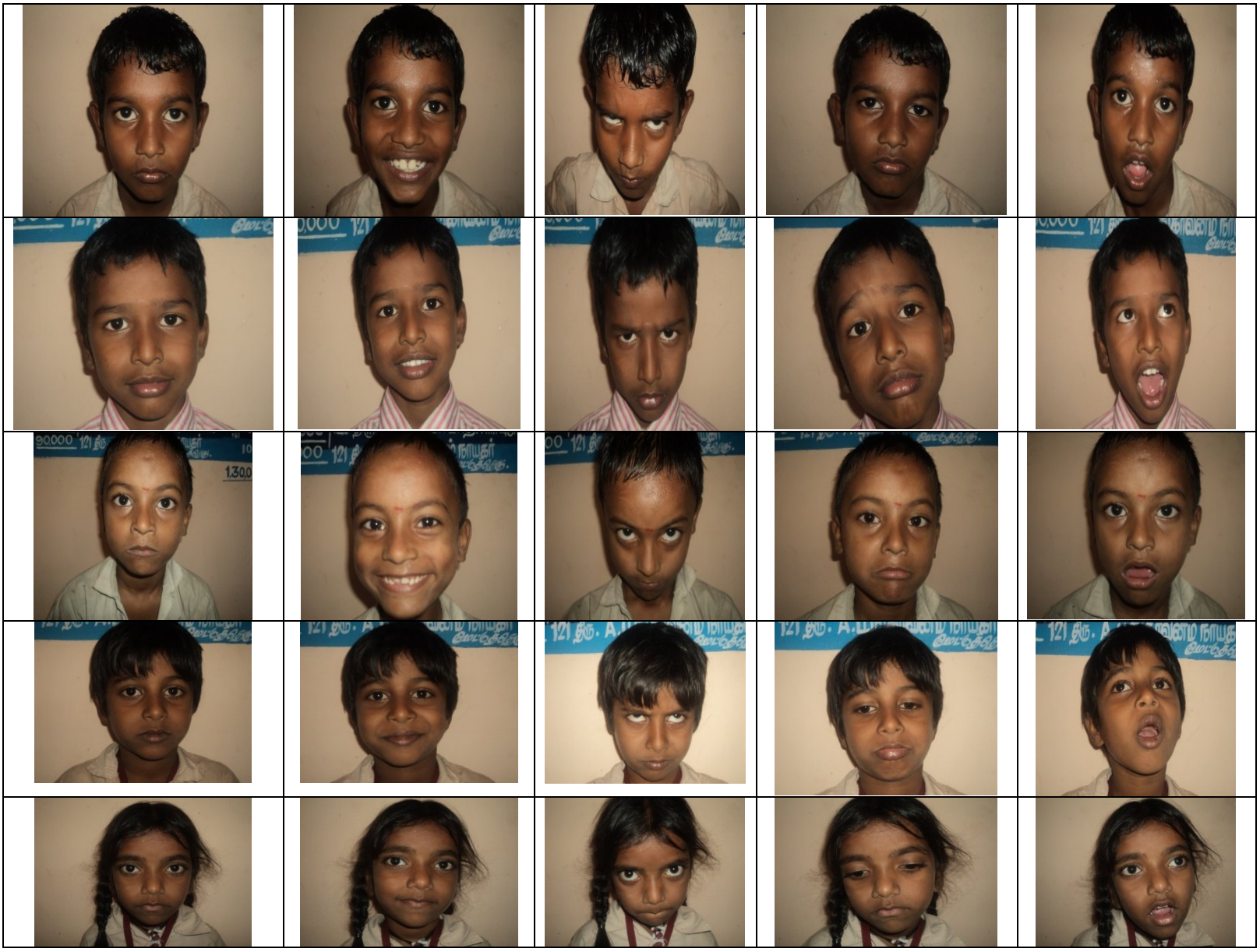


Figure 2 Normative Samples with 5 different kinds of emotions (i) Neutral (ii) Smile (iii) Angry (iv) Sad (v) Surprised

Autistic child express their emotions by means of speech or non-verbal communication like gestures, body postures, eye gaze and facial expression. According to the Severity range, mild autistic children express their emotions like normative children so this application is more feasible and helpful compared to moderate and severe autistic children. For moderate & severe autistic children, adequate training has been required to express their own emotions. After training, some children also lacking in their communication to express themselves for their own needs. To overcome this demerit training duration must have to exceed and therapist has to provide language assessment regularly to utilize this system.

