

LEARNING ASSISTANCE SYSTEM FOR AUTISTIC CHILD

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Abstract - Autism or Autism Spectrum Disorder (ASD) characterizes a vast range of developmental disabilities associated with social interaction, communication and behavior. Though basic education is a must for everyone, but teaching autism community through traditional approach is still quite complex. This project aims in teaching Malayalam to autism students according to their disease condition. Here the affected area of the children is detected and according to that the learning is undertaken. The main areas covering over here is data mining, neuroimaging, deep learning.

Key Words: Autism Spectrum Disorder, AAC, CALL

1. INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disability with atypical traits in behavioral and physiological responses. Autism is a group of complex disorders of brain development. The autism students need special training to make them familiar to words, letters and objects. To improve autism patients reading and understanding skills, a new system is developed which trained them on understanding words, letters (Malayalam) and objects. Even today, there is no system for training in our mother tongue Malayalam. The assessment was based on the voice recorded and it was analyzed using MFCC algorithm. But the developed system's output was not accurate.

Thus by using deep learning algorithms the output is being modified. The learning tool is being modified by analyzing the level by which the student had learnt the letters. If he learnt properly, then he will be promoted to study words and then sentences. After learning an exam will be conducted and the result is provided to the trainer. While learning, the sound of student is being recorded. Thus by using that sound (recorded), the disease prediction is being performed. It is mainly classified into 4

- 1) Nasal problems
- 2) Tongue problems
- 3) Auditory problems
- 4) Brain defects by using ABIDE dataset

1.1. GENERAL BACKGROUND

If you've met one person with autism, you've met one person with autism: - DR. STEPHEN SHORE. Autism spectrum disorder (ASD) is a complex developmental disability, typically appearing during childhood and affecting a person's ability to communicate and interact with others. The word 'spectrum' describes the range of difficulties that people on the autism spectrum may experience and the degree to which they may be affected. The main areas of difficulty are in social communication, social interaction and restricted or repetitive behaviors and interests. People on the autism spectrum may also have:

- 1) Unusual sensory interests such as sniffing objects or staring intently at moving objects
- 2) Sensory sensitivities including avoiding everyday sounds and textures such as hair dryers, vacuum cleaners and sand
- 3) Intellectual impairment or learning difficulties

This project is based upon machine learning concept. By using machine learning algorithms, the output of the project is improved to an extent. Machine Learning is undeniably one of the most influential and powerful technologies in today's world. More importantly, we are far from seeing its full potential. There's no doubt, it will continue to be making headlines for the foreseeable future. This article is designed as an introduction to the Machine Learning concepts, covering all the fundamental ideas without being too high level.

Machine learning is a tool for turning information into knowledge. In the past 50 years, there has been an explosion of data. This mass of data is useless unless we analyze it and find the patterns hidden within. Machine learning techniques are used to automatically find the valuable underlying patterns within complex data that we would otherwise struggle to discover. The hidden patterns and knowledge about a problem can be used to predict future events and perform all kinds of complex decision making.

Most of us are unaware that we already interact with Machine Learning every single day. Every time we Google something, listen to a song or even take a photo, Machine Learning is becoming part of the engine behind it, constantly learning and improving from every interaction. It's also

behind world-changing advances like detecting cancer, creating new drugs and self-driving cars. The reason that Machine Learning is so exciting, is because it is a step away from all our previous rule-based systems of:

if(x = y): do z

Traditionally, software engineering combined human created rules with data to create answers to a problem. Instead, machine learning uses data and answers to discover the rules behind a problem. To learn the rules governing a phenomenon, machines have to go through a learning process, trying different rules and learning from how well they perform. There are multiple forms of Machine Learning; supervised, unsupervised, semi-supervised and reinforcement learning. Each form of Machine Learning has differing approaches, but they all follow the same underlying process and theory. The process in machine learning is as follows:

1. Data Collection: Collect the data that the algorithm will learn from.
2. Data Preparation: Format and engineer the data into the optimal format, extracting important features and performing dimensionality reduction.
3. Training: Also known as the fitting stage, this is where the Machine Learning algorithm actually learns by showing it the data that has been collected and prepared.
4. Evaluation: Test the model to see how well it performs.
5. Tuning: Fine tune the model to maximize it's performance.



