Model of emotional measurement in children with Autism Spectrum Disorder using biometric sensors

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Abstract

Autism Spectrum Disorder (ASD) affects neuronal development and causes problems throughout the life of people who suffer due to different factors such as limitations in social interaction, communication and/or the display of emotions.

Currently there are subjective methods based on observation to recognize the emotional state in patients with this disorder that do not necessarily represent the true state of the emotional situation, from this perspective arises the idea of proposing the MMENA (For its acronym in Spanish of: Modelo de Medición Emocional en Niños con Autismo) prototype, which is a model for supporting emotional measurement with the use of biometric sensors in order to perform a sufficiently approximate measurement of emotions in different tasks of daily life of children with ASD.

Keywords

Autism Spectrum Disorder, emotional measurement, biometric sensors

1. Introduction

Autism spectrum disorder (ASD) is present in 1 of each 160 children worldwide [1]. This condition affects the neural development of people with ASD and can cause lifelong problems because the display of emotions affects communication and social interaction with others. Learning process in people with ASD can be affected in very different ways depending on the degree of the disorder or based on the impairment of social communication and behavioral patterns, which is why partial or total assistance may be required depending on the severity of the condition. Emotions become a universal language and become crucial in the forms of communication in which we express thoughts, moods or feelings in a more effective way [2] and these influence daily life and decisions made, as well as the degree of attention, Because some people with ASD have some difficulty in expressing their emotions, it is complex to know the feelings outside the common procedures used by professionals of Psychiatry and Psychology. It is for this reason that it is convenient to try to use of technologies support, where biosensors can be used to capture signals by measuring the stimuli through physiological responses of the human body [3] and provide a more approximate response to the emotions presented at a specific time in people with ASD.

Currently there are different difficulties in teaching social skills in children with ASD because there are not many tools to try to individualize learning and interactions with society. The Faculty of Electronic Engineering and Telecommunications, with the collaboration of the Department of Systems and the Department of Electronics, Instrumentation and Control of the University of Cauca-Colombia, assumes

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the research presented based on the specific case of the children of the CENIDI foundation. This foundation aims to identify and enhance the capabilities of their students with intellectual disabilities to develop social and communication skills that strengthen their independence and improve their family, educational, community, work and virtual environment [4]. Being an Institution mostly funded by the state, it has very few resources to carry out a practical and fast learning process that includes homes, as well as to provide a long and personalized accompaniment to children with ASD, allowing them to interact between themselves and the world around them. Taking into account the above in addition to the few or no functional instruments for measuring emotions based on technologies, we propose to develop a model that allows to more effectively measure the emotional state in children with autism with the use of biometric sensors. The next section depicts some related works. Then, we present the main goal and implementation of the functional hardware prototype called MMENA that performs an approximate measurement of the emotions presented to different tasks in children with ASD of the CENIDI foundation. In addition, this modell should become an important support to generate more adequate teaching and learning processes, according to the results obtained by the functional prototype, In this way, a theoretical model of an architecture is created for the construction of a measurement device with which it is arranged to observe, depending on the case of study, the different variations that must be made according to the person and the diagnosis that they have, already that as it is known the ASD has different characteristics in each individual. Finally, some conclusions and further works are presented.

2. Related works

There are some researches that use different biometric sensors for emotional monitoring in patients with ASD. In [5] a system for monitoring different emotions of children with autism is presented that provides specialists with a tool to follow up their patients remotely using the concept of IoT (Internet of Things), in this study a GSR (Galvanic Skin Response) sensor was used and through an ESP8266 module using the MQTT (Message Queuing Telemetry Transport) protocol, data is recorded via the Internet on a server for subsequent display on a final device. The authors evaluate the performance of this implementation by comparing the results obtained at different emotional reactions with fourteen children with autism and without autism in an age range of six to ten years.

TIC-TAC-TEA is an application for biometric data collection and emotional self-regulation of people with ASD [6], this paper presents the design of an application in a smart watch with Android operating system, which collects biometric information such as heart rate and movement of the subject with the help of integrated sensors of these devices and sends them to a mobile device via Bluetooth, to identify an emotional disturbance in people with ASD how stress, a strategy is presented through pictograms to try to mitigate this episode.

In [7] a biometric monitoring and alerting system is presented to support therapies for children with autism spectrum disorder (ASD), where a technological solution is sought, both hardware and software, to provide real-time alerts on emotional changes in children with ASD in therapeutic sessions with the help of biometric signals. The author develops this system with a Mindwave Mobile 2 headset that senses brain waves and then processes the information through software in the form of a mobile application on an Android operating system and finally develops a performance evaluation plan through a functional test plan and compares the performance with the theoretical approach.

In [8] a research article is presented that aims to recognize stereotyped movements in children with ASD, an accelerometer is used in a noninvasive wristband to recognize the difference between a random movement in the hands to a normal gesture given by the child, the measurements were by a wired medium and visualizing parameters that allow to analyze the behavior given according to certain values determined in a first study, this resulted in the recognition largely of what movements gives the child according to their behavior studied.

