



SURVEY ON AUTOMATIC MULTIMODAL EMOTION RECOGNITION SYSTEM OF AUTISM SPECTRUM DISORDER PEOPLES

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ABSTRACT

The Multimodal Emotion Recognition is trying to automate to improve the performance and accuracy of the system of Autism spectrum disorder peoples. Still researchers are trying to implement the system. To frame Automatic Multimodal Emotion Recognition (AMER) System is in need of proper training and naming of emotion with different attributes, suitable feature extraction and apt classification methods. This paper is survey of AMER system on Autism Spectrum Disorder peoples for different languages addressing above three vital aspects by different authors. Conclusion is made by finding different emotions in multimodal aspects for different languages all over the world with frequent and best feature extraction techniques and implemented by different classification methods.

Keywords: Automatic Multimodal Emotion Recognition System, Different Emotional corpus, Feature extraction, Computational Intelligence, Classification methods and Languages.

1. INTRODUCTION

Autism is a lifelong developmental disability that affects how a person communicates with and relates to other people. It also affects how they make sense of the world around them. They have fewer problems with speech but may still have difficulties with understanding and processing language. The impairments in different areas of development are:

1. Anomalous social contact and social growth
2. Failure to develop normal communication
3. Limited, repetitive, stereotyped patterns of behaviour

The beginning of these symptoms has to occur before the age of 2 ½ years. Even parents can notice that their child is affected by some health problem before the age of eighteen months, by showing delay in playing activities, by playing repetitive games and delayed in eye to eye contact. Most of the children with autism have a learning disability (mental retardation), although a few have average intelligence. Among them some have visual and hearing impairment too. In India among thousand children 2-3 children are born with autism every year. The same statistics are seen in other nations. In India about 10 million people affected with autism and the disability level increases over the last few years. According to statistics by the Centers for Disease Control and Prevention (CDC), one in every 88 children today is born with autism spectrum disorder (ASD). Few years back, it has estimated one in 110 children born with autism spectrum disorder (ASD), but now-a-day one in 88 children is born with ASD as per the statistics given by the Centers for Disease Control and Prevention (CDC) and projected that 1 out of 42 boys and 1 out of 189 girls are born with autism in the United States. Generally boys are affected by autism than girls.

The major types of ASD are:

- Asperger's syndrome.
- Pervasive developmental disorder, not otherwise specified (PDD-NOS)
- Autistic disorder.

1.1 The Symptoms of Autism Spectrum Disorder Peoples.

Speech and Language Problems with language knowledge is a revealing symptom of the autism spectrum disorders. Autism affected peoples have delayed in or lack of language development by using only nonverbal means of communication. Variation in communication among the autism peoples are:

- Use single word
- Dialogue many phrases suitably
- Using same phrases frequently
- Some children abruptly spoken their own language at short time intervals
- Stoppage in speech
- Speaking in high pitch or producing irregular rhythm.

Basic social interaction may be bothersome for children with autism spectrum disorders. Symptoms might be included:

- Abnormal or badly chosen visual communication, gestures, and facial expressions (e.g. avoiding eye contact or facial expressions that don't match what he or she is saying).
- Lacking in awareness, sharing happiness or achievements with the peoples (e.g. showing pictures, differentiating bird).
- Showing unwillingness to come close to others or to track social interaction; maintain distance and reserved; prefers to be alone.
- Complexity and trouble in understanding the individual person way of thinking, reactions, and nonverbal cues.
- Move violently being touched.
- Feel difficult in making friends and sharing thoughts with same age children also.

1.2. Interrelated Signs and Symptoms of Autism Spectrum Disorders Children

- Sensory issues
- Emotional difficulties in speech
- Uneven emotional facet talents.

Children with Autism Spectrum Disorder (ASD) cannot convey their emotions clearly. Parents and caretakers associated with these children feel difficult to understand the child's behavior like anger and fear emotion etc from different sources. To compute emotions to achieve high precision value Computational Intelligence (CI) is used.

2. LITERATURE SURVEY OF ASD PEOPLES

As per human perspective, emotions are imperative to express his or her psychological condition. ASD peoples haven't natural ability to recognize the emotions and also convey their emotion clearly. From this connection machine does not have capability to analyze emotions of ASD peoples from multimodal sources. In the past decade, identify emotion is attracted by the researchers towards automatic multimodal emotion recognition from different sources [1].

Krupa, N et.al (2016) confers an indecisive, harmless technique to identify and record excitement in children with Autism. To obtain information, a classification of algorithm acquainted with sensation is intended and developed fruitfully with a forceful method consists of a wearable wristband entrenched with sensors. For the specific goal spectators of children with Autism, the wearable system is one of the ground-breaking facilities in the emotional computing liberty. In an educational setup at ASHA, children have

been tested with the hardware without disturbing their regular activities. Emotions namely neutral and happiness of Autistic children have predicted by SVM-based affective model with achievement at the rate of 90 % and the consequences are in procession with the estimated values. Their device can help the child's feelings in the course of a bio-feedback mechanism. For additional research and improvement of individual emotional models for each child, the record of the illustrations obtained at NIMHANS can be utilized. The inadequacy of their system is a post storage analysis system. A real time investigation will need to be extended, however it will be a helpful device in diagnosis of therapy sessions, for a day to day live scrutinizing method [2].