Fig 2.1: Process in machine learning

1.2 OBJECTIVE

The main objective of the project is to provide a better learning experience to autistic society. Autistic children are very much different from normal children. They require special treatment. They may be slow learners and need time to learn something. So it won't be a good for them to provide

a normal children learning experience. Various studies have shown that they are very much fond of visualizing things rather than by hearing it. Keeping this in mind the project is developed with good aesthetics and rather than just showing the letters and words, audio of each letter/word is provided. Thus the students can listen to it and can learn it more effectively. The status of their learning is also noted and hence it is possible for the trainers to change the strategies of learning.

In addition to that, the main objective of the project is to provide learning according to their health status. Sometimes their ENT characteristics are affected due to which they may find it difficult to follow the instructions. Sometimes the brain is affected more and hence it will affect their thinking and understanding skills. Hence it is very necessary to provide them learning based on their health status. Thus a complete learning toolkit for autistic society along with monitoring their health status is the objective. This will improve the lives of the most beautiful creation in the world. Just like everyone, they should also have the right to education. Thus this project aims to provide that education in a more flexible way.

1.3. SCOPE

Sometimes the difficulties of autism can lead to behaviors that are quite challenging for us to understand and address. Most individuals with autism will display challenging behaviors of some sort at some point in their lives. These behaviors can often be the result of the underlying conditions associated with autism. Challenging behaviors represent some of the most concerning and stressful features of autism. These behaviors can often cause harm or damage, family and staff stress, isolation, and caregiver burnout. Parents may feel guilty or responsible, but it is important to know that you should not blame yourself for behaviors that you find difficult. Sometimes, the extraordinary steps parents go through for their children with complex needs might not be enough, and additional supports and resources might be necessary. It is important not to think of your child, or these behaviors, as 'bad,' but to learn how to better understand and respond to challenging situations to make them more manageable for everyone.

Thus this learning kit will help to tackle this challenging behavior and provide a better learning experience to the autistic children.

3. RESULT AND ANALYSIS

3.1 RESULT

This section discusses the experimental results of the regularization of the model and trust model for learning assistance system for autistic child (LASAC). The system that uses the operating system for windows 10 and windows

platforms here is c#.net. And the database created is a SQL server. The proposed system is using results of machine learning algorithms for results assessment.

There is a test data and training data. The training data is collected from various hospitals. The test data is obtained from the users of this system.

The proposed system is implemented using three modules and different sub-modules. The system's input is the audio and the checkup list details of the student. The details about the students ear, tongue, nose and brain is obtained. The ear parameters are HlevelRAC, HlevelRBC, HlevelLAC, HlevelLBC, bilateral/unilateral, reliability, eardrum affected or not, ear discharge present or not, perforation is present or not. The audiogram of the patient is obtained from the hospitals. The audiogram is interpreted is as follows:

1. Is there a hearing loss or not?
To find that compare the collected results with normal results.
2. If there is a hearing loss, what is the type of it?
Compare AC (air conduction) and BC(bone conduction) results. BC should always less than AC. HlevelRAC and HlevelRBC are the AC and BC values of right ear respectively. Similarly HlevelLAC and HlevelLBC are the AC and BC values of left ear respectively.

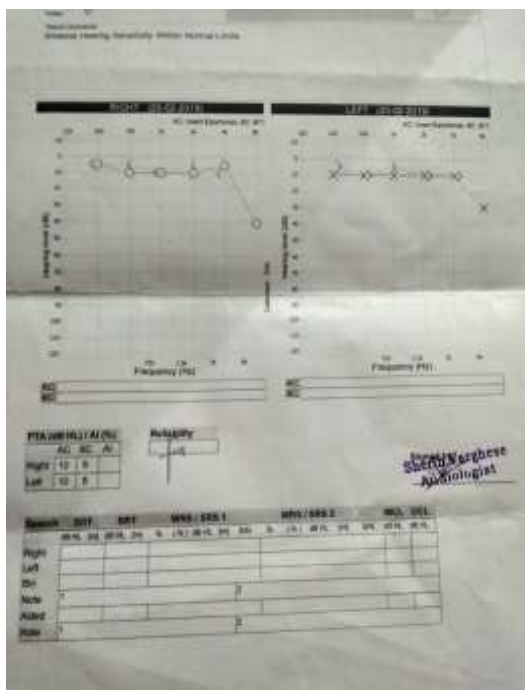


Fig 3.1.1: Audiogram of a patient

3. What is its degree?
The degree of hearing loss is as follows. From this degree the reliability can be found. Reliability have

values like good, fair, severe, moderate loss, mild severe, poor etc.

