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Robotics in Health Care System

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Abstract. Today, when discussing the societal significance of robotic applications, the first example that usually comes up is the deployment of assistive technology in healthcare settings. Despite concerns regarding their technical preparedness and the absence of realistic use scenarios in regular nursing practice, so-called caring robots are touted as solutions to the nursing problem. Investigate the relationship between social robots and medical assistance. Three areas of activity—innovations policy, care organizations, and robotics engineering—are examined to illustrate how the two are mutually accessible. Begin by examining the "logics" of care robotics as they are discussed in the context of European innovation policy, then reveal the tensions that have been building up between care robotics and healthcare organizations over time and finally demonstrate how care scenarios are being employed in robotics research and development. Based on this analysis, it provides a three-pronged criticism of healthcare robots that highlights the political, historical, and social context in which robotics care for the elderly operates.

Keywords: Robotics, automation, artificial intelligence, health care

INTRODUCTION

Recent developments in robotics and AI have opened doors to robots to aid in the medical industries. Hospitals, rehabilitation centers, walking aids, and other healthcare settings are general places to see robotic systems being used for caring for the elderly, children, and people with impairment. The study also addresses the unanswered questions surrounding the integration of healthcare robots into society. The global population's health and safety have been severely compromised by the COVID-19 pandemic, particularly the health and well-being of the elderly. To lessen the burden on professional and informal careers, socially assistive robots (SARs) have been employed to help those affected by the epidemic cope with their feelings of isolation and loneliness [1]. The first comprehensive study and discussion of the ways in which socially assistive robots have aided this community, as well as their overall influence on health and acceptability throughout the epidemic, are presented in this research. The purposes of this evaluation are to determine which SARs were utilized during the pandemic, the task for which they were employed, and the factors that facilitated and hindered the widespread use of these tools. Will also talk about what they gained from their implementation to improve future SAR designs and applications and boost their post-pandemic use and uptake. The goal is to serve as a road map for future study of the pandemic experience of older persons with SARs and to encourage such study by researchers and stakeholders [2].

Historically, the industrial sector has been at the forefront of robotics development because of the need for collaborating robots. The service industries, and the healthcare industry in particular, are an exception to this rule. Opportunities for the advancement of service robots to help people with diseases, cognitive issues, and disabilities have arisen due to a lack of focus on the healthcare industry. In addition, the COVID-19 pandemic has prompted the creation of healthcare service robots as a means of coping with the challenges posed by these viruses. The employment of service robots is beneficial because they lower the risk of infections, cut down on human mistakes, and free up front-line workers to concentrate on more important activities while simultaneously keeping them at arm's length from potential contamination [3].

This article provides an overview of the many applications of robotics in healthcare. The technologies examined are the results of a partnership between academic institutions and the healthcare business, and they serve

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as examples of the extensive testing and evaluation that must precede the deployment of service robots in actual settings. Examine how robots might help during the COVID-19 epidemic from the perspectives of patients, healthcare providers, and businesses. To improve hospital capacity, efficiency, and resource equity, it also examines the developing key concerns of efficient cleaning, logistics of patients and supplies, reduction of human mistakes, and remote monitoring of patients [4]. Many nations have been hit by the COVID-19 epidemic, which is very dangerous to humans and places a heavy burden on the healthcare system. To combat the rapid spread of the COVID-19 virus, this study presents a revolutionary SLAM system based on RGB and depth pictures to increase the effectiveness of hospital operations and decrease the likelihood of infection between medical staff and patients. Current visual SLAM studies often presume a static environment, making it difficult to apply to settings like hospitals. This study provides a strategy for dealing with SLAM issues in situations including dynamic objects, such as humans and moving items, by using a knowledge graph to derive a semantic descriptor from photos. A knowledge graph is used to provide high-level semantic information and to build a priori movement relationships between things [5].

Using this knowledge tree as a foundation, create a robust and rotation-invariant semantic descriptor for key-point semantics. Accurate tracking and placement of robots in dynamic situations is facilitated by the seamless integration of the knowledge network and semantic descriptor. Semantic maps are developed to fulfill the demands of robots providing medical services, and experiments are undertaken utilizing data collected from healthcare institutions. In addition, utilize a publicly accessible dataset in assessment to compare with state-of-the-art approaches. The suggested technique showed a significant increase in accuracy and resilience in dynamic situations compared to state-of-the-art technologies. Equally impressive is the computational efficiency [6].

