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Robotic System For Assisted Living And Healthcare

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Abstract
The lack of qualified caretakers in assisted living institutions has been made worse by the COVID-19 epidemic, which has led to an investigation into technology to address the increasing care requirements of residents. One strategy that may improve older folks' care and the professional lives of those who provide it is the use of care robots. However, there are still some issues with the best practices, ethics, and efficacy of using robotic technology in care facilities. The purpose of the scoping study was to assess the body of research on robots in assisted care institutions, find any gaps, and guide future studies. 73 papers from 69 investigations on the employment of robots in these settings were examined in the review. Some elderly persons expressed concerns about robots and access restrictions, while others reported possible benefits of robotics. The results of the study were mixed. Even though care robots have demonstrated therapeutic benefits, the studies' internal and external validity were weakened by methodological flaws, underscoring the need for more thorough research approaches. Large sample sizes, longitudinal studies, and theory-based research approaches were uncommon. It is difficult to aggregate and assess care robotics research due to inconsistent methodological quality and reporting across the authors' areas.
Keywords: *robot, aging, elder, older adult, gerontology, geriatric*

1. INTRODUCTION

A lot of work has gone into developing technology interventions to address the gap between older individuals' care needs and the quality and capacity of care provided. In an effort to improve the care and quality of life for elderly people and their caregivers, researchers in the fields of robotics and geotechnology are creating care robots that will offer them both physical and social support [1]. Several nations, including the United States, Japan, Germany, and the United Kingdom, have provided financial assistance for care robotics research. According to a recent assessment by the European Commission, 20% of the most important technology for aging initiatives are care robots [2]. With early research indicating they can enhance older individuals' general health, social connections, and feeling of community while lowering loneliness, care robots are showing promise as a geriatric care solution [9]. Ethical questions about safety, autonomy, and possible dishonesty are brought up by the usage of robots in assisted living institutions. The deployment of care robots is also hampered by elements including unfavourable attitudes, restricted capabilities, and technical difficulties. Robots can affect caregivers' work dynamics and offer both advantages and disadvantages. When taken as a whole, these factors pose a serious challenge to academics and practitioners who are trying to develop successful robotic therapies and comprehend related consequences and optimal procedures [3].

However, work conditions and the provision of healthcare will be significantly impacted by the use of robots in care settings. Care robots has been the focus of several prior research studies because of the probable possibility of such wide-ranging consequences. Prior reviews have examined the use of robotics in the home to promote aging in place. These reviews have focused on ethical considerations and variables that affect the acceptability or feasibility of care robots as well as the impact that robots have on caregivers. Examples of these robotic applications include telepresence robots. By specifically focusing our review on assisted living facilities, we aimed to expand on earlier research [10]. Every type of robotic application is covered in our review as well [13]. The majority of the literature that reviews research on robots for older individuals focuses on social robots and their effects on psychological and cognitive results. Our review, in contrast, captures a wider context of robotic research, interventions, and effects that are salient to caregivers and patients in this context [4].

2. REVIEW OF LITERATURE

Second, all of the nonduplicate papers were filtered by the first author (KT) using the abstract and title in accordance with preset inclusion and exclusion criteria. The other authors cross-checked this, and disagreements were resolved through dialogue. Articles that (1) examined the usage of robots in assisted living facilities and (2) had the complete text available in English were included in the study [8]. The National Library of Medicine's Medical Subject Headings served as the basis for the concept of robotics, which is defined as the application of computerized and electronic control systems to mechanical devices that carry out tasks that resemble those of humans [15]. Intelligent assistive devices such as walkers and canes, as well as ambient assistive living technologies without robotic platforms, were not included in the review. In line with other literature assessments, it classified assisted living facilities as residential environments that offer elders long-term care [12]. There was no research on the use of robots in homes to help people age in place [14]. Initiatives that examined the robot in a lab setting or that looked at the robot's foundations were excluded because they did not examine the robot in a real-world setting. The objective and subjective outcome metrics varied greatly from study to study. The most common techniques for gathering data were surveys, interviews, and observations [5]. The robots' software, the research team, or facility-employed caregivers conducted observations. The number of encounters with robots, the duration of interactions, and the emotional responses to robots were typical observational metrics. Overall, the evidence was conflicting; some studies found that the robots had therapeutic effects, while other studies found no compelling evidence. Increased social engagement between the residents and other human interactors, like caretakers and preschoolers, as well as improved mood and emotional condition were the most often mentioned benefits of the social robots [6]. Less loneliness, positive thoughts about pets, better health and quality of life, pain reduction and avoidance of painkillers, cognitive stimulation, and improved behaviour were some of the other commonly mentioned benefits of the robots. Certain robots promoted mobility and prevented unintentional falls [11].

The robot successfully prevented a medication error in one of four trials that looked at robots that assist with medicine delivery. The benefits of increased neuroactivity, decreased stress, lowered blood pressure, and improved sleep were less frequently mentioned but scientifically measured. The potential advantages of robotic pets over traditional animal-assisted therapy have been investigated in a number of research. With no discernible differences between a live dog and a robot, three trials found that these devices could reduce loneliness and promote contact. The research' findings were conflicting; one indicated that interaction with the robot was noticeably more than with a living dog, while another discovered that, in contrast to a live dog, interest to the robot gradually declined with time. The majority of participants had positive sentiments regarding the robots and positive experiences with them. research showed that older persons favored human contact or interventions assisted by humans, whereas a few research expressed displeasure. According to studies, elderly persons felt unwelcome obligation since they perceived the robots as being dependent on them.

