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Perspective on Intelligent Assistive Devices in Rehabilitation

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Abstract: *Intelligent assistive devices have the potential of offering innovative solutions for the disabled and for the new generation of senior citizens. 'e-Tools' stands for Embedded Tools, as we aim to embed intelligent assistive devices in homes and other facilities, creating ambient intelligence environments to give support to patients and caregivers. In particular, we aim to explore the benefits of the concept of situated intelligence to build intelligent artifacts that will enhance the autonomy of the target group during their daily life, which makes technical advances and social policies critical to attain and preserve normal life by use rehabilitation where the quality of normal life process could be improved great.*

Keywords: rehabilitation technology, Assistive technology, intelligent devices.

1. INTRODUCTION:

Intelligent assistive Devices is currently being introduced and developed worldwide as an important tool for maintaining independence and high quality of life among community-living people with certain disabilities[1]. so ways in which Intelligent assistive Devices enhance or detract from individuals' quality of life continue to be understudied by rehabilitation researchers. Varying degrees of use in a variety of situations/environments and with different devices are crucial factors to understand ~ especially when Intelligent assistive Devices use is interpreted as an indicator of both functional and psychological adjustment to a disability.

Nowadays it is clear the growing importance of the role that Intelligent assistive Devices – specially Knowledge-Based Systems (KBS) – is playing to support specialists working in various fields in which emergent technologies are being used to help people enjoy optimal quality of life[2].

2. HISTORY AND DEFINITIONS:

Terms encountered in the literature that fall under the general definition of assistive technology are as follows: Adapted devices equipment and rehabilitation technology. Adapted devices are those designed for the general population but adapted in ways to be useful for people with disabilities (for example, eating utensils with built-up handles)[3].

Rehabilitation technologies are those used to enhance and make possible the rehabilitation process for individuals, Orthotic and prosthetic devices. Orthotic devices are used to provide support for a weak part of the body (e.g. braces). Prosthetic devices replace or substitute a part of the body (such as arms and legs) and include artificial limbs. Qualities of life. Quality of life has been described as life satisfaction, well-being and general affect[4]. It has been studied by looking at subjective reports along with such objective indicators as socio demographic and medical factors, functional impairment, and ability to work. When using different approaches to, and measures of, quality of life, varying, even opposite results from other studies may occur

For example, wheelchairs provide independent mobility for those who cannot walk, while assistive eating devices can enable people who cannot feed themselves to do so. Due to assistive technology, people with disabilities have an opportunity of a more positive and easygoing lifestyle, with an increase in "social participation," "security and control," and a greater chance to "reduce institutional costs without significantly increasing household expenses[5].

Technology providers are looking at ways AI technologies can help more people with disabilities. In 2018, Microsoft launched the AI for Accessibility program to put artificial intelligence tools in the hands of developers to speed the creation of intelligent AI devices that can benefit people with disabilities.

- **Assistive devices :**

Assistive devices are external devices that are designed, made, or adapted to assist a person to perform a particular task. Many people with disabilities depend on assistive devices to enable them to carry out daily activities and participate actively and productively in community life.

The Convention on the Rights of Persons with Disabilities, Articles 4, 20 and 26, asks States to promote the availability of appropriate devices and mobility aids and provide accessible information about them [6]. The Standard Rules on the Equalization of Opportunities for Persons with Disabilities also call upon States to support the development, production, distribution and servicing of assistive devices and equipment and the dissemination of knowledge about them [7].

In many low-income and middle-income countries, only 5–15% of people who require assistive devices and technologies have access to them [8]. In these countries,

production is low and often of limited quality, there are very few trained personnel and costs may be prohibitive.

Access to assistive devices is essential for many people with disabilities and is an important part of any development strategy. Without assistive devices, people with disabilities may never be educated or able to work, so the cycle of poverty continues. Increasingly, the benefits of assistive devices are also being recognized for older people as a health promotion and prevention strategy.