LITERATURE SURVEY

The global impacts of the Covid-19 epidemic have been significant. Particularly worrisome is the impact on healthcare providers and the vulnerable patients they serve. To stop the spread of the epidemic, several places, including live-in care institutions, have implemented near-complete lockdowns. Research into robotics has promised to avoid the spread of COVID-19 and eliminating the requirement for total physical isolation. This study presents the development of a self-cleaning, speech-controlled robot that can transport goods from visitors to care facility patients [7]. To prevent the spread of the virus, the system is automated to lessen the workloads of the facility's personnel and is operated totally by hand-free voice contact. Showcase an extensive examination of the voice interface and an end-to-end delivery test. Also, a voice dataset with two variations is captured: one in which the speaker wore a face mask and another in which they did not. The voice recognition system was then tested using this dataset. This allowed us to evaluate the impact of disguised faces on spoken interfaces in self-driving vehicles [8].

The world's population is becoming older at an alarming pace. An aging population, an increase in the prevalence of cognitive and physical disorders among the elderly, and a growth in the number of people living alone are all consequences of rising life expectancy across the globe. The data shows an increased need for high-quality options in elder care, such as healthcare services and assistive robots. Furthermore, in times of public health catastrophes like the SARS-CoV-2 virus (COVID-19), such robotic technologies give safe healthcare help. In non-standardized health care and domestic contexts, CHARMIE, a humanoid collaborative health care and domestic assistant robot, may perform general service activities [9]. Map creation and self-localization, safe navigations through dynamic obstacle detections and avoidances, a variety of human-robots interface systems, voice and hearing, pose/gesture estimations, and the manipulations of common home objects are all shown by the system's combined hardware and software solutions. Moreover, CHARMIE does complete housekeeping in hospitals, clinics, and private residences. Helping users move objects, seeing when they've fallen, cleaning up a room, following the user, and setting the table are all instances of such tasks. The robot is capable of a wide variety of tasks and may do them alone or with human assistance. To help the elderly maintain their independence and health for as long as possible, CHARMIE offers a general robotic solution [10].

Now more than ever, technology is an essential component of daily life. The healthcare industry has benefited from technological advancements during the last several years. However, there has not been a major increase in the acceptance of the Internet of Things (IoT) and robots in healthcare settings. This research has focused on how this technology is already improving medical treatment. The relevance of suitable IoT-aided robotic systems in healthcare applications was also addressed, along with their numerous features. Rehabilitation, assistive surgery, care for the elderly, and prosthetics were also examined as potential areas of use for the Internet of Things and robots in health care. Comprehensive overviews of the most recent progress, current state, limits, and problems in this field have been provided. The report also analyzes how this technology is being used to control the present COVID-19 epidemic. An in-depth understanding of the potential uses, applications, difficulties, and growth of a robotic system supported by the Internet of Things in the medical field has been presented. This will enable future researchers to develop a comprehensive plan for implementing the technologies into existing healthcare delivery systems [11].

This study introduces novel architecture for creating a smart assistive environment that makes use of Internet of Things (IoT) gadgets, service robots, and human users. This paper provides a novel, intuitive, and multimodal interaction system designed to aid disabled persons and bedridden patients. The user may command the room's service robots and other gadgets through a combination of five input modalities, including touch, eye tracking, gestures, speech, and augmented reality. An assistive robotic arm is a part of the interaction system, and it uses a tablet computer as its interface. The tablet PC may be brought to the user by a robotic arm [12].

The prototype smart rooms, complete with home automation equipment and the robotics assistance arm, are displayed as demonstrations of the created technology. In it, share the outcomes of experiments with these numerous interfaces and technologies. The outcomes include, but are not limited to, user choice with respect to eye-based controls (carrying out clicks, utilizing winks, or gazing) and the usage of mobile phones rather than augmented reality glass [13]. About three-quarters of the world's population resides in developing nations, making them the primary engine of population and economic expansion. Entrepreneurship in the technological sector is crucial to the long-term growth of marginalized communities and ecosystems. These initiatives have the potential to bring technological advancements to less developed areas. Here, talk about MHealth and tele-presence robots in the context of developing country technological entrepreneurship [14]. Focus on how mHealth may aid vulnerable people in developing nations, including the elderly and those living in poverty, in the face of everyday hardships as well as the extreme situation and danger of a pandemic. Draw on previous work in telepresence robotics to offer FLEXTRA, a robot mechanism that can provide real-time video conferencing, the distribution of smart medicines, and remote control. Also, provide examples of how FLEXTRA may be used in healthcare, such as in the battle against COVID-19 [15].