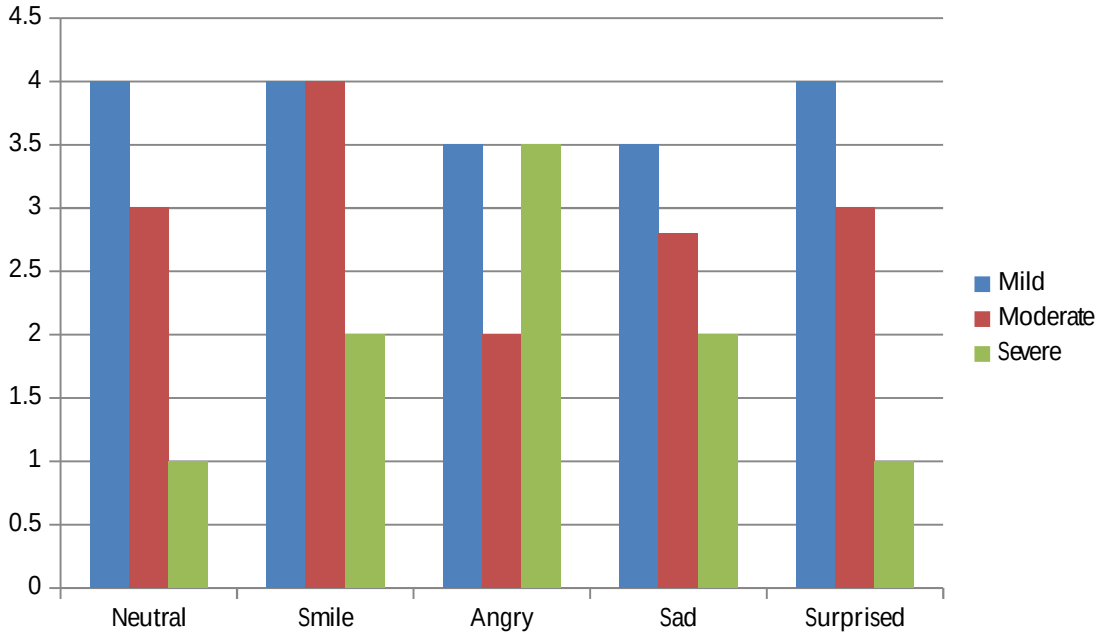


Figure 3 Autistic Children express their Emotions in Different Rating according to CARS Diagnostic Tool

VI. SYSTEM DESIGN

A. Virtual Reality in Autism

VR offers particular benefits for children with autism. It provides a context free environment in which many children with autism feel comfortable and therapist, teachers can use VR tools such as head mounted display, standard desktop computer to simulate real (or) imaginary environments moreover teach life skills and social skills.VR may be particularly useful for child with cognitive and perceptual impairments because the technology can assist in problem solving, planning, management of behavior and offer powerful communicative facilities for children with limited expressive language .virtual environment could be particularly helpful for children on the autism spectrum because the use has active control over their participation.

B. Experimental Setup

The VR environment focuses the level and the number of non-verbal features of communication can be easily controlled and manipulated. The VR task was presented using a 24'' flat LCD panel monitor. An experiment was performed in a laboratory with two rooms separated by one-way glass windows for caregiver observation. In the inner room, the subject sat in front of the task computer. The caregivers sat in the outside room. A therapist was present in the inner room to monitor the process. The task computer monitor was also routed to the outer room for caregiver observation during training session. The session was video recorded for the whole duration of participation

C. Architectural Design

When an image is captured by a web camera; it can be further processed to identify different kind of facial expressions such as surprise, smile, sad, angry, neutral etc .In skin tone detection, it can isolates the presence of faces, arms, hands and gestures of the autistic child. Skin detector typically transforms a given pixel in to RGB color space and then uses skin classifier to label the pixel whether it is skin or non-skin pixel there by confirm face acquisition through common features on the face.RGB color space eliminates the influence of varying illumination to the best extent. Then face clipped image is further processed by texture descriptor known as Weber's local descriptor (WLD) exploits textual nature of human face as well as relationship between component features via eyes, nose and mouth to detect face patterns and reduce the dimension of the feature space. This descriptor makes facial features darker for efficient feature extraction. Then feature extraction module partition the image in to constituent parts to extract facial features.

