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Assistive Technology Management System for Children with Autism Using Digital Board for Communication

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ABSTRACT

Most children with autism spectrum disorder face many difficulties in verbal communication, correct pronunciation of letters, as well as communication and social interaction. Therefore, the use of alternative means that help them communicate has become a necessity, such as the digital board designed as it depends on pictures, pronunciation, sounds, and the formation of complete, understandable phrases then it is designed according to the child's needs and features can be added to it as needed, which enhances the child's confidence, the development of his thinking and independence, and reduces the embarrassment of the difficulty of expression.

The research aims to study the extent to which the use of digital boards affects the improvement of pronunciation in children with autism spectrum disorder.

1. Introduction

Digital boards create an environment for communication and are also interactive, using images, symbols, sounds, pictures of the child's parents, and the voices of the child's parents to easily convey meaning to the child, as well as helping the child express his needs, making the learning process more enjoyable, enjoyable, and effective, and reviewing the benefits as well as mentioning the challenges associated with it. This will help improve their quality of life [1].

The technology of converting symbols and words into spoken speech is a process that relies on special software that allows the user to select images, words, or phrases and convert them into spoken speech by touching the screen to be pronounced in a better and clearer voice to facilitate the communication process [2].

2. Related Works

The search term Digital technology and communication patterns of the autistic child: case analysis by Maria da Luz Vale-Dias 2016 The presence of deficit of language and communication skills is evident in autism. The communication standards may evolve, but not normalize with age. There are obvious benefits of using technology in interventions with autistic, improving motivation, attention, learning, communication and reducing behavioural problems [4].

Digital technologies for autistic spectrum disorder students' education by Jenny A. Vlachou 2023 ICT assessment tools and ICT intervention tools are two categories for them. The evaluation describes each tool's background, functionality, and relationship to this scientific discipline while explaining specific technological features. The result is that a variety of ICT technologies can help with ASD diagnosis [5].

Autism Communication Cards | Free Printable by By Emily Parker 2024Visual aids like communication cards leverage the strength many neurodivergent kids have in processing images. According to a study by the American Speech-Language-Hearing Association, visual supports can

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significantly improve understanding and reduce anxiety in kids with special needs. Images provide clarity and help kids focus on the message without the distractions of verbal cues.[6]

Moreover, these tools help bridge language gaps, especially for kids who struggle with verbal expression. They create a consistent way to communicate, which is essential for building trust and reducing frustration.

3. Autism Spectrum Disorder

The word autism means self or psyche and is most often used to describe a lonely, introverted person or someone with a developmental delay that may appear in early childhood, usually the first two years of a child's life. It may include limitations in social interaction, communication, language development, and communication skills, in addition to repetitive behaviors[6].

4. Assistive Technology

Assistive technology is defined as a device, application, or system used to serve children with autism spectrum disorder (ASD) to provide an assistive technology service, such as providing hearing services at any time and providing a visual and auditory processing area. Different types of technology, from low technology to high technology, should be integrated into every aspect of life to enhance the understanding and communication of children with ASD.[7]

Simple technology includes visual support. These technologies don't require any kind of electronic equipment and are usually very simple and low-cost equipment, such as photo albums and simple computers[8].

Medium technology includes battery- or electrically powered electronic devices, such as projectors and audio devices.

High-end technology includes complex and expensive devices and strategies, such as adaptive devices and sophisticated sound output devices[9]

5. Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that predominantly affects communication, behavior, and social interaction. It is characterized by unusual, repetitive, and somewhat restricted behavior patterns. Although autism can be diagnosed at any age, it is described as a "developmental disorder" because its symptoms appear before the age of three. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), a manual issued by the American Association for Neuropsychiatry and Psychiatry and used to diagnose mental disorders and speech difficulties, people with autism spectrum disorder experience.

- Difficulty communicating, speaking, articulating, and interacting with others
- Restricted interests and repetitive behaviors
- Symptoms that affect a person's ability to function in school, work, and other areas of life [10].

Autism is known as a "spectrum" disorder because there is a great variation in the type and severity of symptoms that people experience. No two people with autism spectrum disorder are exactly alike. Some people have difficulty speaking and expressing their desires and themselves. The severity varies depending on the type of condition, including mild cases such as Asperger's syndrome.

Technology designed as augmentative communication systems for children with autism can be used to increase or improve:

1. Their general understanding of the environment around them
2. Expressive communication skills to express themselves
3. Social interaction skills to connect with others.
4. Enhancing their ability to pay attention
5. Helping them with motivation
6. Organizational skills
7. Academic skills
8. Self-help skills and general independent daily work skills.

