A new decade for social changes
IoT in Special Education

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Abstract. In recent years, there has been an increase in new technologies and their effects in many sectors of life. The importance of IoT in special education and training acquires more and more value over time. Collaboration between technology and educational specialties involved in the educational teaching of individuals is the key to students’ holistic evolution and development. The purpose of this article is to highlight the impact of IoT on the education and health promotion of students in special schools as well as children and adolescents with motor and mental disabilities. The techniques and approaches as a product of therapies and teachings have as their main axis the rehabilitation and functionality of the students and as a consequence of them the most complete awareness and cultivation of their positive emotions with the completion of the IoT intervention programs with the help of sensors that exist in smart devices. The findings highlighted through this article revealed cases of children and adolescents with special needs who benefited from the IoT programs to be reported. The following applications and their analysis led to the conclusion that the dynamic presence of these special interventions in various forms can be administered and improve the functionality & mental health of people with educational needs, a result that was expected by the research team making this research effort.

Keywords. Internet of Things, IoT applications, Attention Deficit Hyperactivity Disorder (ADHD), Autism, Deaf, Blind, Special Education, Special Needs, eyes disorder, smart devices

1. Introduction

According to related regulations, Special Education and Training is the set of educational services provided to students with confirmed special educational needs and with or without disability. Some categories of people who have special educational needs are people with autism, ADHD, the blind and the deaf. Special education is an attempt for the child to integrate into society as an independent and productive member. Special education includes everything that is offered to the child and has a supporting role, something that should be given in the school context and throughout the school life of the child. One way to control an individual's special educational needs is ICTs. The ICTs and IoT technologies can be used for diagnosis and support of the educational need of the disabled [18,22,41,45]. Mobile applications can be used in various forms and ways in IoT in general and special education [19,20,21,31].

As Drigas et al. (2021) has referred, cognitive and metacognitive skills evolve progressively via an individual’s self-awareness of their strengths and weaknesses, their self-
observation, self-regulation, adaptation and flexibility in diverse areas (cognitive, emotional, and behavioral), recognition, discernment and mindfulness. Many children with autism and ADHD are highly interested and motivated by smart devices such as computers and touch screen tablets. These types of assistive technology devices get children to interact, make choices, respond, and tell parents what they are interested, need, think, and maybe even feel. (An IoT-Based System for Supporting Children with Autism Spectrum Disorder, 2013). Also, mobile applications can be used in various forms and ways in IoT in general and special education.

On the other hand, people with deafness and blindness with lower levels of efficiency in daily work benefit from using an IoT application. IoT tools are very useful and facilitate teaching methods for people with disabilities. IoT offers digital skills to users. The devices have sensors and make it easier for people to perform activities without hassle (Hollier & Abou-Zahra, 2018).

2. Internet of Things (IoT)

The term Internet of Things (IoT) was first introduced in 1999 by Kevin Ashton but ten years after their application was realized. Internet of Things technology in which for every creature (human, animal or objects) ability to send data via communications networks, including the Internet or an intranet, is provided. The purpose of the Internet of Things is connecting objects at any time and any place, to any person in any way or network form an ideal usage. Internet of Things (IoT) with continuous monitoring of the people’s activities, provides health improvement and disease prevention. Internet of Things include devices (such as Wearable) with sensors to measure and collect data in the desired field. Sensors measure signals such as electrocardiogram (ECG), skin temperature, respiratory rate, EMG muscle activity, gait (posture), brain waves and blood pressure eyes, eye disorders, etc. IoT enables objects to be controlled remotely. The data collected by the objects end up in another device that plays the role of mediator in order to be analyzed and utilized. The user should have the data supervised and controlled whenever necessary. For this reason, it is common for the device where the data ends up to be a smartphone since the user almost always has it with him and can control the data at any time.

In special education, IoT Applications improve user navigation security by monitoring each student’s internet browsing. Teachers can create smart teaching plans. They learn to collect and process data, monitor the results of their data, and make decisions about the optimal study and teaching model. The use of technology and IoT devices achieve interaction between teacher and student. Students, for example, get away from books thanks to networked devices and are trained with the help of IPAD / Tablet mobile devices equipped with interactive applications with integrated graphics and simulations. AI and Knowledge management applications can be used in parallel with IoT and can be embedded in the IoT design in order to enhance the total offered services [23,24,25,26,36,42,43], in order to improve mental abilities, consciousness and emotional intelligence [29,31,32,33,37,38]. More over IoT can serve to brain rewiring and neurodevelopment [34,35]. Also, Serious games can be used in various forms to enhance IoT environments [27,28,30,39,44]. By using the above they save time and space. This digital transformation will bring new ideas that promise to change the way the student-teacher thinks and studies, thus diversifying the future education system.
3. Internet of Things (IoT) in ADHD

ADHD (Attention Deficit Hyperactivity Disorder) is a neuro-biological disorder of the brain and is characterized by inattention, anxiety and impulsivity. It occurs in childhood (3 to 5% of children in the world) and accompanies the person throughout his life, although some symptoms become milder as he grows older. In adults, most problems are related to the difficulty of organizing, planning, time management, remembering dates, meetings, objects. With the advancement of technology, various solutions have emerged to help our daily lives, as well as for people with some kind of disability, giving them more autonomy. In this context, we have the IoT (Internet of Things), one of the solutions to provide with great potential this autonomy, such as, for example, monitoring our blood pressure or body temperature, without the need to be in the hospital. This paper proposes an IoT-based solution to assist the daily activities of an adult with ADHD. For this reason, a tool has been developed that is able to remember activities and potentially lost items. The evaluation carried out through the proposed solution was based on a questionnaire applied to specialized professionals. The results obtained so far show that the tool has shown great potential to help people with ADHD.