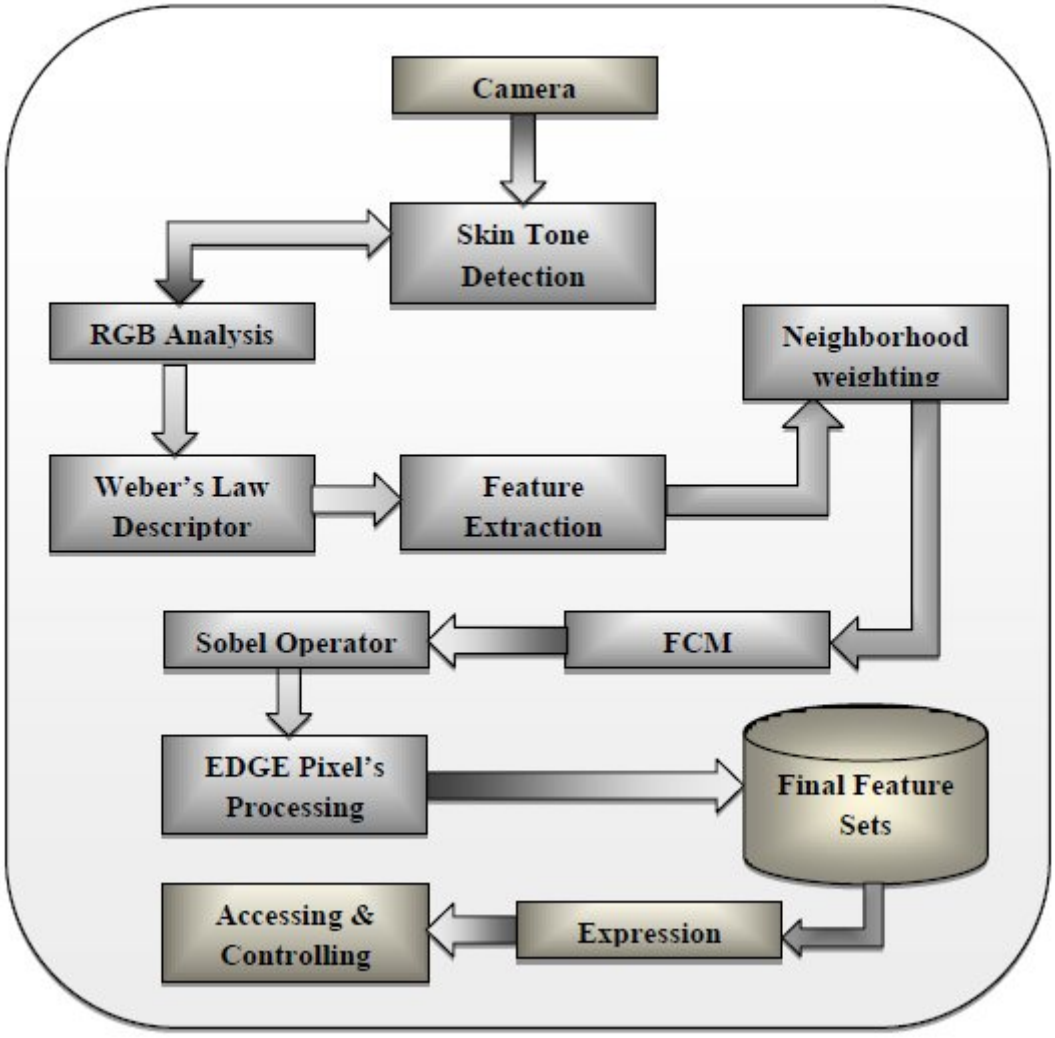


Figure 4 VR-based facial expression recognition system

The end result of extraction task is a set of features commonly called feature vector which constituents a representation of the image. Feature vector can be coarsely classified in to transient features (cheeks, nose, and ears) and intransient features (eyes, eyebrows, mouth) which are analyzed by neighborhood weighting. After that feature selection is used to reduce the feature space which improves prediction accuracy and minimizes computation time. The goal of feature selection is to choose only a subset of intransient features by eliminating unnecessary features. The selected intransient features are used for finding out the facial expression vectors by calculating their difference from average image of the facial feature. Then image representation can be done based on fuzzy c means clustering (FCM) algorithm by assigning labels to an object based on information provided by descriptors (or) pertinent features. Feature filtering is done via sobel operator to detect edges of intransient features that significantly reduce the amount of data and filters out useless information while preserving the important structural properties in an image. After edge detection, edge pixels are processed to maintain final feature set. Based on final feature set analysis different kinds of facial emotions is identified using classification technique called decision tree. Finally, a smart real time audio application is played corresponding to the emotion present on the autistic child face. For a happy mood, some hearty songs are played to maintain it and for a sad mood some rejuvenating ones are played.

VII. SYSTEM IMPLEMENTATION

A. Skin Tone Analysis