3. CATEGORIZATION OF PREVIOUS WORKS:

The interaction of disabled people with technology In the analysis, design and final creation of disabled-oriented devices, it is mandatory to keep in mind the interface problem, either because of a severe mental
or mobility dysfunction or the usual complex relationship among elder people and new technologies [9].

The Rehabilitation Engineering Research Center on Technology Evaluation and Transfer (RERC-TET) has focused on consumer identified needs and preferences regarding several categories of assistive technologies. According to the classification
of Batavia and Hammer [10], 11 criteria have been identified that disabled patients consider important: among others, Effectiveness, Reliability and, mainly, Operability – the extent to which the device is easy to use, is adaptable and flexible.

Figure 1. A telepresence wheelchair equipped with a camera.

The extreme difficulty with which persons with severe disabilities have been taught to maneuver a power wheelchair is an example of difficult interaction with AT: 9 to 10% of patients who receive power wheelchair training find it extremely difficult or impossible to use the wheelchair for activities of daily living; 40% of patients reported difficult or impossible steering and maneuvering tasks; 85% of clinicians reported that a number of patients lack the required motor skills, strength, or visual acuity. Nearly half of patients unable to control a power wheelchair by conventional methods would benefit from an automated navigation system. These results indicate a need, not for more innovation in steering interfaces, but for entirely new technologies for supervised autonomous navigation [12].

. Safety and Soundness when use.

Even though the domain of application is restricted to a quasi-structured, situated environment where the most important landmarks will remain stable, unexpected changes may arise; therefore, the system needs to solve these unforeseen situations without entering in malfunctioning states. This implies that these systems need to exhibit an intelligent goal-oriented behavior and yet still be responsive to changes in their circumstances. However, as observed by Fox & Das [12], the use of heuristics or rules of thumb to solve problems seems unlikely to inspire confidence. In this domain the safety of users imposes bigger restrictions and the systems must be extensively tested – possibly off-line – to ensure effectiveness and performance of the devices. Therefore, safety should be one of the main concerns in the design of disabled oriented devices. One possible option is to add a safety management layer in those systems.

Likewise, the creation of safety plans is mandatory. That is a set of procedures and criteria that specify what the system is supposed to do when, but it deals specifically with hazardous circumstances and events [12].

4. Robotic intelligence solutions during Coronavirus (COVID-19)

UPDATED LOOK AT THE STATE OF THE ART

The pandemic caused by COVID-19 is the first global public health crisis of the 21st century. And today, multiple AI-powered projects based on data science, ‘machine learning‘ or ‘big data’, are being used across
a broad range of fields to predict, explain
and manage the different scenarios caused by the health crisis[13].

Intelligence Devices and assistive technology is contributing to fight the COVID-19 pandemic. Considering the unfortunate pandemic situation of COVID-19 to reduce contagion have found a crucial ally in data science to make progress and deliver results[14].

several robotic technologies developed about the world which could be helpful to be utilized for development of specific robotic systems for epidemic Coronavirus outbreak. These robots are designed and developed by our students and collaborators in recent years and certainly as the nature of the university research, there are still in the level of R&D, prototype and proof of concept.

We will show some of these robots a realistic and concrete example:

– Ambulance Robot (AmbuBot)

The developed Ambubot is capable of driving up to 10 km/hour and passing slopes up to 45 degrees [15]. Meanwhile, the high-resolution video and audio is integrated in this robot to provide human operator detail information of the surrounding, as depicted in Figure 2. Human operator will control the robot either by a control pad or a computer. When the Ambubot has arrived in the location of victim, human operator instructs lay rescuers to apply the pads of AED on the victim's chest based on its instruction.

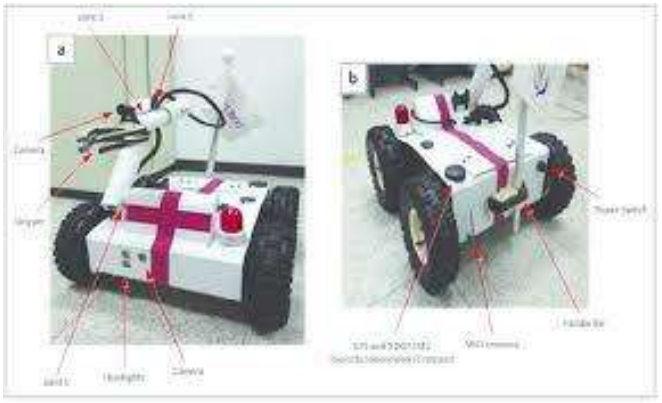

Figure 2. A Ambubot with the Camera and sound sensor.

