INTELLIGENT TUTOR ASSISTANT FOR AUTISTIC CHILDREN- A SURVEY

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Abstract— Learning and understanding any concept is a difficult task for a disabled child. Autistic kids are the gifted ones who need special attention to learn things. Autism is a disorder that causes laggard brain development. A child suffering from autism usually follows same pattern for performing day to day activities and lacks verbal and non-verbal communication. A recent development have provided teachers as well as parents a platform to teach autistic children in a friendly manner. This paper discusses a detailed survey on existing techniques employed for the disabled children-especially autistic.

I. INTRODUCTION

An autistic child can learn better through one-to-one teaching than group teaching. Intelligent Tutor Assistant (ITA) is one of the best ways for one-to-one teaching. Autistic child has to learn from ITA by solving puzzles. The system keeps on updating the difficulty level for every autistic child so that learning difficulty gets reduced. Change in difficulty level is made by capturing the physical behaviour and understanding the nature of child's response by using webcam.

Certain technology tools for students with autism are developed for betterment. Behaviour charts are developed that help in facilitating independent self-monitoring and discrimination. These charts may be managed by an educator or self-sustained by the student. The main enhancement is providing individual workstations that are relatively free from distractions, with specified area for necessary materials. The workspace should be arranged in a natural progression with work to be done on the left side and completed work on the right. Pacing boards are developed that help autistic children to expand their length of utterance or change the rate of speech [1].

A single method for teaching children with autism is not successful. The needs of autistic child change from time to time, that makes necessary for teachers to try other approaches. Many instruction and instructional approaches have proved successful for teachers working with student with autism. Visual aid is strongly recommended approach for teaching students with autism. Usually pictographic and written cues help students to develop self-control and communicate. Oral information may pose problems for students who require extra time and have difficult processing language. It is also important to honour dignity of students with autism. The learning material should be appropriate to the age of the student.

II. RELATED WORK

Some methods which are presently used for guiding the autistic children along with their advantages and disadvantages are discussed in this section.

Intelligent Tutoring System (ITS) considers the learning style and emotions of the autistic child as the factors for personalizing the learning environment. A profile of each autistic child is created by using a questionnaire. The knowledge bases consist of facts about learning style and emotions. Intelligent Tutor System teaches according to the learning style of the child. An assessment based on level of child is provided. The main objective of this system was to develop a system that can teach skating in a customized and adaptive manner [2]. The system decides different teaching plans for every child that helps in maximizing their performance.

B.H. Sreenivasa Sarma and B.Ravindran [3] have developed an ITS to teach pattern classification problem. The main problem is that the students have to classify the pattern given to them. The knowledge base in pattern classification problem contains 2D patterns from four classes. The class is selected in such a way that a random action is selected and the probability of selecting pattern from one class is more than probability of selecting patterns from other classes. RL agent is trained and a slightly modified version of Watkin's Q-learning backpropagation [4] is used. A single layered ANN is used to learn Q function. The number of neurons to be given as input are equal to the dimension of state. The feature size considered is 80 with 72 dimension state with 4 actions to be taken. The goal was to develop a system which is capable of adapting to large deviations from normal learning behaviour. A simulated model for autistic as well as normal child with 15 neurons were considered for capturing information in the input patterns. Classification rate for ANN with ITS and without ITS approached the same value (70%), which indicated that autistic child can be taught effectively using ITS.

K. Ganesh Kumar, R.Arvind, M.Aravind, S.Kartikeyan and P.Dass [5] have used face recognition techniques for understanding and interpretation of the human face in children suffering from Autism Spectrum Disorder (ASD). Autism Spectrum Disorder is a comprehensive neural developmental disorder that produce perceptual, social and communicative deficits. Methodology followed in this case consist of image acquisition and image pre- processing. Image acquisition considers facial expressions as input and are saved in JPEG format. The camera is interfaced with the system to store the captured image as input. Image pre-processing creates an enhanced mage that is useful to observer. Filtering of the image and skin tone detection are the steps used in pre-processing. The proposed system performs in a proper flow

i. Webcam Video- Frame Separation
ii. Prewitt Filtering- Noise Removal
iii. Skin Tone Detection using RGB algorithm
iv. Face Detection and Feature Extraction using Weber Law Descriptor
v. Classification using FuzzyC-Means algorithm
vi. Edge Detection using Sobel Filter
vii. Database Training using C4.5 Algorithm
viii. Emotion Detection- PC Access