ADHD affects people by causing them a low quality of life, not only for those who present with the disorder but also for those around them. Carelessness can manifest itself in different situations, in school, professional and social life. In adults, the main problems are related to difficulties in performing activities, the organization of time, and emotional management. People with this disorder may not pay much attention to detail and make mistakes due to carelessness. They also find it difficult to stay focused on one task and often move from one to another, failing to complete some of them. Carelessness also affects the ability to solve problems, forgetting questions, dates, and objects. They often tend to forget appointments and items in their daily activities. Hyperactivity in adults is perceived in behaviors such as difficulty staying calm, affecting their sleep, and activities that require them to stand still for long periods of time, especially when they are less interested in the activity.

IoT is defined as the ability of many things to connect to each other over the Internet. Its main purpose is to allow various things, such as sensors, actuators, smartphones, among others, to connect to the Internet and to each other. IoT has benefited people with ADHD as it is a network of smart objects with sensors & software. These objects can be connected to the internet and provide real-time information about the individual's behavior in the area. IoT applications help to assess an individual's abilities but also provide information about their feelings.

Finally IoT can help to spread the knowledge about ADHD and increase awareness about it. [13,14,15,16,40]

4. Internet of Things (IoT) in Autism

Autism is a neurodevelopmental disorder that affects a person's communication and behavior. 1 in 68 children in America is diagnosed with ASD. The symptoms of this disorder appear in the first two years of a child's life. They show deficits in language development, interaction with other people as well as limited repetitive behaviors. The difficulty in combining cognitive skills that support social interaction and communication is best describes the autistic person term. Children on the Autism spectrum need to be systematically evaluated for their abilities and difficulties, in order to find appropriate therapeutic and educational goals that meet their educational needs. In the school environment, the symptoms are able to be perceived in the form of learning difficulties, hyperactivity, anxiety disorders, emotional [29] disorder, and sensory difficulties. In the community, there is a large number of educational approaches that
have been designed. Despite the disagreements of their supporters, a common component reflects the general principles such as the clarity of the teacher's approach, the stability, and repetition of his goals, the perception of the specificity of the autistic disorder, and the flexibility in the appropriate structure of the environment. The internet of things is therefore a very easy to use and at the same time smart tool in the hands of teachers, therapists, parents, and caregivers to approach, evaluate and intervene in autism spectrum disorder. Specifically, a combination of new technologies emerges in a general context but also in a more specific one with the specific system and tries to replace to some extent a deficit in the attention, interaction, and communication of these children. It is thus achieved as we will see an inextricably linked relationship between attention and learning readiness.

The smart system consists of a computer, internet, and sensors. By connecting to each child's computer and providing us with information about their movements through the sensor, they help their therapists and caregivers in real-time to observe the reactions and have a picture of their sensory profile. In addition, it can stimulate and regulate the sensory systems so that there is a sufficient level of alertness. These functions make it calmer to respond to the learning context through visual perception activities by providing stimuli such as vibrations in the chair, adjusting appropriate lighting and smells in the space. In addition, the lack of understanding of other people's feelings and thoughts (empathy) as well as the difficulty of neurotypicals in interpreting their own feelings was supplemented and aided by the significant contribution of internet devices. The design was holistic and therefore included bio-sensory, behavioral data as well as techniques applied to social psychology. The materials used for this purpose and helped in its implementation were a clock worn by the child for measurement, touch and pressure sensors for the observation of body movements and facial expressions, and a camera to record the moments. Additionally, receptors were placed on specific toys. With the help of the internet, the relationship between the child's contact and behavior such as his preferences and feelings could be recorded.

5. Internet of Things (IoT) in People with sensory difficulties

People with sensory difficulties benefit from IoT applications from a large number of effective assistive technologies. For example, people who have hearing disabilities face challenges every day. The biggest challenge faced by them is communication. Deaf people can use an IoT Application to solve this problem. An App has been created on a system with two ends, at one end there is a normal person and at another end, there is a deaf person. The normal person will speak into the system through speech to the text module, a deaf person will get the text via Wi-Fi, Bluetooth, or Cloud Server according to the situation. (Patil, P., & Prajapat, J. (2017)).

On the other hand, Deaf and people with hearing impairment face everyday challenges in identifying the occurrence of household sounds like door bell, child crying or phone ringing, simple things but very important. For that reason when the visitor presses the doorbell, captured image is transferred to the wearable device which helps to know the right person at the door or intruder. After transferring the image, the wearable device vibrates to notify. Those simple ways can help deaf people to gain independence and flexibility in different areas. Also, IoT apps have helped blind people and people with optic nerve disorder as a doctor. The eyeglasses can transmit the signals of the eye blood flow sensor and lens color and see the bleeding in the eyes; sending messages to the patient, physician, and the emergency contacts as well as informing the hospital emergency GPS and friends/families of a patient to be aware of the exact location of the patient.
6. Discussion
Using IoT Cognitive and metacognitive functions such as memory, attention, self-regulation, self-observation were tested and improved. Many neurodevelopmental therapies have been reported but more and more ICTs applications are being developed.

Some of the benefits offered to users with disabilities and their caregivers who use IoT applications only by using a smart device, for example through a smartwatch, is that they perceive the feelings of people who cannot express themselves. Stressful moments are perceived, caregivers are notified through applications about when the person is in a state of emergency, they provide information about the person's position in the space, and it is possible to monitor a person's behavior and analyze the treatment time differently, would be required would be a very long time with a multitude of therapists to monitor the person.

New technologies and in particular IoT applications came to provide solutions in a demanding field with many users and many needs, special education. Internet connects all the people together, whereas the Internet of Things (IoT) connects all the tools together [46, 58]. The Internet of Things can offer people with special needs more independence, a more manageable home environment with only some smart devices that will help them to stay safe and secure.

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