We have designed and developed the Ambulance Robot (AmbuBot) which could be a solution to address those issues. AmbuBot could be placed in various locations especially in busy, remote or quarantine areas to assist in above mentioned scenario.

The AmbuBot also brings along an AED in a sudden event of cardiac arrest and facilitates various modes of operation from manual to semi-autonomous to autonomous functioning.

– Doctor Robot

It is unfortunate to see how medical workers such as doctors and nurses risk their life to be in direct contact with the patients. Robotic systems could be used to examine and monitor the health situation of the people when it is dangerous to be in direct contact with them.

Using deep and machine learning, AI systems analyze enormous amounts of data to make predictions and recommend interventions. Advances in computing power have enabled the creation and cost-effective analysis of large datasets of payer claims, electronic health record data, medical images, genetic data, laboratory data, prescription data, clinical emails, and patient demographic information to power AI models[15,16].

Figure 3. Robot with the Cameras and multi sensors.

AI is 100 percent dependent on this data, and as with everything in computing, "garbage in, garbage out," as the saying goes. A major concern about all our health care datasets is that they perfectly record a history of unjustified and unjust disparities in access, treatments, and outcomes across the world.

The data we are using to train our AI models could lead to results that perpetuate—and even exacerbate—rather than remedy these stubborn disparities. The machines do not and cannot verify the accuracy of the underlying data they are given. Rather, they assume the data are perfectly accurate, reflect high quality, and are representative of optimal care and outcomes. Hence, the models generated will be optimized to approximate the outcomes that we are generating today. It is even harder to address AI-generated disparities because the models are largely "black boxes" devised by the machines and inexplicable, and far harder to audit than our current human health care delivery processes.

– self driven cars

A self-driving car, also known as an autonomous vehicle (AV), connected and autonomous vehicle (CAV), driverless car, robo-car, or robotic car, is a vehicle that is capable of sensing its environment and moving safely with little or no human input.

Self-driving cars combine a variety of sensors to perceive their surroundings, such as radar, lidar, sonar, GPS, odometry and inertial measurement units. Advanced control systems interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage [17,18] , you can see figure below .

Figure 4. self driven cars contain intelligence system

In the Corona pandemic, these vehicles are equipped with smart devices to provide medical and preventive services to the population and to provide medical supplies. Most of the developed societies have made this development these days in order to limit the spread of the virus.

Note None of the those companies are making any money from their deliveries, but are gaining experience and data on delivery operations, several operators said[19].

– 3D Delivery System

The 3D delivery system is utilizing a UAV robot to bring required goods such as food or medical supplies to the person in any floor of the apartment. The system receives a request for delivery via an APP from a client and later delivers that item to a desired location in the three dimensional environment. The UAV has the ability to navigate in the outdoor environment and move from the base location to the supplier at the first stage and later find the optimum path to the client for delivery. The system focuses on delivering above ground level locations, such as a specified floor in a building. This system can be used in various coronavirus infected area scenarios in order to autonomously deliver goods medical items and food from an arbitrary point to a client in multistory buildings[20].

Figure 5. Drones carrying out human missions

Unmanned Aerial Vehicle (UAV) is employed in order to deliver the product to the requested location. These locations include various elevations, for example, an apartment on the 10th floor of building.

The ultimate goal of the experiment is that a client can order food items from a menu using a software APP or website and the items will be delivered fully autonomously via a UAV. In this paper we present an initial prototype where, due to safety reasons, the above mentioned scenario will be performed semi – autonomously [21].

Speaking of the **Gaza Strip**, some companies, individuals, and shopping centers have begun to offer applications for Android and iPhone to deliver orders after the person has shopping through the application and requested his special needs.