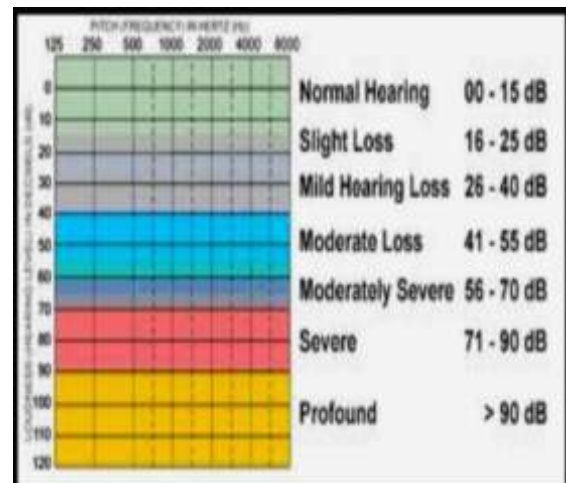


Fig 3.1.2: Degree of hearing loss

4. Bilateral or Unilateral: If both the ears are affected, then the ear is said to be bilateral. Otherwise unilateral

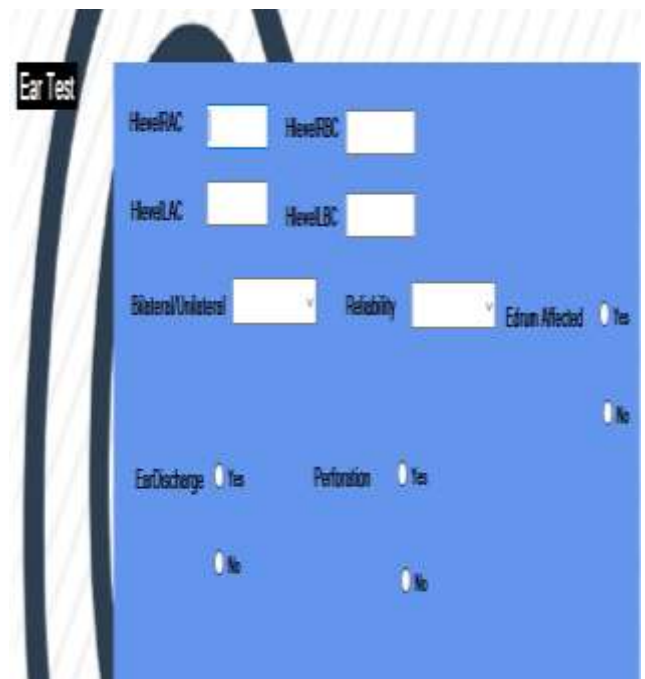


Fig 3.1.3: Test data collection of ear

The details of nose and tongue are also collected. The parameters used for nose is hyper nasality, hypo nasality, air emission and esr. Hyper nasality means too much sound resonating in the nasal cavity. Hypo nasality means not enough nasal resonance on nasal sounds. ESR is checked to help the diagnosis of inflammation. Air emission is checked to

find air leaks through the valve. It is also helpful in finding defects in voiceless consonants. The tongue test parameters are tongue tie, tonsil enlargement and phonation



Fig 3.1.4: Test data collection of nose and tongue

In addition to the above ENT statistics, brain impressions of the student are also collected. The main three parameters of brain used here are presence of white matter, virchow robin, temporal leftlobe, temporal right lobe.

1. **White matter:** It refers to areas of the central nervous system (CNS) that are mainly made up of myelinated axons, also called tracts.[1] Long thought to be passive tissue, white matter affects learning and brain functions, modulating the distribution of action potentials, acting as a relay and coordinating communication between different brain regions. White matter is the tissue through which messages pass between different areas of gray matter within the central nervous system. The white matter is white because of the fatty substance (myelin) that surrounds the nerve fibers (axons). This myelin is found in almost all long nerve fibers, and acts as an electrical insulation. This is important because it allows the messages to pass quickly from place to place. If white matter problem is present, it will affect the thinking capability, the ability to walk straight. The various problems associated with white matter is as follows:

- Trouble learning or remembering new things
- A hard time with problem solving
- Slowed thinking
- Leaking urine
- Depression