6. What is Assistive Technology?

With our understanding of the Modern Technology Assistance Acts for Children with Disabilities of 1988 (Public Act) No. 407-100, assistive and augmentative technology can be defined as an item, device, or production system, whether designed or purchased for use, that provides easy services to children with disabilities. These services help this group of children by making them use digital visual information more easily than auditory information only. Therefore, digital technology devices are incorporated to provide visually processed information[11].

7. Technology of all kinds

Simple technology: This is for visual support and is low-cost, easy-to-use equipment, such as three-ring binders, photo albums, simple computers, highlighters, etc.

Intermediate technology: This may be certain battery-powered devices with limited technology, such as simple projectors or simple audio devices.

High-end technology: These are complex and expensive strategies, including sophisticated audio output devices[11].

8. Visual Representation Systems

The most important step is to determine which visual representation system is most appropriate for the child based on their diagnosis. Various visual representation systems are used, such as pictures, line drawings, realistic drawings, images of the child's self, and written words, while integrating technology, assuming the child can understand the type of visual representation being used. For example, some children need visual and motor representation systems in various situations, such as when representing hunger, sleeping, or going to the bathroom. Therefore, this is an attempt to facilitate attention, facilitate the organization of thoughts, and facilitate the ability to express themselves to facilitate communication with others[7].

9. Materials and Methods

In this section include proposed system design, it works in this project and used programs html,css,Java script, sql and c#.consists of three sectionseach section has a specific performance.As infigure(1) shows the interface of the program:

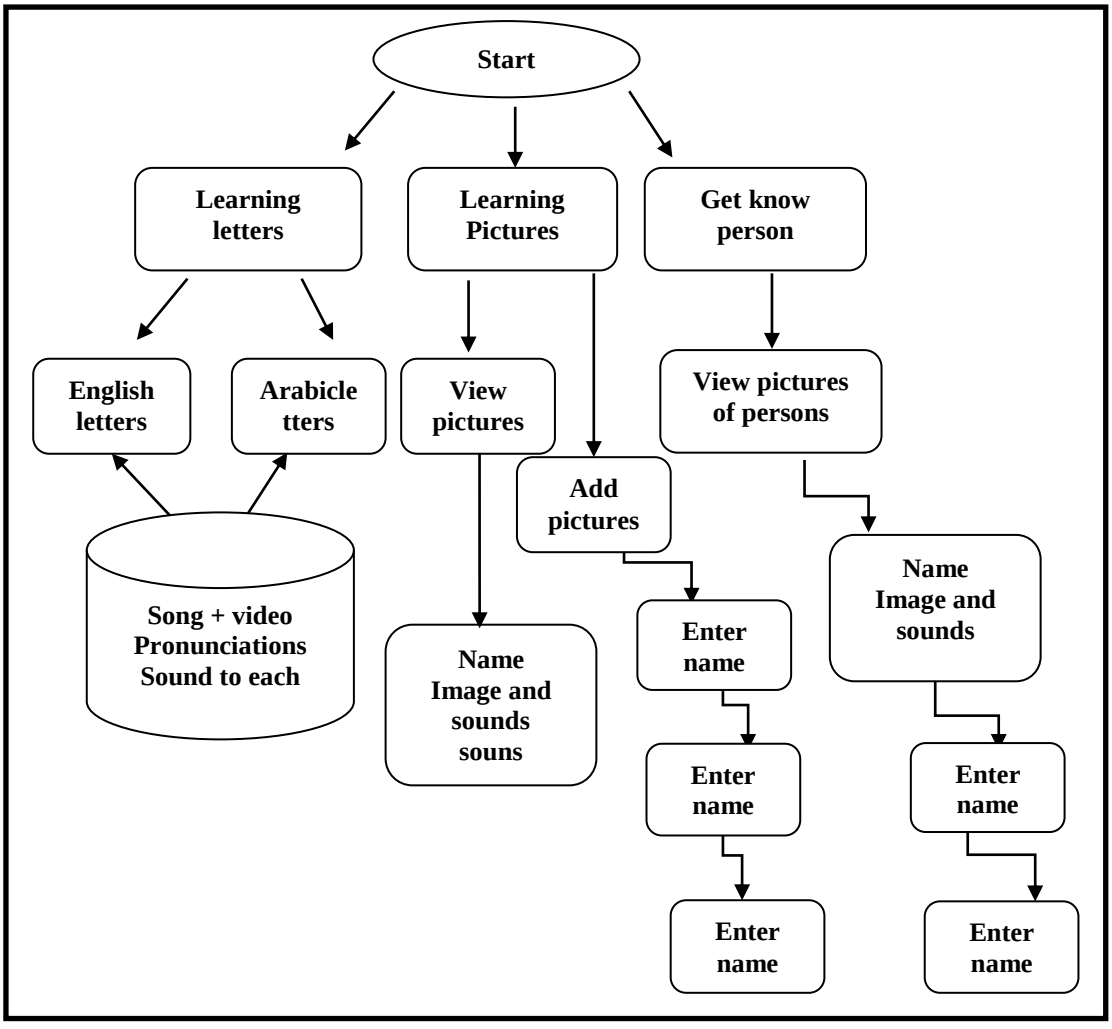

Fig. 1-.proposed digital board

9.1 Forms Representation

Fig 2- The interface of the program

Fig. 3-The interfacelearn Arabic

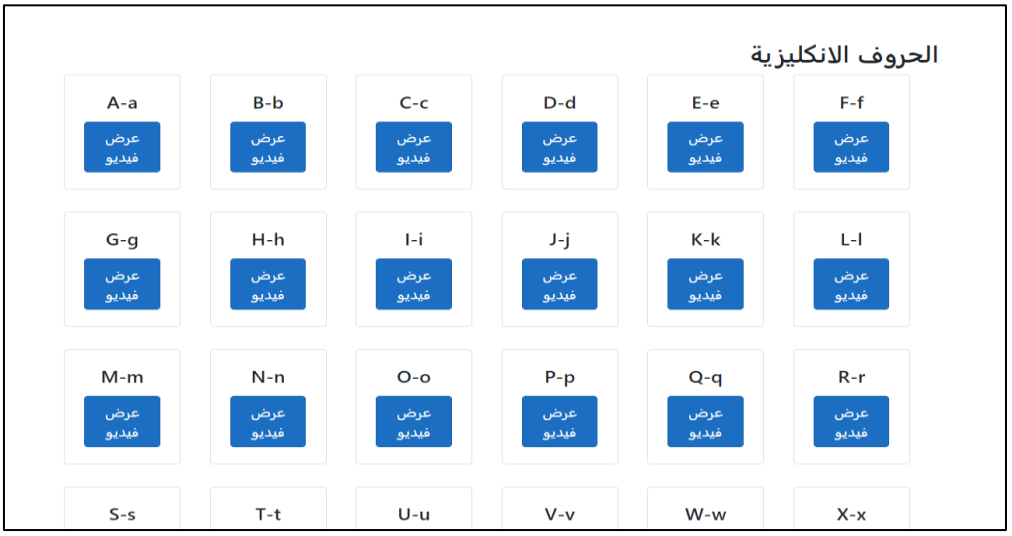

Fig. 4-. The interfacelearn English

When you click on any letter, there will be a sound for the selected letter. If you click on the blue button, a video will be shown, followed by a redirect to YouTube, where the singing tutorial video for the selected letter will be shown.

Fig. 5 - A picture to go to YouTube

We can also return to the main interface, which we named "Home Page," which we explained earlier, using functions shown in JavaScript, along with the original database that was built and used and linked to the second and third scripts for this purpose

9.2 Learning with pictures section

In this section, we click on the image learning interface, where sounds will be added to the images, as shown in Figure 6 and Figure 7

Fig. 6 -. Image learning interface

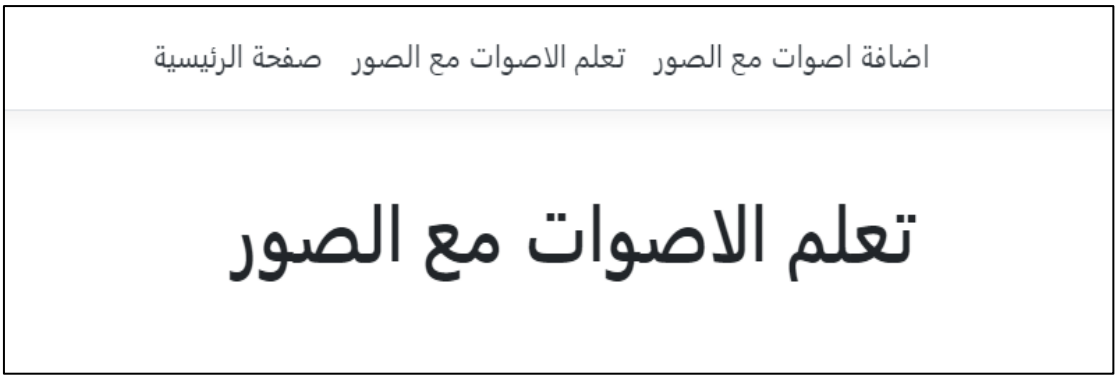

Fig. 7.-Image and sound learning interface

Click the "Add Image with Sound" option, add images with both image and audio extensions, and type a name for the selected image

