

Improving the Joint Attention and Intelligibility in Speech of Autistic Children by an Assistive Robot

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Abstract: - This paper presents an assistive robot for the children with autism to improve their joint attention and intelligibility in the speech over some traditional approaches for rehabilitation of children with autism spectrum disorder (ASD) where the robot can detect the affective cues of the children implicitly and response to them appropriately. Autism spectrum disorder (ASD) is a developmental brain disorder that is characterized by abnormal social behaviour, reduced interest in communicating with others, language disorders, repetitive and obsessive behaviours and rituals and narrowly focused rigid interests. A reinforcement learning based adaptation mechanism is employed to allow the robot to adjust its behaviors autonomously as a function of the predicted children's affective state. Although there is no definite treatment or medicine for autism so doctors and therapists can help kids over some kind of difficulties by different psychological and physical therapies. In the above scenario robot detect the child attention at each session. We detect the child attention by reading the child eye gaze pattern and improve the intelligibility by using some training data. Here robot is able to change the scenarios according to the performance of the child.

Index Terms— Assistive robot; Autism

I. INTRODUCTION

Core deficits in social communication and interaction, imagination characterize the neurodevelopmental disorder known as autism [1][2]. To provide better applications which are helpful in treatment for autism, studies have been investigating the application of advanced interactive technologies, namely computer technology [3], virtual reality (VR)[4][5], environments [6], and robotic systems [2][7]. Due to the diversify nature of autism [8], no single intervention technique will work for the entire population. Therefore, the technique work on autism intervention assistive tools is generally guided by the individual characteristics, needs, and preferences of the children. The different irregularities in speech communication are non response, making low sounds in response, making unintelligible sounds, making delays in answering questions, answering incorrectly with articulate words, difficulties in making correct sentences with words, lacking the sense of turn taking [9][10]. Intelligibility refers to the clarity and proportion of the speaker speech that a listener can understand. Most of the autistic children are suffer from the speech unintelligibility. They can produce loud sounds but listener cannot get the proper meaning of any pronounced word.

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Children are attracted towards robot [11] due to their highly structured motion and communication function so we can use this attraction to create interaction to provide the better learning environment [12]. For an autistic child lack of non verbal communication is because of incapability of joint attention. [13]. It has discovered that due to weak eye gaze dexterity and head direction rotation any autistic child has lack of joint attention. The autistic child felt awkward in maintaining eye contact in human – child interaction but with robot they did not seem to have any difficulties looking in to robot artificial eyes. A assistive robot seems to be very beneficial for the autistic child as the child can interact well with robot as compared to a therapist [14].

II. RELATED WORK

In the 1960's Ivar Lovags began teaching autistic children through a technique called "applied behavior analysis" in which environmental consequences encourages or discourages the behavior of the child. In his technique he gave some rewards for the desired behavior [15].

There are some drawbacks of this kind of treatment:

- It places some financial burden on the family of the autistic child because this treatment require many training session with the trained professional as they are few.
- Session require more attention and long contact from parent.
- One of the main character of the autism disorder is anxious, detached and alone interaction with other individuals [16][10].

III. PROPOSED METHOD

In this paper we propose an assistive robot which detects the autistic child attention through their eye gaze pattern and also increase the intelligibility in speech by matching the pronounce word with the database. This proposed method is useful in enhancing the joint attention skills between the child and robot. Robot read the eye gaze pattern and gives some words to pronounce and according to the feedback increase and decrease the difficulty level of the training session using machine learning algorithms.

IV. PROPOSED INTERACTIVE SCENARIO

An interactive scenario is that which enhance the skills of joint attention between the child and the robot. The adjustment of the robot depends on the changing of interaction pattern that are based on the performance of child joint attention and pronunciation. Many complications are shown i.e. how to obtain accurate eye gaze data to train the machine learning algorithm [20].

Through this the autistic children will try to pronounce the clear words while communicating with the robot. Process of training session is as follows:

- Robot tries to gain the attention of the autistic child by performing some action or movements.
- When robot is successful in gaining the attention of child then it point out towards an object
- If child is able to notice the object then the child pronounces a word (mono-syllabic).
- If child correctly pronounce the word then go to other level of training session (di-syllabic) and starts the same process again.
- Training session is over otherwise continuing the session with some other words.
- In case child is not able to recognize the object then teacher help the autistic child to understand it and then again repeat the process for the attention.

To trace the child eye gaze pattern a method has been defined by [20] which is sufficient to trace the pattern of eye gaze at each interval of time. There can be many numbers of attempts for the mono-syllabic, di-syllabic and tri-syllabic word.

Some of the advantages of these interactive scenarios are:

1. Through these scenarios robot interact with autistic children very easily.
2. The whole scenarios depend on the children interest .If children gave the answer it means they show their interest. It is important for trainer to feedback the children behavior during the time of this approach.
3. It also increases the confidence of the children.

V. DATA FLOW DIAGRAM

Researchers and doctors are focusing on design of innovative and less complex therapies and exercises which are beneficial for the autistic children to improve their social communication and social interaction. In our research we are focusing on the joint attention and intelligibility using supervised learning to take decision whether the robot is successful to gain the child attention. For different eye gaze pattern we are using Naïve Bayes algorithm to classify patterns. The robot has an ideal set of words in its database from where it can match the pronounced word. Data flow diagram is explained in Fig: 1.

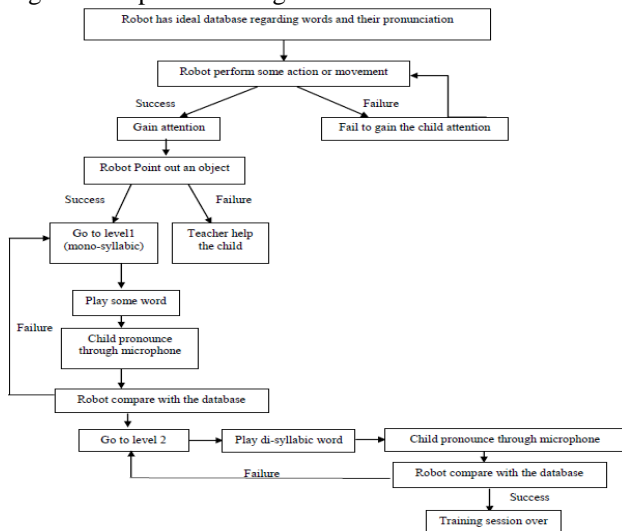


Fig: 1 Interaction of robot with autistic child

VI. CONCLUSION

This is an impressive method to gain the attention of the child because children are easily attracted towards the robot in comparison to human beings. A robot can properly compare the pronunciation of the child with the recorded ideal database whereas human cannot perform this function much accurately. This can easily used as a tool to train the autistic children having communication disabilities. This tool is more beneficial for the young child because a young child is more likely to adapt new things with a proper communication and learning methods where an older child already know many things so it become difficult to train an older child and change its behavior.

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