M.S. Mythili and A.R.Mohamed Shanavas [6] have used different classifiers to predict the learning skills of autistic child. The basic algorithm used for classification are decision tree

classifier and support vector machine. A common decision tree classifier C4.5 (J48) and a kernal method (SVM) are used. J48 is an algorithmic program that can be considered as a successor to ID3. J48 handles continous and categorial attributes to form a decision tree. The datasets collected form children database consist of

i. Attention Skills
ii. Hand Writing Skills
iii. Spelling Skills
iv. Language Skills
v. Reading Skills
vi. Writing Skills
vii. Memory Skills
viii. Level of child autism.

40 samples were taken for the implementation. The decision tree classifier (J48) and normalized PolyKernel based classifier (SVM) were enforced in Weka. The work explored the potency of machine learning algorithms and decided the influence of result.
Several powerful devices are nowadays coming into existence. The processing speed of the devices has also increased. Authors G. Parrelli, M. Chuah and D. Li have made use of these devices to develop the applications which are useful for the development of autistic students [7]. They have focussed on mainly three aspects

i. Emotional Recognition Training (ERT) tool
ii. Conversational Simulator (CS)
iii. ATM Simulator

These three aspects are being used for autistic children [7]. The ERT tool is used to improve the emotional recognition of the autistic student while CS is used for improvement of the conversational skills. The ATM Simulator is used for teaching the ASD students how to use an ATM machine [7].

The humanoid robots indeed can attract attention and improve the social skills of autistic children. Ja Young Kwon, Bo Hee Lee, Keum-Hi Mun and Jin Soun Jung [8] used a cat robot for enhancing the social interaction of children suffering from Autism Spectrum Disorder (ASD). When applying the personification of a cat robot, the character of both a human and an animal were considered. 9 electric motors were arranged in such a way that eyes, eyebrows, mouth and ears represent emotions. The observer observed the behaviour and the response patterns during the interaction of autistic child with cat robot. The observer and therapist discussed the individual characteristic of the child. Social interactions with the cat robot were enhanced and reaching functions and hand-eye coordination increased overall. The level and span of concentration increased because the children showed greater interest and attention to this robot as compared to other existing mediums. Children improved their intimacy towards the robot by naming it and singing to it their favourite songs. The children generally exhibited more negative behaviour than other children such as aggressively throwing or slamming the robot or roughly handling it. As the treatment proceeded, the intensity and frequency of the negative behaviour appeared to decrease.

Kerstin Dautenhahn, Iain Werry, John Rae, et al. started using robots to help autistic children since 1998 [9]. This project which is called "The AuRoRA Project" [10] has been executed for over than 10 years. One of their former experiments was using a wheeled robot, Labo-1. They put Labo-1 and an autistic child together in a mall room which size is 2x3 square meters. Labo-1 tries to catch the child, and it makes sound when Labo-1 is near the child. They analysed the record and got feedback such as whether Labo-1 attracted the child, how much time the child played with Labo-1. After Labo-1, they tried and developed many different types of robots one by one to support the Aurora project. The following robots are being used: Pekee robot, an upgrade version of Labo-1; Robota robot, a humanoid doll robot which has an infrared sensor and some rotatable joints; KASPAR, a humanoid robot that has many movable joints (over 11) and tactile sensors, and its eyeballs are rotatable. There are some researches that used KASPAR interact with the autistic children by tactile interaction, and get good results.

