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Computer Vision-Based Autism Evaluation Children: Examining Relationships, Feelings, Human Position and Life Abilities

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ABSTRACT: Autistic children suffer from some difficulties including social skills, repetitive behaviors, speech and nonverbal communication, and accommodating to the environment around them. Thus, dealing with autistic children is a serious public health problem as it is hard to determine what they feel with a lack of emotional cognitive ability. Currently, no medical treatments have been shown to cure autistic children, with most of the social assistive research to date focusing on Autism Spectrum Disorder (ASD) without suggesting a real treatment. In this paper, we focus on improving cognitive ability and daily living skills and maximizing the ability of the autistic child to function and participate positively in the community. Through utilizing intelligent systems based Artificial Intelligence (AI) and Internet of Things (IoT) technologies, we facilitate the process of adaptation to the world around the autistic children. To this end, we propose an AI-enabled IoT system embodied in a sensor for measuring the heart rate to predict the state of the child and then sending the state to the guardian with feeling and expected behavior of the child via a mobile application. Further, the system can provide a new virtual environment to help the child to be capable of improving eye contact with other people. This way is represented in pictures of these persons in 3D models that break this child's fear barrier.

KEYWORDS: autism spectrum disorder; augmented reality; systematic review

I. INTRODUCTION

Disabilities in social behavior and interaction are characteristics of ASD. According to Jon Baio [1], an estimated 1 in every 59 children is diagnosed with ASD. Special care and welfare facilities are needed by all impaired children more than by healthy youngsters [2]. In addition to limiting the lives of the sufferers, this long-term condition has a detrimental impact on their caretakers' quality of life (QoL). Patients can be monitored remotely using systems based on IoT devices, which have numerous beneficial characteristics. There have so been a number of healthcare applications leveraging IoT devices in recent years. GPS, heart rate, microphone, and ear clips [2] are some of the most common IoT sensors used in wearable devices like smart watches and smartphones. Sensors and devices are used to identify autistic youngsters, rather than traditional techniques of diagnosis [3, 4].

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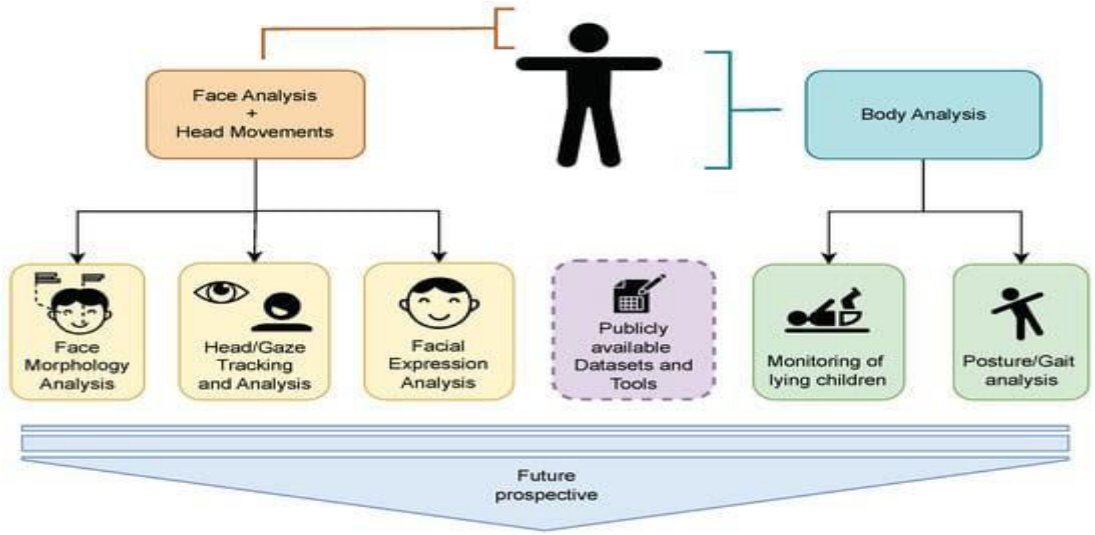