PROPOSED SYSTEM

Despite significant advancements, the research evaluation conducted for this paper reveals that robotic rehabilitation systems (RRS) must overcome significant obstacles before they can be effectively incorporated into everyday practice. One of the most talked about issues with robot-assisted systems is how to keep costs down. However, in the current day, medical professionals are beginning to see the potential advantages of robotic technology, such as reduced in-patient treatment times, better data administration, better decision-making, and simpler EHR maintenance. Thus, the rising popularity of surgical robots for use in hospitals is a glaring illustration. Accurate robot motions, image processing algorithms, and cognitive systems allow these devices to perform basic surgical operations autonomously. Therefore, it seems that process automation is crucial to both lowering costs and improving standard rehabilitation therapies. Based on the findings of this research, the area of upper-extremity rehabilitation robotics is increasingly moving toward the creation of more autonomous systems. Current ideas on digital health are consistent with goals of increasing automation and better-using data analytic skills. Therefore, incorporation into healthcare procedures is anticipated to occur gradually within the existing e-health framework. To speed up the widespread use of robot-assisted healthcare systems, it is important to call attention to the most pressing technological challenges.

This paper presents frameworks for robot-assisted rehabilitations, which consider human-robot interaction (both patient-robots and therapist-robots), exercise elaborations (tasks and environments) to maximize motor gain, and data analysis capabilities to promote greater independence in treatment. The following section will attempt to highlight the demands that, from the authors' perspective, robotic rehabilitation systems must solve to improve their practicality and independence in clinical settings. Methods are discussed for enhancing human-robot interaction, facilitating the enhancement and incorporation of motor gains, and acquiring more autonomous devices. The therapist, the patient, and the robotic equipment are all visible in the above robot-assisted framework. Thus, there are two axes from which to view human-robot interaction: therapist-robots (T-R) and patient-robots (P-R). Facilitating appropriate avenues for such exchanges is crucial for optimizing therapeutic outcomes. Proper stimulation of elements, including cognition, perception, and action, is highly critical from the patient's perspective to improve recovery. The ability of the patient to do activities and adapt to their surroundings simultaneously is included in this category. Therefore, it is highly associated with the degree of patient independence in ADLs. Figure 1 shows the system architecture of the proposed system.

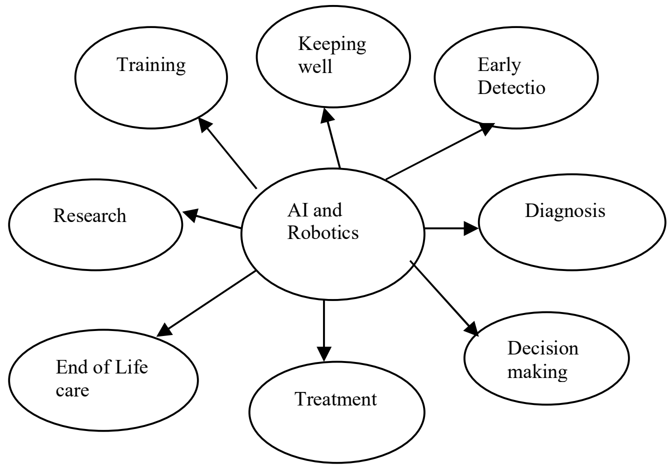

FIGURE 1. System architecture of the Proposed System

To begin with, in the realm of cognition, present-day robot-assisted therapies use techniques (often video games) to engross the user and boost motivation during treatment. By requiring players to complete hard objectives, game-based approaches may also be used to hone players' strategic and problem-solving skills. This degree of stimulation is perhaps the RRS's most refined tactic. Second, when it comes to perception, the most typical techniques target the visual, auditory, and kinesthetic systems. Digital games may be a great resource for providing both visual and auditory stimulation. One obvious drawback of game technology is its inability to provide tactile input. In this case, haptic feedback is used to compensate for this shortcoming. Combining digital games with haptic feedback might be the best option for producing more potent stimulation at the perceptual level. Finally, the action level is connected to the situation of the action. The human arm has many degrees of freedom, allowing for a wide variety of possible motions. This is analogous to determining the robotic arm's inverse kinematic solution. The "degrees of freedom problem" refers to the challenge of deciding between possible actions and coordinating the various muscles and joints needed to carry them out.

While most robot-based systems prioritize task repetition, it's also important to provide patients with many paths to the same goal. When compared to exoskeleton-based methods, those based on end-point devices provide users with more leeway in selecting an appropriate "solution" for a given task. This means that patients have more freedom to make their own compensatory motions when using end-point device-based systems. Finding a happy medium between the advantages and disadvantages of endpoint and exoskeleton-based systems is difficult. The use of external systems to observe patients while they carry out activities and identify any compensatory movements may be an option in the case of end-point systems. As a result, therapists can observe compensatory motions and draw whatever therapeutic conclusions they see appropriate. The large number of degrees of freedom (DoF) required to approach human arm mobility with exoskeleton-based devices is a significant challenge. Consequently, in a rehabilitation setting, it is crucial to provide the user with as many joint configurations as feasible that coincide with obtaining the same objective position.

