Improving the Treatment Process of Bengali Autistic Children using Specialized Mobile Application

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Many children in Bangladesh have ASD. The rate of Autism Spectrum Disorder (ASD) is increasing in Bangladesh and other countries, day by day. Autistic children find it difficult to talk and express themselves regarding what they want or not. Also, some autistic children are not comfortable dealing with the outside world. For example, they do not feel comfortable in social settings or in any program. There are some schools and organizations where many kind-hearted people are trying to help those autistic children in many ways. We all know that there is no cure for autism. But it can be reduced. After good treatment, an autistic child can recover. To help the treatment process, we have developed an interactive app that will help them to cope with social events and places, as well as help them with verbal tasks. We have developed a model to access the severity of an autistic child and help the child to improve communication. This paper presents our interactive app and also provides a concise comparison of it with existing apps to support children with ASD.
Keywords *- Autism, ASD, Android Apps, Bengali, Machine Learning, ABLLS*

1 Introduction

Autism Spectrum Disorder (ASD) is a brain disorder. It is a lifelong disorder that is understood by weakness in social skills, having difficulties with speech and nonverbal communication, and engaging in repetitive behaviors. Almost one percent of the world population has ASD [1]. The percentage of ASD increased day by day. Children with ASD have problems with their social skills. Statistics show that children with ASD find it difficult to communicate with others and form relationships with others. They find it challenging to make sense of the world around them. Some children with ASD can only speak a few words. Some cannot even speak in their whole life [2].

Because of their lack of social skills and communication skills, it is difficult to teach them. Therefore, they need special care and a special Individual Education Plan. They also need special tools and apps to help them to learn.

We know that smartphones and mobile apps have made our life simpler and better. So why shouldn't the smartphone and mobile apps make the hard life of an ASD child easier?

That is why we are building a mobile application that will help ASD children to learn and get friendly with the social environment, and it will also help non-verbal children to express their emotions and needs to others.

2 Background

Autism is a very common neurodevelopmental disorder. It may be defined as challenges in social interaction and stereotypic behavior. As it is not a single type of disorder, rather it involves various degrees of severity, it is referred to as the Autism Spectrum Disorder (ASD) [3]. According to recent estimates, ASD has a prevalence of about 1 in 54 children and occurs about four

times more frequently in boys than in girls [4], [5]. Every year, the total number of children diagnosed with ASD is increasing, which can be seen in Fig. 1.

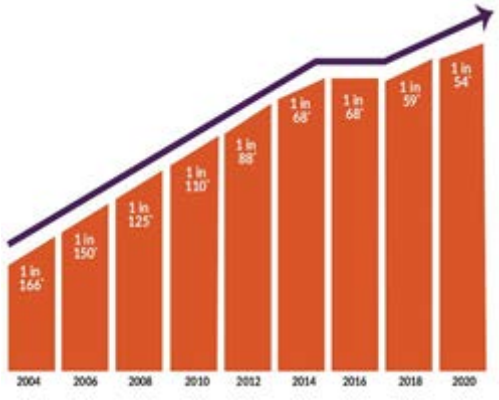

Fig. 1. Statistics of prediction of children with ASD

There is also a risk of recurrence of up to 20% for children when their elder brother or sister is detected with ASD [5]-[8]. ASD is still a non-curable disease. Research shows that if we can diagnose ASD early, it is beneficial for the challenged kids for their treatment [9]. However, many pediatric doctors and health professionals do not share information about a child with ASD with its parents. In some cases, the doctors hope that the children might get cured with age and in some cases, the doctors feel uncomfortable sharing the negative information considering its impacts.

Individuals with autism often remain undiagnosed or incorrectly diagnosed because many clinicians hesitate to discuss this possibility with parents of young children, even when some symptoms are present. These physicians are often concerned about family distress, the negative effects of labeling a child, the possibility of being wrong, or the hope that symptoms will reverse or improve over time. However, healthcare researchers believe that the pros of early and correct diagnosis are much higher than the cons and help the child's family in the long run.