Fig 1: Computer Vision Tasks

To help protect youngsters from developing life-threatening disorders, several studies have been conducted during the last decade. However, there were no major breakthroughs. Hence, the most important components of assisting the patient are early diagnosis and improving the QoL of the patients. Autistic children are frequently misdiagnosed until they are two years old [4]. As a result, they are still unable to carry out their daily routines. Consequently, this article examines several IoT device techniques for children with ASD to evaluate and contrast novel ways of detecting the disorder or enhancing quality of life for individuals already diagnosed [4, 5]. The Internet of Things is using artificial intelligence, machine learning, SS network, and deep learning to identify and protect patients from physical and emotional problems [5]. Patients' vital signs are gathered by these systems, which then use various machine learning and deep learning algorithms to select the most appropriate responses. They may even be able to assist in the early detection of ASD. There are risky behaviors that autistic children perform when they are irritated, which can impair their physical health. An alarm is sent to caretakers and doctors, informing them of the condition and requesting assistance. Every one of these IoT-based devices monitors the body's vital signs and records any changes depending on a variety of criteria (e.g., sensitivity, specificity, time, and accuracy) [6].

According to our knowledge, the ASD methods have not been extensively studied. In this work, methods for a Systematic Literature Review (SLR) are presented so that developing technologies such as wearable devices and mobiles can be utilized in ASD research. A technical taxonomy [6, 7] describes the classification of existing ASD approaches and algorithms employing IoT-based devices and ML/DL. Through the use of SS networks in the health sector, there will be an increase in communication and collaboration, with individuals sharing information about similar conditions and healthcare professionals sharing their knowledge of care and treatment. As a result, better health decisions can be made.

II. LITERATURE REVIEW

Caregivers and families dealing with autistic children face one of the most challenging and difficult challenges. Systems that use the Internet of Things have attracted a lot of interest in recent years. ASD treatment and diagnosis have been the focus of several publications, but only a small number of relevant studies have been presented to study ASD in the same way.

addressed issues in a wide range of smart devices, sensors, and systems connected to health concerns, which are closely related to our study. Internet of Things (IoT) has emerged as a modern information technology, according to [7]. One of the most interesting uses for a growing number of wearable sensors in healthcare is to store the data collected from monitoring physiological parameters like heart rate. IoT, cloud computing, and Wireless Body Area Network (WBAN) are the primary components of this technology (WBAN). IoT-powered wireless "SS networks" rely on a machine learning technique for their effectiveness since there is a lot of data that has to be intelligently managed.

Demonstrate that children with ASD, like those with dementia and Alzheimer's, also experience forgetfulness. As a result, individuals are more likely to encounter dangerous circumstances, such as fleeing their homes. On the other hand, this technology allows children with ASD to remain in their comfort zone. Alzimio, a solution based on IoT

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devices, was presented to address these problems. Using a method developed by Aisuwarya he exact location of patients can be displayed on the smartphones of medical professionals. When patients have departed from their comfort zone, these systems may be of great assistance.

Data mining approaches like as classification, regression, and clustering were used by to diagnose ASD early. For patients and their careers, early detection of ASD is critical to providing appropriate education and support. For the most accurate diagnosis, their research found that categorization algorithms are the best.
Using data mining tools, have studied the impact of autism treatments on proper conduct. Autistic children can be predicted and better understood using this method. On the basis of these techniques, they could distinguish between what were deemed acceptable and unacceptable behaviors.

analyzed 45 papers that applied supervised machine learning and classification techniques to ASD. SVM, random forest, decision trees, Least Absolute Shrinkage and Selection Operator (LASSO), Neutral Network (NN), regression, Conditional Forest (CF), Nave Bayes (NB), Elastic Net regression (ENet), Random Tree, and Flex Tree were the most utilized models. A survey of 83 publications published after the year 2000 was conducted by Koumpouros and colleagues for their study. The papers committed to intervening in the treatment of ASD with wearable technology and computer power.
An autistic youngster can benefit from the Robota robot toy, which was used in [15] to demonstrate the potential of the AuRoRA project. An evaluation element known as Conversation Analysis (CA) was used to study the development of three children with autism. As a result, they came to understand that the youngsters are in fact interacting with the adult robot. An autistic child's joint attention was not only defined in the study, but computer and robot therapy for ASD was also highlighted.