Fig. 8 -. Image and sounds with app and screen display

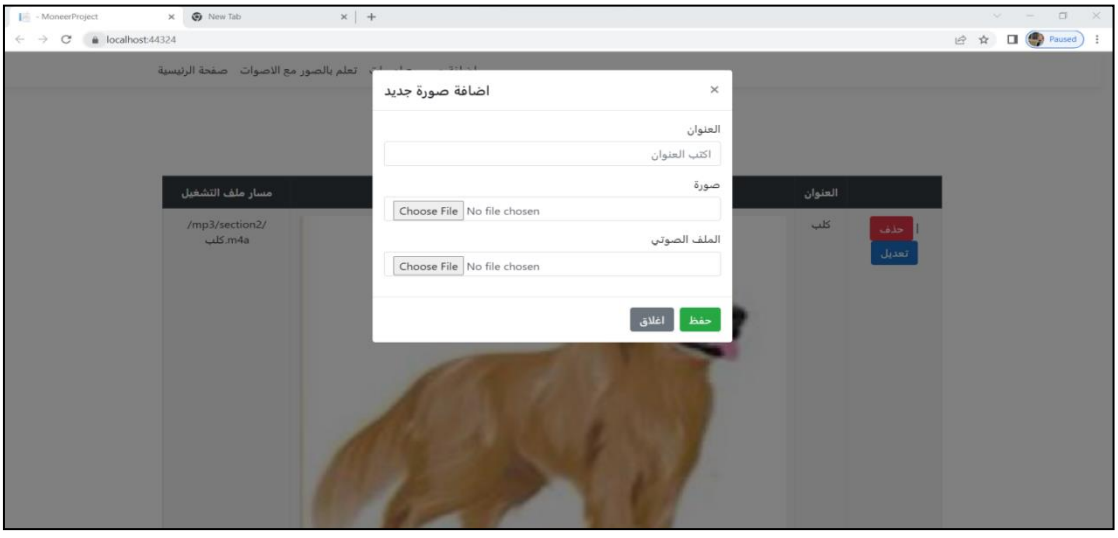

Fig. 9.-Added via this interface

Fig.10.- view with sounds

Then when you click on any image, a sound displays the name of the image's content. The third section displays pictures of people close to the child, such as the mother, father, and siblings, from the previously stored database of people close to the child. Therefore, it is better to use the application to contribute to the child's identification of his parents, teachers, and siblings by adding their pictures and voices to the stored database.

Fig. 11- Getting to know people

After clicking on the main interface, we will move to another sub-interface. This interface allows authorized persons to enter the system and the program. Their data will then be included in the database

Fig. 12- Entry of permitted persons

Now, the commands in the third block allow us to access a field in addition to the display table, so that with the help of the main command we can return to the home page

Fig. 13- Entry of permitted persons

10. Challenges

- Privacy: Collecting highly confidential data from children and their parents may raise concerns.
- Cybersecurity: The system must be secured against hacking and cyber-attacks.
- Integration: Integrating the system with other systems, such as language or sign language systems, may be difficult.
- Cost: The cost of installing and maintaining the system may be high.

11. Improvements

- Integration of artificial intelligence technologies: AI can be used to automatically analyze images and identify sounds and child movements.
- Development of an interactive user interface: A user interface can be developed that allows users to easily view and analyze data.
- Enhanced integration with other systems: The system can be integrated with other systems, such as child behavior monitoring systems, to enhance attention and rapid response.

12. Added Value

- Improved Security: The system improves security and prevents unauthorized activities.
- Increased Efficiency: The collected data can be used to enhance efficiency in special cases for children with autism spectrum disorders.
- Decision Support: The collected data helps in making better decisions.

13.Author Contributions

- Conceptualization
- Data creation
- Formal analysis
- Funding acquisition
- Investigation
- Methodology
- Project administration
- Resources
- Validation
- Writing—original draft

14. Conclusion and Future Works

The concept of the role of a technological system designed for children with attention and speech difficulties is to improve children's integration into daily and social life, and to provide training services for easy pronunciation of letters, as well as the ease of expressing important life needs such as hunger, going to the bathroom, drowsiness, and anger. This is done using a new technology based on sounds, images, video, and Arabic and English letters, as well as the use of a virtual environment, or the use of a cartoon character or image that the child likes, or through paintings and drawings that attract the child with attractive colors. Future work to improve the designed system includes the possibility of training an algorithm with artificial crying, or using languages other than Arabic and English. It is also possible to use an intelligent robot that performs specific movements that express needs.

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