The inspiration to use skin color analysis for initial classification of an image into probable face and non face regions stems from a number of simple but powerful characteristics of skin color. Firstly, processing skin color is simpler than processing any other facial feature. Secondly, under certain lighting conditions (i.e. illumination), color is orientation invariant. The major difference between skin tones is intensity e.g. due to varying lighting conditions and different human race .The color of human skin is different from the color of most other natural objects in the world. An attempt to build comprehensive skin and non-skin models has been done. Automatic face recognition is a process of identifying a test face image with one

of the faces to isolate or segment facial regions to be fed to a face recognition (FR) system. Though human beings detect/track faces with some effort, but it is not easy to train a computer to do so because robustness and computation complexity plays major role during face recognition task. In pattern recognition, human face is a complex pattern. Different poses and gestures of the face accentuate complexity. The detection scheme must operate reliably and flexibly regardless of the background clutter in the image, lighting conditions, multiple faces in the image, and variations in face scale, pose and expression [2]. Hence, a robust system that detects and tracks a face is necessary. Skin tone color detection is a technique that can isolate the presence of faces, arms, hands and gestures. After isolation, skin-colored pixels and regions in an image are identified then converting the image into RGB color space in which skin pixel can be clustered as compact as possible as well as eliminate the influence of varying illuminations to the best extent.

Summary of the method

- Normalize colors on the image to eliminate background clutters
- Mark the pixels on the image using an established skin color model
- Remove regions that are unlikely to represent faces
- Confirm face acquisition by examining common features on face