Mathew D Lerner et. al (2013) proposed an emotional system of ASD peoples that found defects in Face, speech and EEG parameters. 40 speakers (26 Male and 14 Female) are participated, segregate and labeled primary emotions (Happiness, Sadness, Fear and Anger) for English language. Features are extracted and classified the emotions by Event Related potential method [3].

Catherine R.G. Jones et.al(2011) proposed an emotional system of ASD peoples those analysis errors in existing patterns of parameters like Face, speech (verbal and nonverbal) and IQ. 99 participants (53 ASD and 46 others) are participated, segregate and labeled primary emotions (Happiness, Sadness, Fear, Surprise, Disgust and Anger) for English language. Features are extracted and classified the emotions by Structural Equation modeling method [4].

Karla Conn Welch et.al (2011) modelled to recognize the affective states of ASD children from physiological signals. A robot is designed to respond for appropriate affective state to find deficits of ASD children in the social communication. Objective of this model is to identify and predict best possible level of affective state and also report the problem for further treatment to ASD children [5].

I-Fan Lin1 et.al (2015) proposed an emotional system of ASD peoples those recognizes speech identity via naming and gender classification in ASD database. 14 Peoples (20-47 years, 3 females) are participated for Japanese language. Features are extracted and classified the emotions by Two-way mixed design ANOVA (analysis of variance) method [6].

Mirko Uljarevic et. al (2012) propose a method to recognize emotion in ASD and it is identified as an disorder in human beings. This provides meta-analysis method to recognize impaired in happiness, and worse in recognizing fear emotion. The age range and Intelligent Question by answering also recognize by this method [7].

Table 2.1 expresses the related work on Emotion recognition system of ASD peoples.

Georgia Chronaki et. al (2016) provide a framework to find the abnormalities in facial and vocal expression of ASD children [10].

Erik Marchi et.al (2013) proposed digital gaming method to convey their thoughts w.r.to primary emotions (Happiness, Anger, Sadness, Surprised, Afraid and Neutral) of ASD children. Face, voice and body gestures are the parameters which is used in database. 10 children (5 Male and 5 Female) are participated and labeled primary emotions for Hebrew language. Energy, Pitch, Duration and MFCC features are extracted and classified the emotions by Support Vector Machine [11].

Jean Xavier et.al (2015) compared emotions between normal children and ASD children using Face and speech parameters. 19 children (14 boys and 5 Girls) are participated and labeled primary emotions (Joy, Sadness, Fear, Disgust, Neutral and Anger) for Germany language. Features are extracted and classified the emotions by GLMM method [12].

Laurence Chaby et.al (2012) builds a support to identify characters of ASD children using speech, face and postures parameters. 6-12 years of children are participated and labeled primary emotions (Happiness, Sadness, Neutral and Anger) for French language. Features are extracted by prosody features and classification was done by k-NN and Dynamic HMM method [13].

TABLE I

Summary of Related Work on ASD Multimodal Emotion Recognition System

Authors	Databases	Different Emotions	Languages	Feature extraction and Classification Methods
Matthew D.Lerner et. al(2013)	ASD Database (Face , vocal and EEG)	Happiness, Sadness, Fear and Anger -	English	Event Related potential(ERP)
Catherine R.G. Jones et.al(2011)	ASD Database(Face),vocal (verbal and nonverbal) & IQ	Happiness, Sadness, Anger, Fear, Surprise, Disgust-	English	Structural equation modelling
Karla Conn Welch et.al(2011)	ASD database (Eye Gaze)	-----	-----	VR tools
I-Fan Lin1 et.al(2015)	ASD Database		Japanese	Two-way mixed design ANOVA(analysis of variance)

Mirko Ujarevic et.al(2013)	Facial Database	Fear, Surprise, Anger, Disgust, Happiness and Surprise		Meta -Analytic approach
Line Gebauer et. al(2014) [8]	Speech and facial database	Happiness, Sadness		Music technology --- Statistical Parameter Mapping, mixed model analysis of variance (ANOVA).
Harrold .N et.al (2012) [9]	Facial database	-----		Game technology
Erik Marchi et. al (2013)	Face, Voice, Body gestures	Happiness, Anger, Surprised, Afraid, Neutral, Sadness-	Hebrew	Feature Extraction- Energy, Pitch, Duration, MFCC Classification- SVM
Jean Xavier et.al(2015)	Face, voice	Joy, Fear, Anger, Sadness, Disgust and Neutral-	Germany	GLMM
Laurence Chaby et.al (2012) [14]	Speech, face, Postures	Happiness, Anger, Sadness and Neutral-	French	FE- Prosody features Classification- k-nn and Dynamic HMM
Mary E. Stewart et.al(2012)	JAFFE database	Happiness, Fear, Surprise, Anger and Disgust		Mill Hill (Verbal IQ) Test

3. COMPUTATIONAL INTELLIGENCE

To compute emotion from different sources CI is used. Computational intelligence is a branch of computer science studying problems for which there are no effective computational algorithms [15]. CI techniques are commonly used and recognized in real world applications. These developments supported and improved by CI techniques. Some critical infrastructures problem such as radiation leak, cyber terrorism etc.