Ying-Hua Peng, Min-Liang Wang and N.Michael Mayer[11] introduced a robot that worked on three phases including attract the children's attention, imitating and training, and observe their reactions and paper tests. At the beginning, robot plays a song to attract the attention of autistic child which was the most important step in the research. After the robots plays the song, child was let to play the instrument freely. The robot will imitate what the child played and reaction of the child was checked. Robot teaches the child to play the song which it just played at the beginning by mimicry which helped in improving the coordination of the autistic child. Joint attention and learning mimicry made sure that autistic children can be integrated into a group more easily.

Sandra Costa, Hagen Lehmann and Filomena Soares [12] used an exploratory study in which children with autism interact with KASPAR, a humanoid robot, equipped with tactile sensors able to distinguish a gentle from a harsh touch and to respond accordingly. The results showed that the children started looking for a longer period of time to the experimenter and a lot of interest in touching the robot was observed. They also showed that the robot can be considered as a tool for prolonging the attention span of the children. The results are primarily based on the analysis of video data of the interaction. Overall, this highlighted issues of scenario development, data collection and data analysis.

Marry Ann Romski et al [13] developed a Prologue2: it is a symbol supported computer application to promote language development and increases communication skills. It's an English, French, Spanish symbol supported. It is deployed on i-pads in which autistic child responses in the form of text and the response is converted into audio.

Naseer Farhan's et al. [14] recent work includes that the autistic child interacts with the system through touch and based upon the touch, system responds in such a manner which enhances the learning of the child. This android application was deployed on smart phones.

III. SUMMARY

Author	Paper	Description
Jaydeep Karangia, Prof. Mayura Nagar and Dheeraj Pandey [2]	Personalized Intelligent Tutoring System using Reinforcement Learning for Autistic Student to Teach Skating	General features of ITS, Reinforcement learning for customizing and adapting a system to teach skating.
B.H. Sreenivasa Sarma and B.Ravindran [3]	Intelligent Tutoring Systems using Reinforcement Learning to teach Autistic Students	The history of past 50 questions and summary of past 300 questions as state variables for state of the ANN.
K. Ganesh Kumar, R.Arvind, M.Aravind, S.Kartikeyan and P.Dass [5]	Facial Emotion Based PC Access for the Benefit of Autistic People	Enable individuals with ASD to access PC by processing nonverbal communication.
M.S. Mythili and	A Novel Approach to	Potency of machine learning

A.R.Mohamed Shanavas [6]	Predict the Learning Skills of Autistic Children using SVM and Decision Tree	algorithms in deciding various factors like read, write, memory skills to analyse the performance of autistic child.
G. Parrelli, M. Chuah and D. Li [7]	Customizable Mobile Applications for Improving Quality of Life of Autistic Teenager	ERT tool to improve the emotion recognition of the autistic student.
Ja Young Kwon, Bo Hee Lee, Keum-Hi Mun and Jin Soun Jung [8]	A Study on the Effects of using an Eco-Friendly Cat Robot to Treat Children with Autism Spectrum Disorder	Potential use for a robot as a treatment medium was confirmed.
Kerstin Dautenhahn and Iain Werry [9]	Issues of robot-human interaction dynamics in the rehabilitation of children with autism	Robots with infrared sensors and rotatable joints for the development of autistic children.
Ying-Hua Peng, Min-Liang Wang and N.Michael Mayer [11]	Autistic Children and Music Playing with Humanoid Robot	Music playing as a good non-verbal medium to integrate autistic children into groups.
Sandra Costa, Hagen Lehmann and Filomena Soares [12]	Where is Your Nose?- Developing Body Awareness Skills Among Children With Autism Using a Humanoid Robot	Improve the ability of autistic child to interact with robot and identify parts of their own body with their own hands.
MaryAnn Romski, and Rose A.Sevcik [13]	Augmentative Communication and Early Intervention	Developed a symbol supported computer application to promote language development and increases communication skills.

IV. CONCLUSION & FUTURE WORK

Above studies suggest that there are several methods for providing knowledge to autistic children. The goal of this paper was to provide a knowledge on features and methods for building Intelligent System for autistic children. Empirical evaluation proves that decision tree are most commonly used classifier and are best suited for classifying the autistic data. Using decision tree as a classifier provides low error rate and high accuracy. Using image processing an advanced module can be developed.

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