There are many protocols for assessing and educating children with ASD, one of the popular is - The assessment of Basic Language and Learning Skills (ABLLS) by Dr. Partington [10]. In this protocol, the children face an initial assessment at the beginning. Then an Individual Education Plan or IEP is created for each child. IEP is created based on their disability. Every child has a separate learning timeline from others. The teachers used various materials to train the autistic child. They also use smartphone apps, such as puzzle apps, drawing apps, mix, and matching apps, etc. But most of the apps are in English and many of them have a lot of bugs. So, it is getting difficult to teach ASD children in Bangladesh and find helpful apps in the Bengali language. To address these issues, we have performed research, interviewed the stakeholders, and developed a mobile-based application.

3 Objectives and methodology

Children with autism have a disability in communication and lack social skills. And it is difficult to develop communication skills. Therefore, our objective is to create a media between autistic children and other people to communicate with each other and help them to learn social skills. As Autism is not curable, our motive is to reduce the effect of the disorder on their attitude and improve the communication skill of the challenged kids. Another goal is to develop the app in the Bengali environment as in Bengali, no such app is available. Therefore, Bengali parents face difficulties to get used to another language app to teach their challenged kids.

4 Data collection and analysis

We have already collected data sets from a renowned school for autistic children. This school follows the ABLLS protocol to train students diagnosed with ASD. We have visited the school a few times and met with their teachers and children. We also received suggestions for our work from the school teachers. We have collected their manually evaluated data. Currently, there are 26 students enrolled in the school and we have 26 data sets of 9 children diagnosed with ASD at the school.

In ABLLS methodology, there are 12 steps for initial assessment:

1. Cooperation with Adults
2. Requests (Minds)
3. Motor Imitation
4. Vocal Play
5. Vocal Imitation
6. Matching to Sample
7. Receptive
8. Labeling (Tacts)
9. Receptive by Function, Feature, and Class
10. Conservational Skills (Intra Verbal)
11. Letters and Numbers
12. Social Interaction

We got all data sets in handwritten format, so we had to digitize them. The initial assessment has 12 events. Each event has 5 scores. When a new child comes to the school, a teacher runs the assessment and scores against every event. Then after running the IEP for some months (maybe 3 or 6 months, depending on the performance of the Initial Assessment), the teacher performs the assessment again and sees if there is any progress in the score.

5 Proposed model

The following diagram of Fig. 2 shows our proposed model to automatically predict the level of autism of a child based on the scores of 12 assessment tests proposed in the ABLLS protocol.

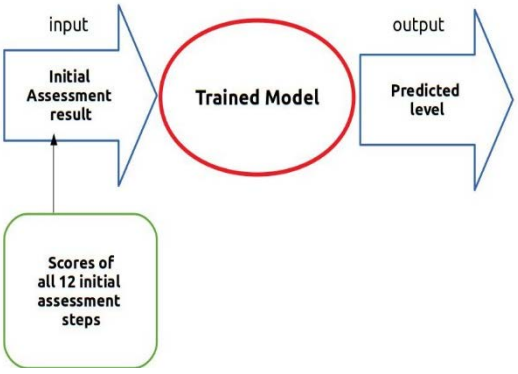

Fig. 2: Block diagram of Autism level predicting model

From the values of each category in the Initial Assessment, we see that 1 indicates the most negative behavior. 5 indicates the most positive behavior. 2 to 4 indicate the behaviors gradually improving from negative to positive. As ASD has 3 levels: Mild, Moderate, and Severe. We can correlate the values with those levels. We calculated the severity value for Model 1 of the twelve categories to predict the level by the following equation 1.

$$Severity = \frac{\sum_{i=1}^{n} Value\ (i)}{n} \quad ---(1)$$

Table 1: Autism Leveling in Proposed Model

Level	Range
Level - 3: Severe	Severity<2
Level - 2: Moderate	2<=Severity<3.5
Level - 1: Mild	Severity>=3.5

For Level 3 - Severe we have considered 2 as the threshold average value. If we consider 1 which is the most negative value for each category as the threshold average value for Level 3 - Severe, an individual who scores 1 in every category will not be in the severe level. If he scores 1 in the maximum categories and more than 1 in the remaining categories, he will not also be in the severe level. To overcome the level, we considered the threshold value as 2. Similarly, we considered 3.5 as the threshold average value for Level 1 - Mild, because if an individual scores 4 in maximum scores less than 4 in the remaining, he will not also fall in the mild category. To overcome the problem, we considered 3.5 as the threshold value. The values between 2 and 3.5 indicate the Level 2 - Moderate group.

