

# Detection of Fine Motor Deficit In Autism Spectrum Disorder Using ML Algorithm

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**Abstract-** *The aim of this study was to determine if patients with Autism Spectrum Disorder (ASD) have syndrome-specific motor deficits. The proposed application uses machine learning classifiers to detect autistic symptoms based on motor parameters. It also indicates the type and severity of fine motor deficit in the patient with ASD. The system uses motor parameters which represent activities in the application and the Autistic patient is made to perform the activities. Based on the results of each activity a final report is generated. We also find it beneficial to observe motor development in Autistic patients because it can be measured over time and results of testing can be easily reproduced.*

**Keywords-** ASD, ML, Fine Motor Deficit, Motor parameters.

## I. INTRODUCTION

Autism Spectrum Disorder (ASD) is a complex neuro-developmental disorder that includes problems with both communication and behavior. Autistic patients experience trouble in communicating with others. They also experience trouble in understanding what other people think and feel. This makes it hard for them to express themselves, either with words or through gestures, facial expressions, and touch. People with autism might have problems with learning. Their skills might develop unevenly. For example, they could have trouble communicating but be unusually good at art, music, math, or memory. Because of this, they might do especially well on tests of analysis or problem-solving [1]. Although autism can be diagnosed at any age, it is said to be a “developmental disorder” because symptoms generally appear in the first two years of life. Autism is known as a “spectrum” disorder because there is wide variation in the type and severity of symptoms people experience. ASD occurs in all ethnic, racial, and economic groups. Although ASD can be a lifelong disorder, treatments and services can improve a person’s symptoms and ability to function. Fine motor delay is when a child is not able to use their hands and fingers to hold, manipulate, and use objects when the child is at the right age to do these things. Fine motor skills require eye-hand coordination — the ability to see something and respond with the right movements in the hands and fingers. The ability to speak also uses fine motor skills because the lips, tongue, and

face muscles must coordinate to make different shapes so a child can speak. Children can have a delay in fine motor skills, gross motor skills (big movements like crawling or walking), or both. Children grow and develop on their own schedules. Some children can pick up toys or use a crayon earlier than others. Many children with a fine motor delay are able to do the activity at some point, but do it later than most children their age [3].

Fine motor impairments in Autism Spectrum Disorder are amongst the most common signs and are not used in diagnostic criteria till now. Autistic patients are not all challenged by motor skills development to the same degree. Some have difficulty with fine motor skills, some are more challenged by gross motor skills, while others have difficulty with both. So, there is a need of such system that can easily classify the type and measure the severity of ASD using motor parameters. Using the proposed system, we can:

- Help professionals discover brain functioning differences, even in cases of high functioning autism.
- Patients which are fine motor deficit can be detected early with the type.
- Gives more accurate and precise results, by making patient perform various activities.
- Help the autistic patients to manage their health and see their growth in a better way.

## II. LITERATURE SURVEY

Recent studies suggest that Autistic patients experience some level of motor difficulties, and that this maybe because of poor social communication skills. However, other studies show that Autistic patients with language impairments but without poor social communication problems, are at risk of motor difficulties. We have studied more than 30 papers to gather information about motor deficit in Autistic patients. Based on the information we have written the literature review. Some of the important findings are listed below:

In this [4] paper the author examines the speed of finger tapping task of both Normal people and Autistic patients. This identifies suspected ASD with fine motor and helps in earlier diagnosis of Autism. Fine motor skills are very important for everyday functioning and they are a significant predictor of a child’s later academic achievement.

In the paper [5] the author describes the prevalence of motor deficits in ASD. To address whether the motor deficits in children with ASD were properly identified and treated, they evaluated whether the children with the motor deficits were more likely to receive physical and/or occupational therapies as compared to the children with ASD who did not show motor deficits. Hypotonia was the most common motor symptom in ASD cohort (51%) and this appeared to improve over time, as suggested by the significant reduction in prevalence in older children (p=0.002).