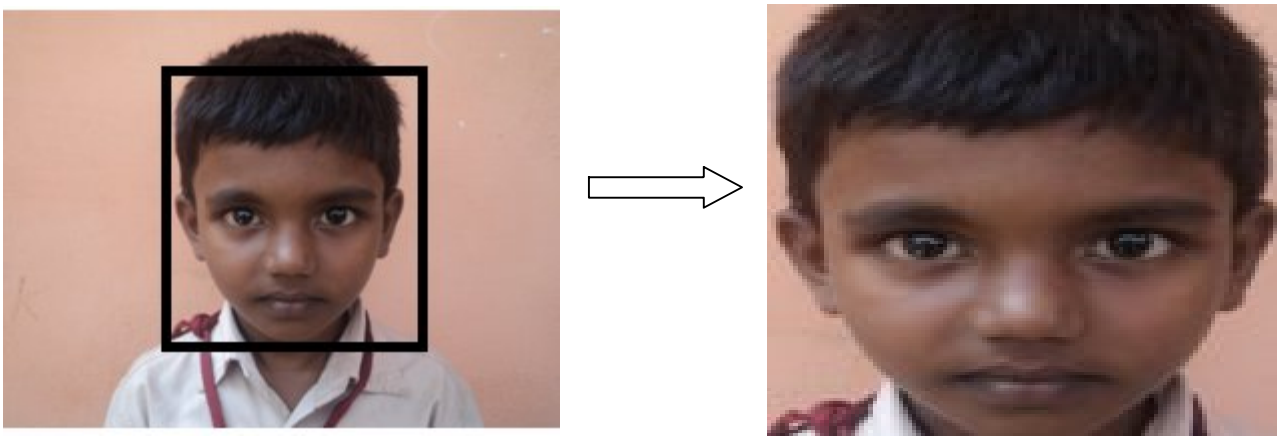


Figure 5 Face Acquisition is examined using RGB Color Space

*B.**Feature Extraction***

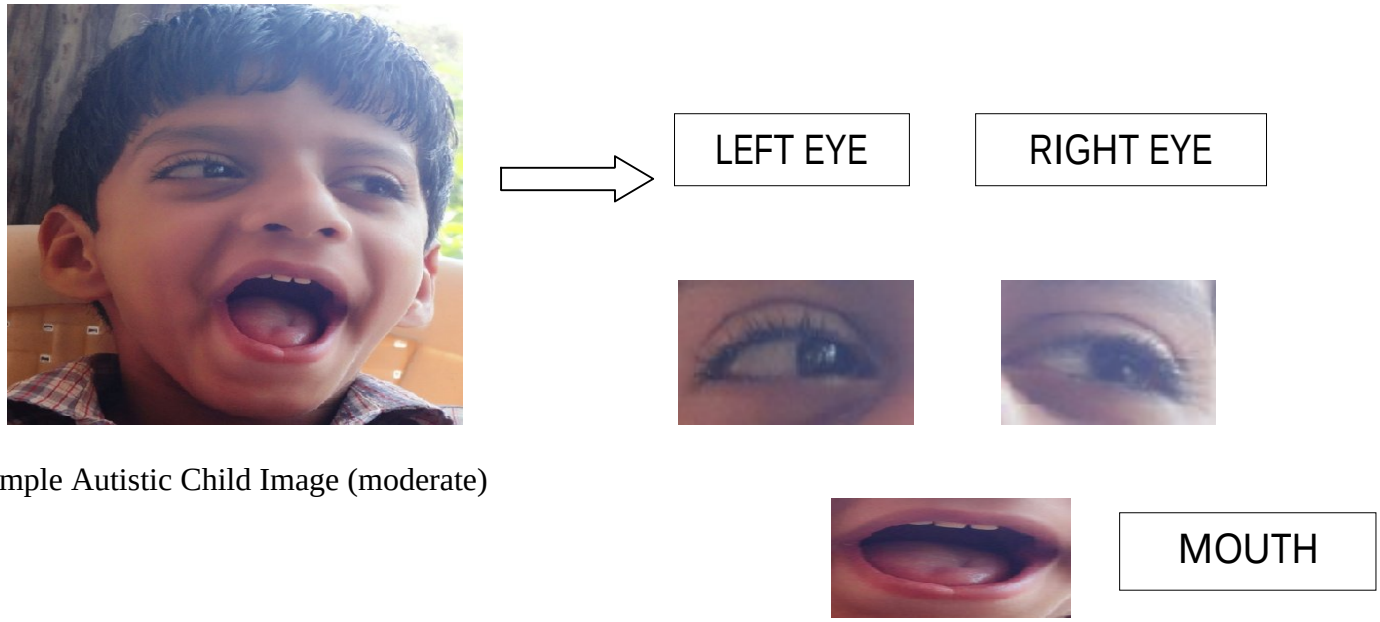
The feature is defined as a function of one or more measurements, each of which specifies some quantifiable property of an object, and is computed such that it quantifies some significant characteristics of the object. The extraction task transforms rich content of images into various content features. Feature extraction is the process of generating features to be later used in the selection and classification tasks to determine an appropriate result that may be features, pattern identification or representation of that image [9]. Application dependent features such as human faces, fingerprints, and conceptual features. These features are often a synthesis of low-level features for a specific domain. Feature selection helps us to reduce the number of features provided to the classification task. Those features which are selected are likely to assist in discrimination and also used in the classification task. Features which are not selected in the extraction task are discarded .of these three activities, feature extraction is most critical because the particular features made available for discrimination directly influence the efficacy of the classification task. The extraction task transforms rich content of images into various content features. The end result of extraction task is a set of features commonly called Feature vector which constitutes a representation of the image. This feature vector is further classified as transient (wrinkles, cheeks and nose) and intransient features (eyes, mouth, eyebrows) to reduce the dimension of the feature space as well as computational complexity. Features such as shape, texture, color etc. are used to describe the content of the image. Image features can be classified into primitives [7].