Advantage of CI techniques is:

- System may be automated and computerized by machine learning process.
- It has the capability to model the system very effective
- Knowledge extracted from intelligent agent is automated
- It has the capability to recognize new patterns from available pattern.

CI techniques are

- Fuzzy systems- Handle uncertainty in knowledge and data

- Neural Networks- find out patterns and relationship in data
- Support Vector Machines- categorize data and assemble robust models
- Evolutionary Computation- Generate originality by computer-generated evolution
- Swarm Intelligence - Optimize by using social communications
- Intelligent Agents– Capture developing macro activities from micro relations

3.1. CI in Emotion Recognition System:

Multimodal emotion recognition is more attractive in computer application fields such as health care, children education, etc. Dealing with multimodal emotion recognition enhancement, computational intelligence is widely used in emotion recognition, speaker identification in emotional mode, speech, body gestures and facial enrichment. It is also used for classification, indexing and retrieval of multimodal emotion data corpus.

Initially few works have been implemented by such methods as SVM, GMM, etc. They used filter and transformation to get back relevant information by face, body gestures and acoustic signals. This is done by feature extraction and selection. While computing these methods become too expensive to get optimum values.

Focusing on these issues, many works are carried out by CI in speech emotion recognition:

- CI illustrated novel approaches like rough set and SVM is presented to reduce computing cost to achieve high recognition rate [16].
- CI suggested evolutionary programming to evade NP-hard exhaustive search [17].
- CI uses different dynamic techniques to acquire suitable features.
- CI introduces hybrid classification methods to get precise results.

3.2. Future of CI

- Technologies used in CI:
 - Hybrid systems
 - New techniques/algorithms
- New applications and uses of CI:
 - Internet of Things (IoT)
 - Ubiquitous and pervasive computing

4. PROPOSED ARCHITECTURE OF AMER SYSTEM

The various components of a typical automatic multimodal emotion recognition system are shown in figure 1. At first the multimodal databases with emotion files are acquired by using standard databases.

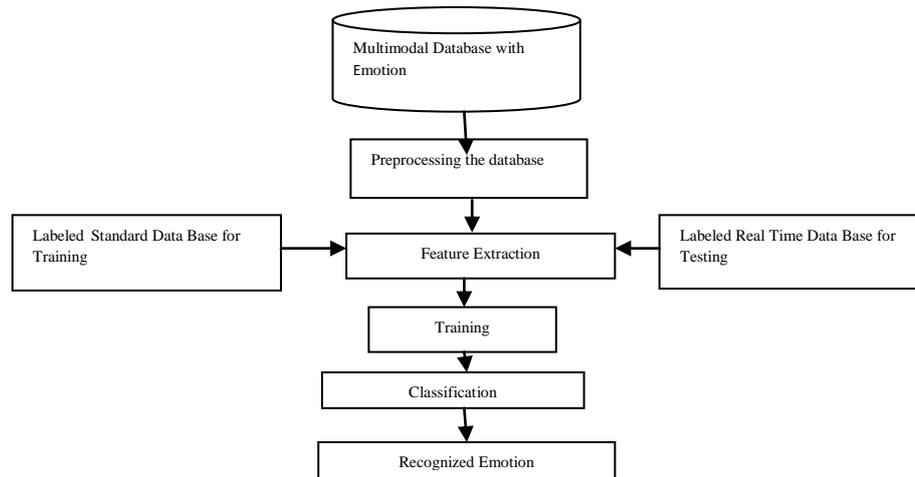


Fig. 1 Architecture of AMER System.

In the preprocessing stage, the acquired multimodal file is denoised; enhanced or segmented features depend on their parameters. The next stage is training, testing and classification is done between labeled standard database with labeled real time database by different feature extraction and classification methods.

5. CONCLUSION

Most of the authors discussed emotion recognition through facial, vocal and physiological signals. Multimodal system is implemented to recognize primary emotion. Different feature extraction, technology and classification methods are used to identify emotional expression. No standard technologies, feature extraction and classification methods is implemented to get accurate recognition rate. Languages to express emotion are limited. No Indian languages still implemented to express emotion in speech alone for ASD peoples. Limited number of real time databases is used. No standard database is created and compared with ASD peoples.

In this work put efforts on introduction and symptoms on ASD peoples. Though there are many approaches, Computational intelligence has recently been proposed as new method for feature extraction and classification analysis. In this work, some of the important existing methods and work done so far by different researchers in the area of multimodal emotion recognition system expressed in table form. This will help us to design emotional recognition system in different sources for ASD peoples. In this connection we will discuss about architecture, databases and feature extraction methods as per our framework.

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