III. METHODOLOGY

presented wearable technology based on social sensing, privacy audio feature merging, environment sensing, and behavior tracking. To evaluate voice quality and information without storing unprocessed audio data, the wellbeing monitoring platform developed privacy audio wellbeing capabilities. In their case study, they utilized Android smartphones and servers to create an application that explains the long-term relationship between physical and psychological data. It may also be evaluated on actual humans in clinical trials. Krishna and Sampath [20] have also presented an IoT system for monitoring important patient metrics and health situations. This information is transmitted to the cloud server via a smartphone or other device. Using cloud computing and the collected metrics, such as heart rate, oxygen saturation percentage, and body temperature, we can determine the health status of a user. A programmed laptop or smartphone can be used to display the data from the user's mobile phone.

A Service-Oriented Architecture (SOA) for persons with an autistic condition was developed by In the proposed wearable sensors, autistic persons and their environment may be monitored for their physiological state. Using readily accessible and inexpensive devices such as smartphones, cameras, and other wireless items, developed an Internet of Things therapeutic system for the home use of handicapped patients and the elderly. For the treatment of patients, they made use of image processing and embedded computers and aided in the development of a health-conscious household. Accuracy and cognitive theory emphasize were outlined by the authors. For Parkinson's sufferers as well as children with ASD, this therapy may be able to enhance facial expression. Some of the behaviors and reactions of autistic children, such as voice pitch, communication without words, and complex techniques, have been reported by Lavanya et al.

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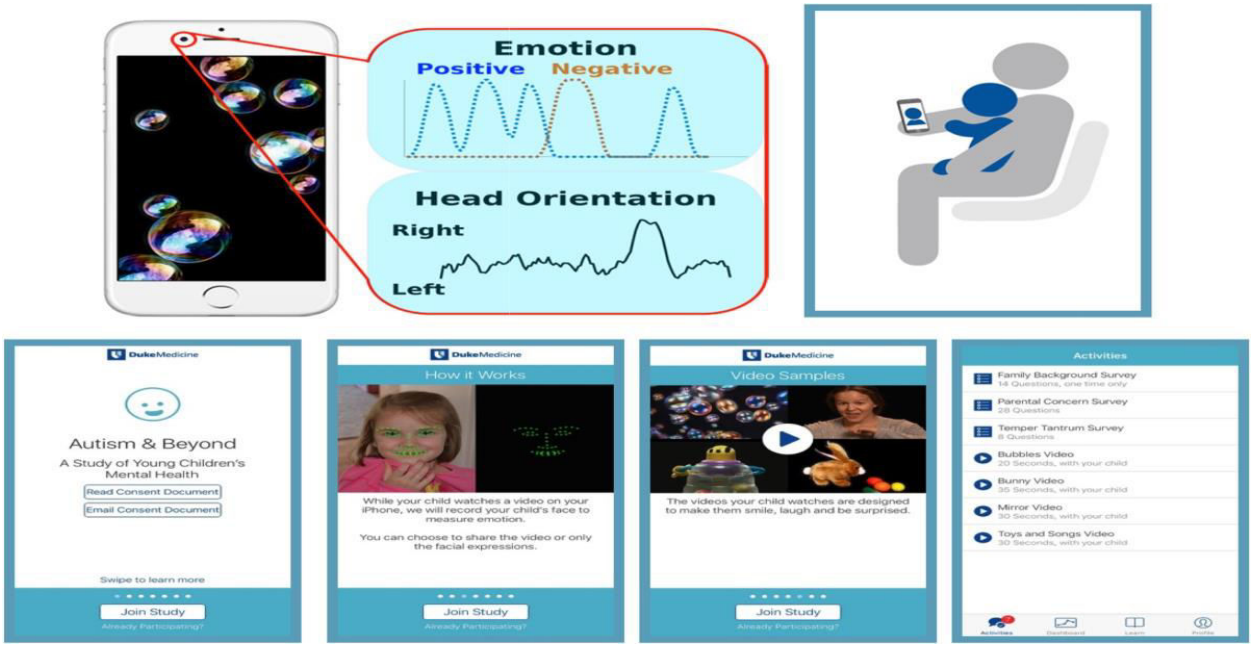