6 Features of the developed app

For developing our app, we have followed the Prototype model. The prototype model is an iterative trial-and -error-based procedure that works between the software developers and the end-users. This model works fine in situations where all the project requirements are not known a priori. The model is presented in Fig. 3. In this model, a basic prototype is developed with the initial

requirements of the stakeholders. Then, using an iterative process, customers' feedback is collected and the basic prototype is updated. This process ends when the stakeholders are fully satisfied or all the functionalities meet. We have developed the basic version of *PicTalk* using our initial requirement analysis. Then from the feedback of the teachers of the autistic children and with some feedback from the specially challenged students, we have improved the app in an iterative way.

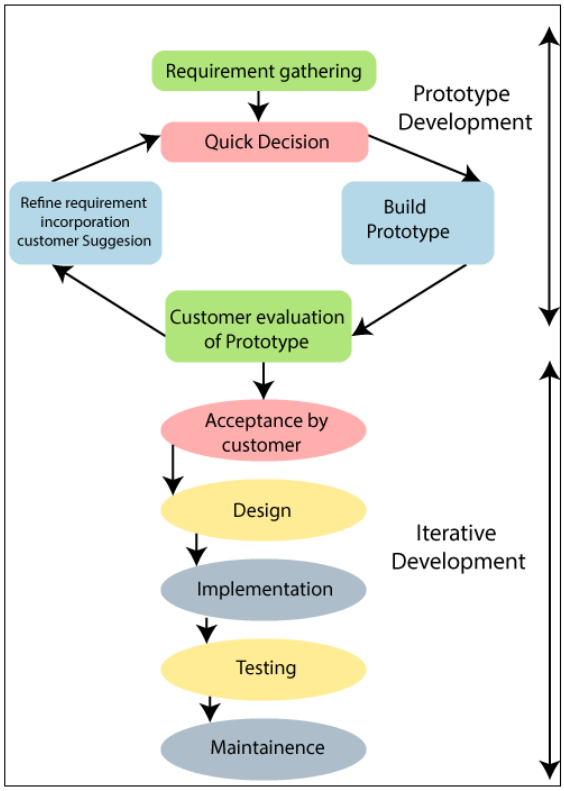

Fig. 3 Prototype model

Our application *PicTalk* has two parts, a social interaction learning part and a communication part.

1. Children with autism learn social interaction using various pictures. Generally, teachers show some images and try to make you understand what to do and what not to do in a place. For example, do not speak loudly in the mosque, etc. So, we make a compilation of places in our app with interactive information. We believe that children will become more interested in learning with our app.

2. Our second feature is for the non-vocal or less talking children. Children can use our app to ask for something, for example, "I want to eat rice" or yes/no answer, etc. Our app has a list of tasks and important elements' names, children can just click and the app will say the task. The app is fully in the Bangla language. So it will also speak in Bangla. Fig. 4 – Fig. 7 provide a pictorial view of our developed app to improve the social skills of children with ASD.