- Problems walking
- Balance issues and more falls

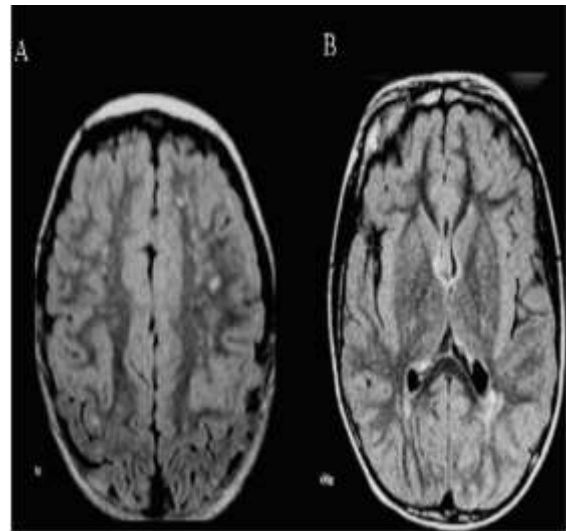


Fig 3.1.5: White matter abnormalities

Dilated Virchow-Robin: Virchow-Robin spaces (VRSs) are CSF spaces that accompany blood vessels as they perforate the brain substance. Dilatation of VRS is associated with microangiopathy. Microvascular disease has a major etiologic and pathogenetic role in dementias. To our knowledge, no investigators have looked at the relationship between dilated VRS on MR imaging and cerebral microvascular disease. Dilated perivascular spaces are common among the elderly and uncommon in children. Studies have noted the association between both developmental delay and non-syndromic autism and enlarged or dilated perivascular spaces. Non-syndromic autism categorizes autistic patients for which there is no known cause.

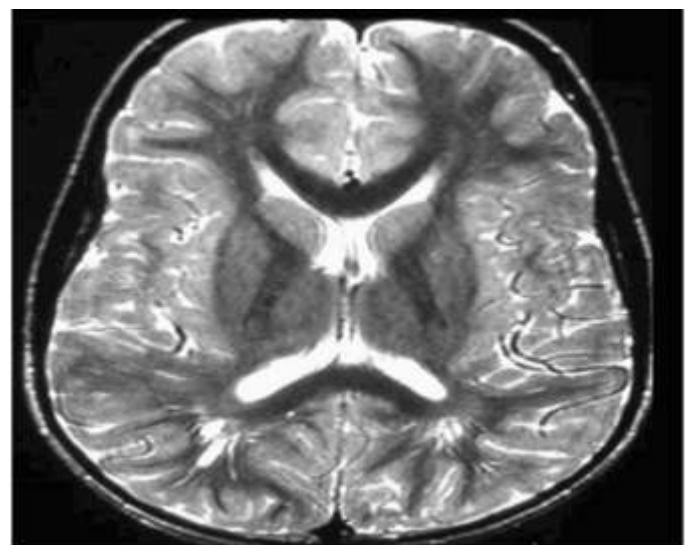


Fig 3.1.6: Dilated Virchow robin

Temporal left and right lobe: The temporal lobe is involved in processing sensory input into derived meanings for the appropriate retention of visual memory, language comprehension, and emotion association. The temporal lobe consists of structures that are vital for declarative or long-term memory. Declarative (denotative) or explicit memory is conscious memory divided into semantic memory (facts) and episodic memory (events). Medial temporal lobe structures that are critical for long-term memory include the hippocampus, along with the surrounding hippocampal region consisting of the perirhinal, parahippocampal, and entorhinal neocortical regions. The hippocampus is critical for memory formation, and the surrounding medial temporal cortex is currently theorized to be critical for memory storage. The prefrontal and visual cortices are also involved in explicit memory. The temporal lobes are involved in the primary organization of sensory input (Read, 1981). Individuals with temporal lobes lesions have difficulty placing words or pictures into categories. Language can be affected by temporal lobe damage. Left temporal lesions disturb recognition of words. Right temporal damage can cause a loss of inhibition of talking. The temporal lobes are highly associated with memory skills. Left temporal lesions result in impaired memory for verbal material. Right side lesions result in recall of non-verbal material, such as music and drawings. Seizures of the temporal lobe can have dramatic effects on an individual's personality. Temporal lobe epilepsy can cause perseverative speech, paranoia and aggressive rages.

condition is also checked. All the necessary details for understanding the health status is obtained from the test results provided by the students. Results of students are collected and it is fed in to the system. Then it is checked against the dataset collected from the hospitals. Finally a suggestion is given to the trainer. So that trainer can improve training of students according to their disease conditions. Autistic patients find it difficult to remember their daily schedule. Hence, a schedule notification is also provided. Hence, LASAC is trying to improve the lives of the most wonderful and differently abled students.