The phrase "smart city" refers to collections of ideas and innovations aimed at improving the quality of lives in urban areas via increased productivity, sustainability, and social cohesions. Innovations in technology, the economy, and society are all part of these ideas. Since the turn of the century, many people in the fields of politics, commerce, administration, and urban planning have used this word to describe the introduction of technological breakthroughs into urban settings. In response to the economic, social, and political problems that post-industrial countries face in the new centuries, the concept of the smart city is employed in tandem with the exploitation of digital technology. Environmental pollution, demographic shifts, population expansion, healthcare, the economic crisis, and resource scarcity are just some of the issues that metropolitan societies must contend with. Sustainable urban innovation may also refer to non-technical improvements to city living. Using sensor networks built on the Internet of Things in healthcare settings is an intriguing concept that has the potential to reduce wasteful practices. Given the sheer volume of data that must be intelligently processed, a machine-learning technique is essential for implementing IoT-powered wireless sensor networks for this reason. The study will focus on the healthcare industry's use of IoT and WSNs driven by artificial intelligence. This study will serve as a foundation for further investigation into the impact of the Internet of Things (IoT) on healthcare delivery in smart cities.

RESULTS AND DISCUSSIONS

Extending the RRS's usage in clinical settings raises serious safety issues. Since robots might do harm to humans if not utilized properly, it is logical that people would be afraid of accidents and injuries caused by robotic devices. This worry has spread beyond the realm of medical robotics to include industrial applications. However, as the use of robots in the workplace has increased, so have the effective ways developed to further ensure the safety of employees, to the point where humans and collaborative robots may now share the same working environment. For the most part, the same holds true for the rehabilitation robots. The RRS is one of a kind since it must ensure the patient's safety as an inanimate item in the treatment area while simultaneously treating the patient. Due to this contradiction, there is a pressing need for tailored safety techniques that would let the robot engage with the patient while maintaining the appropriate safeguards. Collisions (when a robot link strikes the users), pinch injuries (when a robot captures a bodily component), and internal variables (such as abrupt spasms or twitches) are major dangers in robot-assisted therapies. It's important to remember that different kinds of robotic equipment carry different levels of danger. Figure 2 shows the system performance of relative error with an end load.

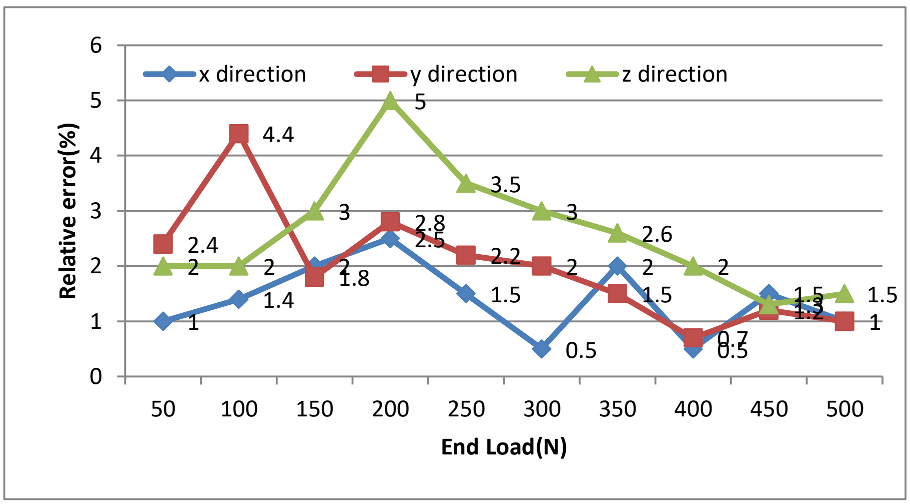

FIGURE 2. Relative error performance with end load

When dealing with an end-point robot, for instance, the risk of a collision increases. However, since patients with exoskeletons are effectively enclosed in the device, spasms, and twitches may be more harmful in this setting. Hardware and software perspectives may both be considered by the RRS's safety measures. Typical safety features include a back-drivable mechanism, pneumatic actuator, stroke limitations (hard stops or software-based), emergency stop buttons/handles, and forces/speed restrictions. Realizing that safety is not a universal idea is important. The goal of any safety system must be to make the potential for harm as low as possible. The wide diversity of safety tactics, including those designed to lessen the likelihood of patient harm during human-robot interactions, necessitates the implementation of precautions to manage dependability and safeguarding. The RRS may be more useful in clinical settings if it were standardized in this way. To facilitate international trade and market expansion, many standards have been developed to ensure the security of industrial robots, for instance. There is currently no accepted method for designing rehabilitation robot systems without compromising patient safety. Figure 3 shows the system performance of relative error with several points.