In the paper [6] the author aimed to determine if children with ASD have syndrome specific motor deficits in comparison to children with specific language impairment (SLI). They used an independent groups design with three groups of children (8-10 years old) matched on age and nonverbal IQ: an ASD group, an SLI group, and a typically developing (TD) group. All of the children completed an individually administered, standardized motor assessment battery. They found that the TD group demonstrated significantly better motor skills than either the ASD or SLI groups. Detailed analyses of the motor subtests revealed that the ASD and SLI groups had very similar motor profiles across a range of fine and gross motor skills, with one exception.

In the paper [7] the author investigated the degree of engagement of children in interactions with their parents. The result of this study shows that engagement is easier to predict for TD children than for ASD children, and that the parent’s actions/movements are better predictors of the child’s degree of engagement.

**III. PROPOSED SYSTEM**

The proposed application is developed using C# language and is capable of detecting the type and severity of Fine motor deficit in Autistic patient this is achieved by using various motor parameters. These parameters resemble some symptoms and can be used to test the Autistic patient and find the area where the patient in having trouble. Motor parameters are of three types,

1. Kinetic parameter (Motion with regard to force)

2. Kinematic parameter (Motion without regard to force) and
3. Temporospatial (Timing and Distance).

The below table.1 shows motor parameters with the associated activity:

Table.1 Motor Parameters

Symptoms	Motor parameters	Activity
Poor name call response	Temporospatial	Chatbot
Poor Joint Attention	Kinematic	Finger Tapping Test
Attention Deficit	Kinematic	Block Matrix
Poor Emotional Response	Temporospatial	Face Recognition

Chatbot as shown in Figure.1 is used in this application to detect whether the Autistic patient is able to response when the Chatbot tries to communicate with him. Most of the time, when Autistic Patients are called by their name they lack response. Using this technique, we can achieve the first task.

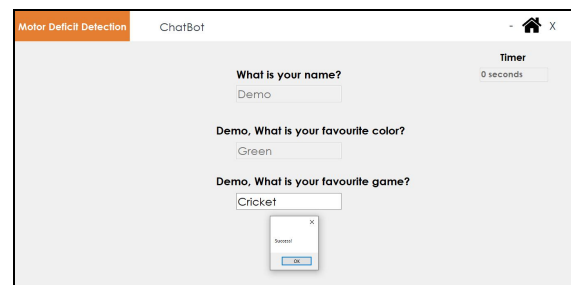


Figure.1 Chatbot

Secondly, Finger Tapping Task as shown in Figure.2 is used in the application to detect poor joint attention where the Autistic patient is made to tap on a button for exactly one minute, depending on the number of tapes the result is declared. To achieve this, we have created a threshold by making normal people do the same task and based on the data a threshold was set for the autistic patients.

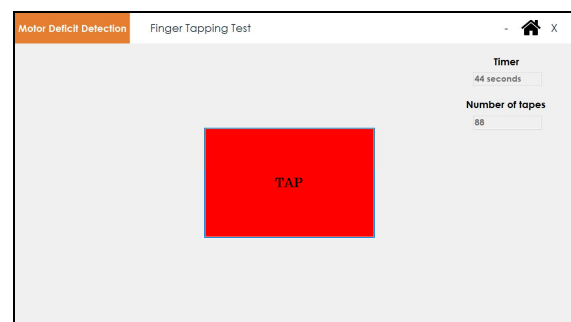


Figure.2 Finger Tapping Test

Block Matrix (Puzzle) as shown in Figure.3 is used in the application to determine the attention level and short-term visual memory of the Autistic patient. Doing this, we achieve the motor parameter: Attention Deficit.