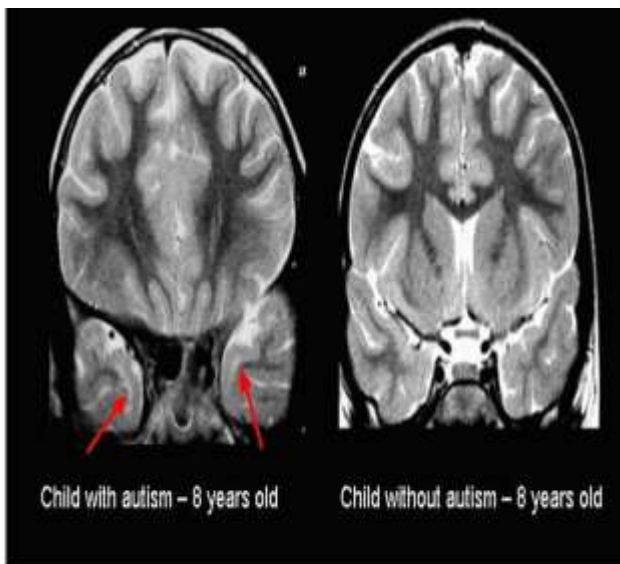


Fig 3.1.7: Temporal lobe problem

First of all, trainer teaches malayalam letters, words etc. to autistic students with the help of audio. Then the trainer will ask the students to repeat the same. Those audios are recorded and send for analysis. So that the trainer will be aware about how much the student had learn. In addition to the checking of his/her learning capability, the students health

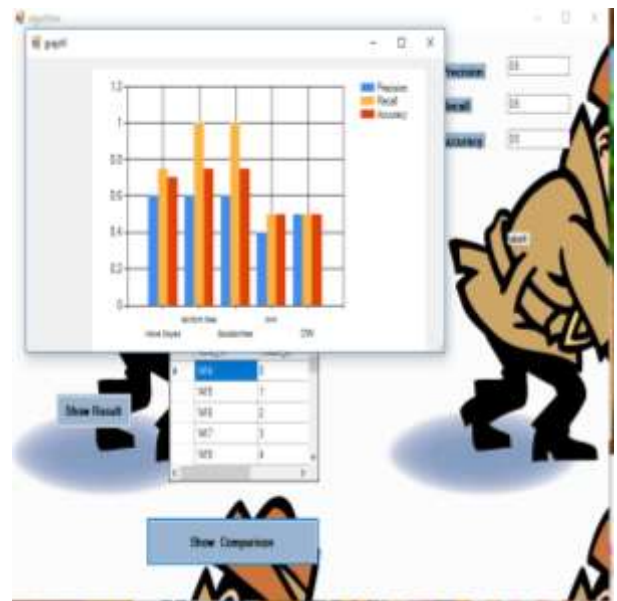


Fig 3.1.8: Analysis of finding which algorithm is better



Fig 3.1.9: Disease is being predicted and sound is analyzed using algorithms

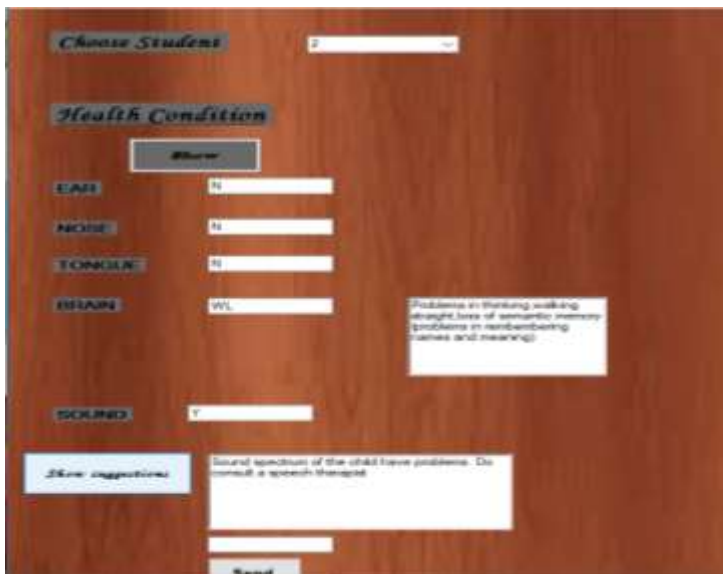


Fig 3.1.10: Disease Prediction and Suggestion Page

3.2 ANALYSIS

The analysis shows how much student had learnt and the rate of each disease in a group of individuals. By looking into this analysis it is possible to find the improvement of each student. In this project, disease prediction is based on ENT and brain results of student.