Fig 2: Research Methods

An IoT system that uses a wristwatch to identify autistic children's stereotyped behaviors was introduced by. For children with autism, weeping, flapping of the hands, and painting are frequent behaviors. The accelerometer in the wristwatch is designed to recognize these three common reactions. Sensors are used to collect data, which is subsequently sent to the cloud for processing. Parents, clinicians, and caregivers will benefit from this technology since the process changes decision trees and improves their correctness. When it comes to early detection, used a smart toy automobile. In the toy car, the SVM algorithm was used to tell between healthy children and autistic youngsters. So far, this method has the highest level of accuracy, sensitivity, and specificity, based on the results of their experimentation. An autistic child's emotional, attentional, and social ties can be reinforced in a therapy-based virtual world that has several levels. Attracting attention with color lights and loud noises first, the atmosphere focuses on boosting social ties and engagement by allowing people to touch each other, as well as throw a ball at each other. When it comes to choosing a decision, this is it! Autistic children's terror, frustration, and eagerness may all be predicted with virtual reality therapy.

IV. RESULT ANALYSIS

Using linear or nonlinear EEG variable selection, enveloped a robust technique for early identification of children with ASD using EEG data description and analysis. MI, SVM, GA, and -nearest neighbor were all important factors in the feature selection process (KNN). In terms of KNN and SVM, they came out on top. Deep neural network and hybrid classifications were not supported by the suggested technique.

Data analysis and machine learning techniques were used by to create a paradigm for diagnosing autism in babies. Their structure also made extensive use of SVM-based training of data models and of data analysis in general. It was able to attain an accuracy of 89% but will need to be improved using DL and biomedical imaging in order to be more efficient. used ML algorithms to diagnose ASD early enough to provide the most effective treatment for the condition. They used the UCI dataset to test their own method. The technique can be used in conjunction with other diagnostic tools for autism spectrum disorder, such as EEG and MRI scans. For SVM and DL algorithms, in particular, an intelligence detective needs to be constructed.

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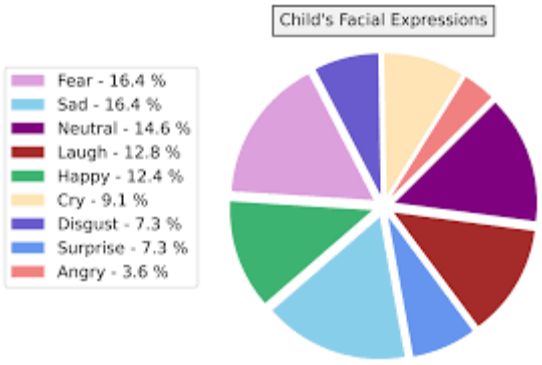

Fig 3: Result analysis

An IoT system was described by ASD symptoms and indicators are gathered by ubiquitous sensor nodes in the Belief Rule Base (BRB) in order to categorize different autistic kid kinds. They monitored their heart rate, social contact, and other activities with a variety of devices. Rule weight and patient believe level are the system's criteria. Sensors and IoT systems can, however, be used to increase their accuracy. For children with autism, developed an individual need platform that assessed physiological signals and utilized data gathered and converged from applications. The wearable system's design featured an array of sensors, multiple integrated wearable sensors, and medical servers to detect the health state of autistic children. Sensors and other embedded devices are used in the multimodal intelligent mode to enhance patients' day-to-day activities. Wearable features that are comfortable for laboratory usage cannot be employed in the workplace or for everyday activities. A wearable gadget developed by is also being used in classrooms to study the interaction and behavior of children with ASD. Obsessive-compulsive disorder (ASD) sufferers can improve their social skills with the use of technology. Using this strategy, teachers receive the best feedback and responses, which improves classroom involvement.

V. CONCLUSION

Sensors, platforms, and methodologies in ASD can have a significant influence on the children, and this is often the case. There were 28 articles included in this review that looked at various methods to ASD published between 2014 and 2020. In both 2016 and 2018, the number of articles published was close to the previous year's total. The most papers are published in the IEEE journal, with a percentage of 51%. Selected 28 studies were divided into two groups: those that focused on diagnosing patients and those that supported efforts to enhance the QoL of such patients. Nearly 43% of respondents thought of studies examining new methods for diagnosing and assessing the severity of ASD in children, while 57% thought about ways to enhance the quality of life for such youngsters. Additionally, all of the selected methodologies were evaluated in terms of accuracy, sensitivity, specificity, and time, among other variables. There has been a comparative examination of ASD and IoT-based devices based on the case studies offered. Most research studies are aimed at enhancing the QoL of autistic children, according to the findings.

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