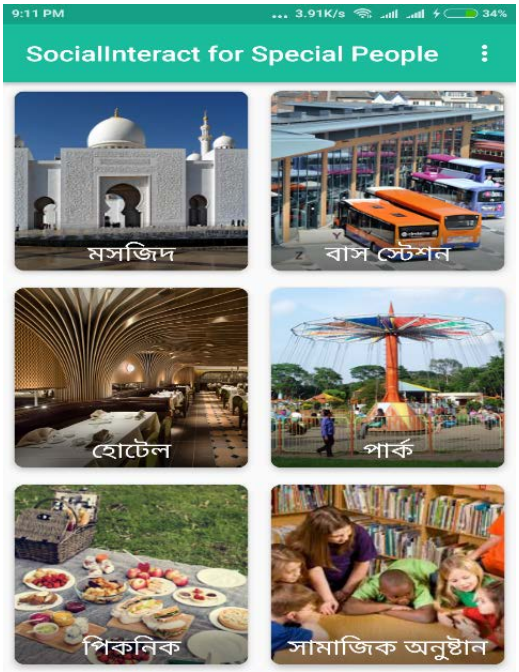

Fig. 4. All areas of the social interaction part

Fig. 5. A part of how to react in a Mosque

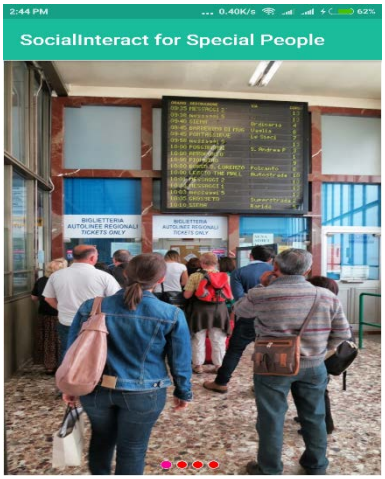

Fig. 6. How to react at the bus station

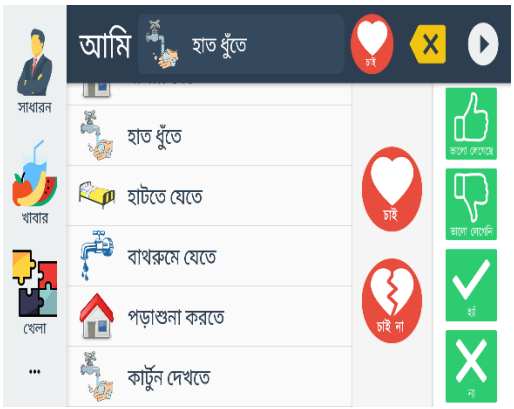

Fig. 7. Home page view of Pic talk part

7 Comparison with existing tools

We searched for other apps for autism training. Comparisons between our app and other existing apps in the English language are presented in Table 2.

Table 2: Comparison between our app and other apps

App Name	Language	Text To Speech	Learning with image	Helpful for non-verbal students	Text-based learning	Online or Offline	Ref
PicTalk	Bangla	Yes	Yes	Yes	No	Offline	[11]
Teach Autistic Children	English	No	No	NO	Yes	Online	[12]
Otsimo	English	No	Yes	Yes	No	Online	[13]
Talking pictures	English	Yes	Yes	Yes	No	Offline	[14]
LetMeTalk	English	Yes	Yes	Yes	No	Offline	[15]

8 Usefulness survey

We interviewed some of the teachers and doctors about the prospective impacts of our developed app. They were all positive about our idea and research findings. DR. Fahmida Islam Chy, vice president of the Foundation of Autism Research and Education (FAREBD), said that it will be a great addition to ASD treatment procedures, as well as for teachers and also for family members of an ASD-diagnosed child. The General Secretary of the Foundation of Autism Research and Education (FAREBD) said that ASD-diagnosed children stay in the training school for a maximum of 5 to 6 hours. The rest of the time, they stay with their parents and family members. If any app can be used to train them about social interaction and verbal talk, it will be quite beneficial for the children. One of the guardians of an ASD-diagnosed child told us that her son always screams if he goes to a train station, bus station or any crowded place. This app will be very helpful for her to teach her son how to react in a crowded place.

9 Limitations

Though the app is fully interactive, it needs a human helper to perfectly use it, and make it help autistic children. As our developed app is the first one of its kind in Bengali, there are still many scopes for improvement by considering the short-term and long-term effects of the app among children with ASD.

10 Conclusions

ASD is a neurological condition, meaning that people with ASD are born with it, and have it for life. But they can be trained and they can become skilled. The main skills they need are social skills, behavioral skills, and communication skills. We are trying to help the children with ASD by supporting them in improving their social skills with the help of our smartphone-based application, which is fun and interactive. Also to help the non-vocal or less talking children to communicate with others using the application. We believe it will help them learn and communicate with others.

As autism is not remediable, we believe that our work will at least help in the training process for ASD-diagnosed children. Teachers, as well as parents, can use this app for children to teach them about society and how they will react in social places such as bus or train stations, restaurants, social programs, etc. Also, it will help non-verbal ASD diagnosed children to express their feelings and what they want to do or not. The Government of Bangladesh should take proper steps to facilitate the development and improvement of apps for the training of special children in their own language.

Acknowledgment

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