3. MMENA Development

The objective of this paper is to propose the functional prototype MMENA, which allows us to measure different stimuli in children with ASD, in order to know the response of their body to the different emotions presented and thus characterize the condition of autism in children and to know the characteristics of learning in them.

This research is a work in progress, since the physical implementation of the device has not been carried out as of the date of presentation of the article in question, therefore a general description is given of the implementation and results collection that will be carried out in the following months.

First of all, the base tool of the work will be Arduino, from which the programmable hardware card called Arduino Nano [9] is selected in order to perform the assembly and connection of the biometric sensors. The sensors that for the moment were selected (although they are subject to future changes) for the implementation are:

- GSR sensor: Galvanic Skin Response
- Heart rate sensor

With the help of these sensors it is expected to obtain the different emotional variations of the children with ASD, through the responses that the body has to different stimuli as in the case of the GSR sensor which recognizes the biometric information of the electrical conductivity in the skin with which responses to changes in the sweat glands of the skin which show a reflection to the intensity of the emotional state of the person are observed, similarly with the heart rate sensor the heart rate of a child is evaluated according to what he feels. At the same time, an accelerometer will be available to define and mitigate possible noise measurements that may affect the census of the sensors by means of the product of the movement that the child may make. It is necessary to define this starting point to be able to recognize with the help of our functional prototype if the child is having a behavior out of the usual that was defined at the beginning of the research and that directly affects their emotions, this starting point will be made by taking results of only this feature and thus know better what types of movements are determined in the normal behavior of the children with ASD.

The MMENA prototype will be similar in appearance to a bracelet as can be seen in Figure 1 with which the child will feel much more comfortable allowing real measurements and not conditioned by feelings of being inside an investigation. Therefore, the mounting of the sensors should be as subtle and compact as possible allowing the device to be portable in the daily life of children and can make use of it both in the space of the institution and at home, likewise, to be an electrical development the battery to select should be of a fairly comfortable size but that allows a good duration charge.

Figure 1: Sony Smartband [10] .

All these characteristics are of great importance in the implementation of the device, so it is of great relevance to choose devices that can be easily found in the city and are accessible in price and demand of the people who will use the device.

The method with which the results are going to be taken is through weekly attendances to the CENIDI institution. In the first place they will be given to generate an adaptation of the children with ASD and the presence of strange people around them thus allowing to help in the adaptation of the children to the device in something of every day for him and in this way to know that the results obtained are according to the emotions that in reality are being presented at the moment of the measurement and not perhaps answers given randomly and that would not be accepted for the solution of the project. In the same way, different tests such as the assessment method studied in Neurohab[11], a platform for the virtual training of daily living skills in autism spectrum disorder, will be done regarding the children's likes and dislikes, thus giving a starting point with which all the data collected throughout the nine months of the research will be evaluated. The tests to be done will be through visual tools, games and songs in order to know the emotion of joy and sadness; to recognize the emotion of anger, certain behaviors that the personnel of the CENIDI institution knows that are not liked by the child but that may not lead to a problem in the classroom but only a recognition and evaluation of the experienced sensation will be done.

With all the aforementioned characteristics, the creation of an architecture for the measurement model is proposed in order to be able to be adapted and reformed according to the case of each individual, since, as each of the children with ASD is known, they are like a new world and each of the inventions given in them must be adapted according to the characteristics of the child and his environment in general.

In addition, we pretend to validate the MMENA design by a panel of experts using the Conceptual Research Method, which has great scientific value for its contributions to the development of theories, models and conceptual schemes that should later be validated using other research methods [12] that allow quantifying and analyzing the perceptions to the stimuli in children with autism by the proposed system.

4. Implementation

For the validation process of the MMENA device, a series of activities are defined with which it is sought to know if the elaboration, implementation and results of all the research were of great value and allowed to reach the objective set at the beginning of this project, This is done in order to give an answer to the question of the degree work and to the defined problematic to which a solution or a mechanism is sought that will facilitate the CENDI institution and its education of children with autism spectrum disorders, as well as to propose a more comfortable scenario for the child's daily life, which in the best case scenario would be that the project can be used in their daily life, thus facilitating their independence in certain tasks and a better family environment around them. Finally, the method of conceptual research will be used in conjunction with the validation of content by a panel of experts to give their evaluation and concept on what has been done and thus have feedback on the device, in order to give the best possible result to the situation raised.

5. Conclusions and further work

Based on the little documentation observed on the subject of measurement tools by means of biometric sensors in children with autism condition using technologies, we seek to generate the functional prototype MMENA that serves as support for teachers of children with disabilities in order to improve the quality of life of teachers, students and parents enrolled in the institution CENIDI. With the development of this prototype we pretend to improve the ways of learning of children with ASD through the help of human-computer interaction, since by measuring the stimuli given through the sensors it will be possible to know in a better way what is the response of children and what activities

can encourage in their learning, thus giving that the education process is more efficient and generate better results in shorter periods of time to the stipulated so far.

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