Weber's local descriptor (WLD) act as a texture descriptor plays an important role as it exploits textural nature of the human face via human visual system (HVS) as well as relationship between component features(eyes, nose and mouth) to detect and recognize faces [3].WLD descriptor based on Weber's law. According to this law "the ratio of the increment threshold to the background intensity is constant". this descriptor represent an image as a histogram of differential excitation and gradient orientations and has several interesting properties like robustness to noise and illumination changes ,powerful image representation etc. finally, facial features become darker and used for feature extraction analysis.

C. Feature Selection

After feature extraction, selection helps to reduce the feature space which improves prediction accuracy and minimizes the computation time. This is achieved by removing irrevalant, redundant and noisy features i.e. it selects a subset of available features by eliminating unnecessary features therefore it considers only intransient features. Feature selection can be done based on FCM clustering which is frequently used in pattern recognition [6]. Once feature selection is analyzed information gain on a per emotion class basis is used (e.g., the features for the class of anger differed from those of happiness). Information gain describes the difference between the entropy of the labels in

the dataset (e.g., "happy") and entropy of the labels when the behavior of one of the features is known (e.g., "happy" given that the distance between the mouth corner and nose is known). This feature selection method permit as ranking of the features by the amount of emotion class related randomness. The top features were selected for the final emotion-specific feature sets. It can be done based on clustering process.



Sample Autistic Child Image (moderate)

Figure 6 Feature Extraction, Selection & Labeling Intransient Features

D. Feature Filtering

Facial features can be filtered out using edge detection technique. Edges detecting an image significantly reduce the amount of data and filters out useless information while preserving the important structural properties in an image. There are extremely large numbers of edge operators available each designed to be sensitive to certain types of edges variables involved in the selection of edge detection operator include edge orientation, noise environment and edge structure.Edge detection is a very important area in the field of Image processing. Edges define the boundaries between regions in an image, which helps with segmentation and object recognition. Edges are significant local changes of intensity in an image. Edges typically occur on the boundary between two different regions in an image. The main problem is that different edge detectors work differently. Some takes more time with respect to other, while some finds more edges (works deeply) with respect to other. The detection of edges in an image depends upon illumination, blur, noise, intensity, objects. There are problems of false edge detection, missing true edges, edge localization, high computational time and problems due to noise etc.. According to an edge detection variable, an efficient edge detection algorithm "**Sobel operator"** is chosen for its simplicity and fast processing [10]. The result of the Sobel operator is either gradient vector or norm of its vector and convolving the image with a small, separable and integer valued filter in horizontal and vertical direction and relatively inexpensive in terms of computation.Sobel operator also integrates smoothing and gradient calculation. The result of the Sobel operator is either gradient vector or norm of its vector.

VIII. RESULT

We have developed a VR-based controllable facial expression recognition system that was able to collect facial features data while the subjects were involved in emotion recognition tasks. Specifically, we developed controllable levels of facial expressions of emotion based on normative patterns of children and further comparative study between normative child and autistic child has been done for understanding the behavioral patterns .Subsequently, a usability study involving typical controls was performed to evaluate the efficiency of the system as well as to study behavioral pattern differences in how individuals processed different valences of these expressions. . Although, this particular study did not employ direct interaction between the user and the system, the study is a precursor to a more interactive adaptive multimodal VR social platform that is under development. Such capabilities are expected to be useful in understanding the underlying heterogeneous deficits individuals with ASD often display in processing and responding to nonverbal communication of others. In turn, such a system will hopefully contribute to the development of novel intervention paradigms capable of harnessing these technological advancements to improve such impairments in a powerful, individually specific manner. The system successfully collected the synchronized facial features of autistic persons. Future extensions will : (1) identify different kind of facial emotions from Sobel filtering (2) final feature set was determined for each emotion class (3) play smart audio player corresponding to the face emotions to break the dependency in modern environment

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