3.2.1 Analysis: ENT Statistics

Here, the statistics of nose, ear and tongue condition in a group of students is depicted. From this result it is possible to find which part in the ENT section is affected mostly. This analysis will help to know the autistic societies current health status.

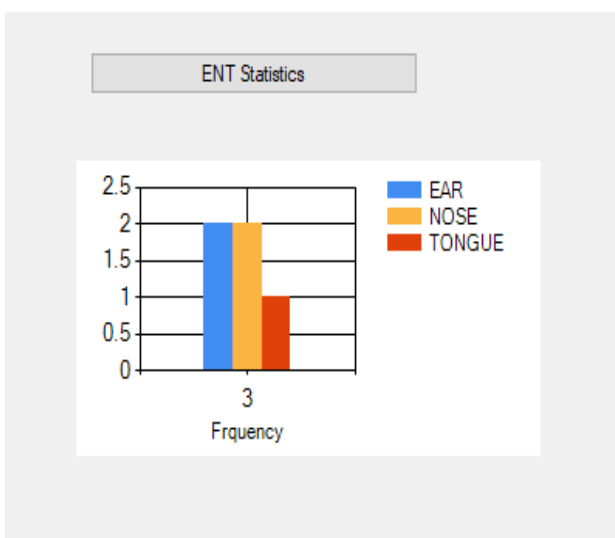


Fig 3.2.1. Analysis of ENT health condition in autistic society

3.2.2 Analysis: Brain Statistics

Here, the statistics of brain MRI result in a group of students is depicted. From this result it is possible to find which part in the brain is affected mostly. Thus it is possible to understand their thinking, understanding and developmental capability.



Fig 3.2.2. Analysis of brain MRI results of autistic society

3.2.3 Analysis: Sound spectrum analysis

The sound of the autistic children is recorded and it is checked by using two methods

- i) Cosine similarity
- ii) Naïve bayes. The analysis of two methods is performed. Thus it is possible to find whether the student is pronouncing the word or letter correctly

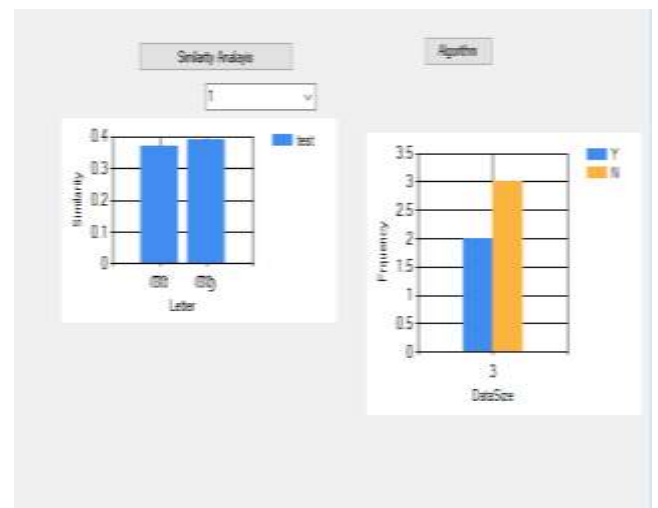


Fig 3.2.3. Sound spectrum analysis using cosine similarity and algorithm

The similarity analysis will help us to find how much the student had learnt each letter. Thus it is possible to know the

improvement in learning. But the output of the cosine similarity was very much affected by noise in the environment. So to overcome that disadvantage, an algorithm is used to check the similarity. Naive bayes is the algorithm which is being used to check whether the sound of the student is correct or not. The output was almost correct. Here an analysis is performed on a group of autistic patients and find out that only 25% of the students were pronouncing the letters or words correctly.

4. CONCLUSION

Autism is a group of complex disorders of brain development. The autism students need special training to make them familiar to regional language. To improve their reading and understanding skills, the LASAC is developed. By overcoming various disadvantages of traditional approach, the latest technologies like deep learning, neuro imaging are executed in the project. By this project, the life of the differently abled autism patients will be improved to an extent

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