– Mood Booster Robot

Due to Coronavirus situation various quarantine on travel in and out of home or city have been imposed. People have been locked down in their homes, hotel rooms and communities. That leads to a serious stress and mental instability. The world have developed a robot called Mood Booster which is a novel robotics system with affective interaction capability.

This robot acts as a personal companion with focusing on the mood of the user. The robot has the ability to detect emotions of the user through visual and audio sensors. The emotional processing unit employs advances in the field of affective computing and artificial intelligence in order to estimate the emotional state of the user. Additionally, the artificial intelligence unit activates certain behaviors of the robot to generate positive emotional interaction towards the user. Such expressions would be projected by various behaviors of the robot such as audio output and music[22], You can see in figure 6.

Figure 4. Mood Booster Robot

The uniqueness of this robot is that additionally the robot generates relevant smell accordingly by digital scent technology. The robot is capable of appropriate moving as a mobile agent. For example when the robot detects the stressed emotion by the user, it plays relaxing music, produces relaxing scent and navigates smoothly around without disturbing the user.

5. CONCLUSIONS:

Artificial intelligence and intelligence devices has advanced in recent years at an accelerated pace. Artificial machines can artificially move through huge amounts of data from a variety of sources and translate this data to perform a wide range of tasks.

In this paper we reviewed the power of using artificial intelligence to produce equipment, machines and systems that had a great role in facing the greatest challenge to humanity in this century (**Covid19**) This means that we need a great use of artificial intelligence in all areas of life this means that we need a great deal to produce more smart tools Help .

Of course, scientific progress cannot stop at a certain point, and this means that we will have to coexist with artificial intelligence, and we want to hope that we will become friends.

6. FUTURE TRENDS OF THE TECHNOLOGY:

Robots that speak, machines learn, and cameras that perceive the presence of humans, developments that may be difficult for some to believe, but the intelligence and spread of machines have become a reality.

The urgent need to adapt to this reality is expressed in numbers:

Artificial intelligence will add $15.7 trillion to global GDP by 2030, more than the size of the economies of China and India together!

Huge opportunities await investors, the returns on investment in artificial intelligence will grow 25 times in the next eight years.

Corporations and big countries have started taking their positions, betting on revenues that will rise in the coming years, from $ 640 million in 2016 to $ 37 billion in 2025.

Big companies are racing to find the technology that will empower them to dominate the market, either by developing units internally or through acquisitions that McKinsey valued at between $ 8 and $ 12 billion in 2016.

The challenges of the future are not confined to specific fields , but they seem to penetrate all fields, Here we will mention the most important fields :

Breakout moment of artificial intelligence (AI) in manufacturing, Practical deployment of Internet of Things (IoT), Increased demand for edge computing processing power, Commercialization of quantum computing usage in mass scale, Evolution of aerospace technologies, New era of the internet — deployment of 5G and Starlink broadband internet technology, Evolution of health care, Evolution in Agriculture – technology to Grow Crops Efficiently

The fear of robots dominating the world may be justified, especially as machinery intelligence approaches humans, but the real threat posed by artificial intelligence comes from the inequality that it will create as it will fundamentally change the process of producing wealth.

7. SUMMARY:

The study focuses on the implications and repercussions of the rapid development of applications of artificial intelligence in several areas, the most important of which is the medical field, and how the world is now facing the spread of Virus **Covid19**, the development of personal assistance able to recognize, analyze and respond to voice commands, faces recognition techniques and product filtering applications used by some sales platforms Electronic and how to connect to limit the spread of the virus, such as Amazon and prediction programs to identify the virus, in addition to the development in the areas of control, follow-up, monitoring and autonomous driving of cars, manufacturing and smart homes.

It also focuses on applications that include robots, self-driving cars, drone, 3D printers, Internet of Things, voice assistance programs, follow-up, comprehensive monitoring and automated systems to respond to customers and anticipate customer needs, and in the end we talk about the most important challenges facing our world, especially in the face of the **Covid19** virus.

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