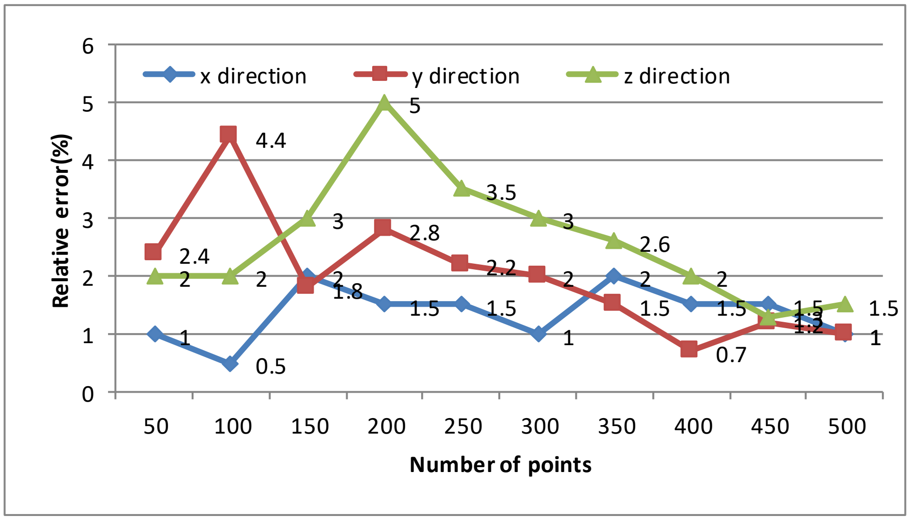

FIGURE 3. Relative error performance with several points

Given the extensive study of robots for medical purposes, numerous organizations are working to ensure the public's protection while interacting with rehabilitation robots. The International Organization for Standardization (ISO) and the American National Standards Institute (ANSI) are two of the most prominent. Therefore, the field of rehabilitation robotics is seeing the creation of industry-specific norms like IEC/DIS 80601-2-78. It is clear from the various standards that restricting the robot's forces, speed, and power are the most important functional criteria for safe robotic applications. These continuing efforts to standardize rehabilitative robotics hold great promise for expanding the use of robot-assisted therapies in healthcare. One area that has seen significant growth in recent decades is robotic rehabilitation devices. However, the uptake of these technologies in actual clinical settings has been slower than anticipated. In addition to discussing the obvious cost concerns, this article looks at the technological needs of robot-assisted systems to help speed up their incorporation into clinical settings. There is some worry that the benefits of robot-based therapy are not always carried over to the execution of everyday life tasks. Robot-aided systems have primarily focused on developing mobilization techniques (task-related), but factors other than task-related and that also intervene in movement generations have not been sufficiently addressed, which may account for the limited transfer of motor gains to ADL. Other aspects include those associated with the patient themselves (thoughts, perceptions, and actions) as well as the task's surroundings. Robot-assisted systems have made extensive use of gaming technologies to stimulate patients. The major goal is to simulate a positive relationship between the patient and robotic equipment. Challenging activities involving additional sensory channels are necessary to prolong cognitive and perceptual stimulation. Clinical settings might benefit from deployable solutions like combined workouts using gaming and biofeedback technologies.

CONCLUSIONS

The existing and future capabilities of autonomous humanoid care robots are insufficient to account for their conceptual success in all three domains. Instead, research reveals how the link is socially created as an element of a certain robotic regime of care that limits the scope of problems and approaches that may be taken. Understanding the topic's constitutive contingency is facilitated by admitting this. The interactions within the venues may be seen as feedback effects inside a loop, in which assumptions made in one arena permeate and modify activity in the other arena. For instance, the epistemic practice of robotics projects is influenced by the financing goals established in innovation policy. The notion that autonomous machine construction would "fix" population shifts suggests that innovation will occur in a linear fashion and limits the scope of such initiatives to their technical details. This implies that rather than negotiating requirements and use cases with care staff and older users within the care organizations, considering existing power dynamics, these aspects are often determined at the outset of research programs. From there, engineers often remove care techniques from their original context, ignoring their innate effectiveness in the process.

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