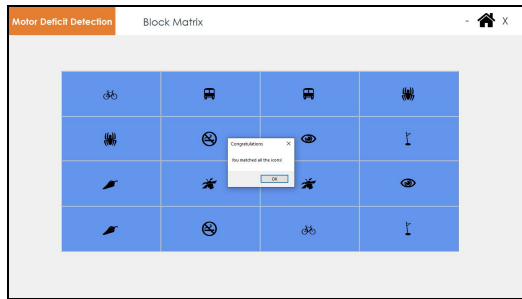


Figure.3 Block Matrix

Poor Emotional Response as shown in Figure.4 is captured by using Face Recognition system in this the Autistic patient is shown a comic video. We have marked the capturing points by making normal people perform this task. For Autistic patient, the activity captures their emotion on these points. If their emotion doesn't match the emotion of normal people, then they are Poor Emotion Deficit.

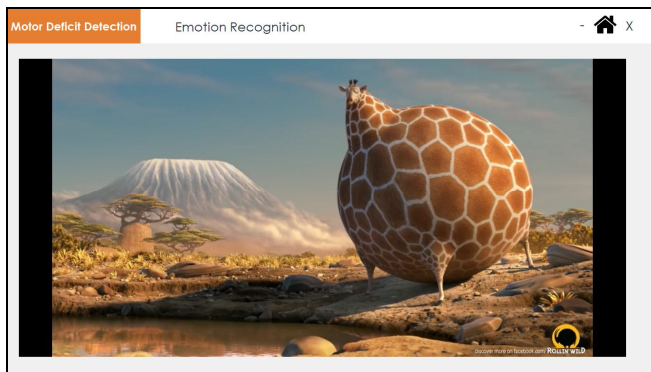


Figure.4 Emotion Recognition

The proposed system as shown in Figure.5 consists of a personal computer (with an inbuilt web-camera). The Autistic patient is required to perform activities. Based on the results of the activities, a report is generated to specify what type and severity of Motor Deficit they are.

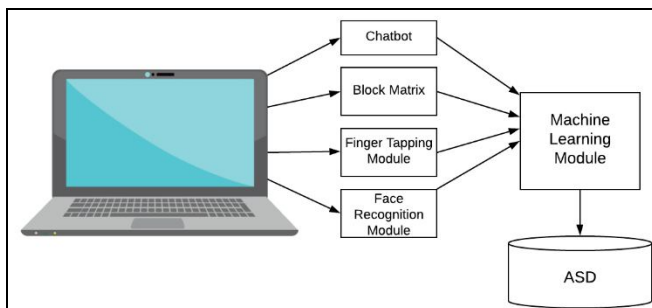


Figure.5 Architecture Diagram

After the Autistic patient completes all the activities the data is submitted to the Machine Learning Algorithm. Based on the data the ML Module compares the data with the threshold range and submits the data to the database. A report is generated with the help of the submitted data which can be used by Medical Professional to examine the patient and decide way for improvement.

#### IV. RESULTS

The proposed system is capable of generating a report based on the results obtained from the different motor parameter activities (i.e. ChatBot, Finger Tapping Task, Block Matrix and Emotion Recognition System). This report may provide help to medical personnel while examining the Autistic patient. The report will consist of the Personal Details of the patient, the results of the activities performed, and will also specify the type and severity of fine motor deficit in the Autistic patient.

#### V. CONCLUSION AND FUTURE ASPECTS

The paper identifies Autistic patient with Fine motor deficit with the type and severity. This may lead to earlier detection and quicker diagnosis of ASD and Fine motor deficit. Deficits in fine motor skills are periodically displayed by children and youngsters. In the proposed application we used various activities and tests that can identify if the person is autistic or not. The application uses the data generated by these activities to identify if a person is autistic or not. We conclude that Autistic patients with Fine motor deficit can be treated if it is detected and classified earlier in the process. However, in future behavioural and neurological studies of fine motor skills should include motor parameters in order to identify possible autism-specific deficits.

The key limitation of the study is that we don't have a large set of data to train the prediction model. In future, our goal is to collect more data from different sources and to improve the prediction model accuracy. Another limitation of the application is that it is not suitable for the age group below 3 years as they can't use or perform the activities that are given in the application. Lastly, the future system may be able to capture Kinetic parameters as well by using EEG tool.

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