According to other studies, older people did not want to interact with the robots because they thought of them as toys. Staff members' perceptions of the robots' agency decreased over time, according to the study. Our summary clarified some of the issues surrounding the use of care robots and the obstacles to their adoption. There were recurrent themes of ethical concerns about the robots' age appropriateness, autonomy, and privacy preservation. According to one study, there are safety concerns when family members use telepresence robots instead of caregivers to handle emergencies. Physical difficulties and technical difficulties in hearing and seeing the robots were obstacles to use. However, other studies found that despite cognitive issues and a lack of technology literacy, humans could easily operate the robots. Numerous elements, most likely including the robot's operation, design, user interaction, and individual user needs and preferences, can be responsible for the effects of care robots on seniors in assisted living facilities. Among these was gender, but the results were inconsistent.

3. MATERIALS AND METHODS

One study, for instance, revealed no difference between participants who were male and female, while another discovered that robot interactions often adhered to socially imposed gender norms: women treated the robot as if it were alive, while men tended to focus on the technical aspects of the robot (also known as "engineer-style" interaction) [7]. Regarding how participant age and the degree of cognitive decline affected the efficacy of robot-based therapies, the findings were likewise conflicting. While some studies found more success with older people and more severe stages of cognitive decline, others found greater performance with younger participants and less advanced stages. If the robots were able to speak in the participants' native tongues, that could have also had an impact on the study' results. Lower satisfaction and participation rates might have resulted from the robots' incapacity to speak in the participants' native tongues or with appropriate accents. Because translation services were required, this restriction probably resulted in an increase in staff workload.

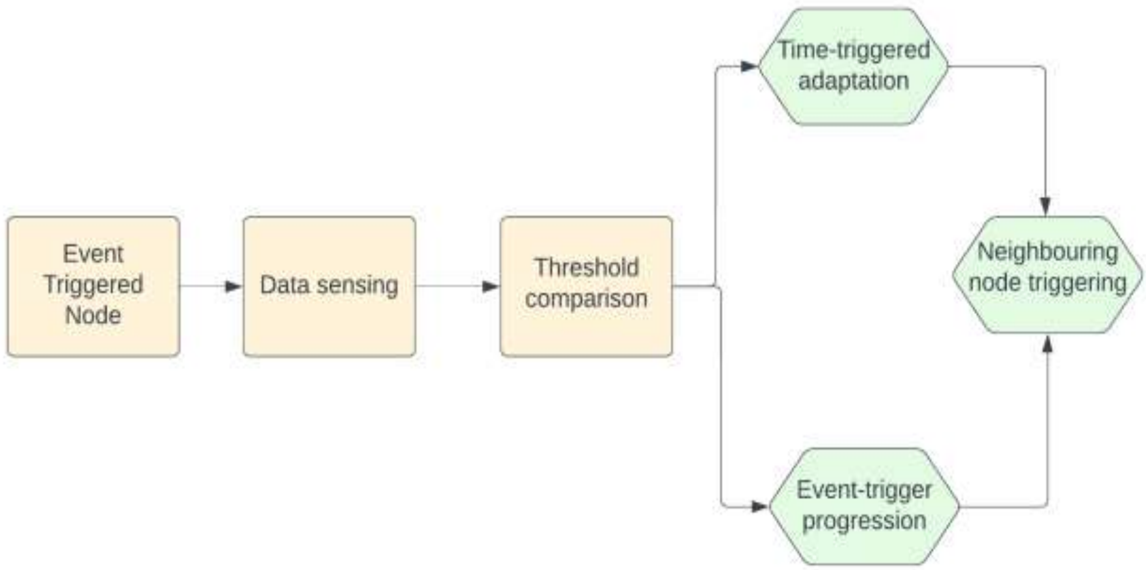

Figure 1: Proposed block diagram

According to several studies, older persons' interest in or effectiveness with the robots was lowered by their limited skills. Due to its small size, the robot's range of motion was restricted, which would have reduced its usefulness during physical therapy sessions. Because it lacked the features required for medicine ingestion, like water provision, another robot that assisted elderly people with taking their medications required caregiver accompanying. The older folks in the study wanted the robot had a companion feature or was more like a human. Because participants' first reactions to new technology can differ from their answers after longer use, once the novelty wears off, novelty effects may have altered the impact of care robots. On paper, in trials, the initial benefits of the robots were either eliminated at the end of the investigation or lessened. However, in other trials, the researchers demonstrated that the advantages of interacting with the robots increased over time. Given that longer-term studies (up to a year) shown increasing interactions and engagement as well as noticeable gains in emotional, visual, and behavioural involvement over time, some research indicates that the advantages of care robots may not be exclusively attributable to novelty effects. Although there is little research on how robots affect professional caregivers, several studies indicate that robot use may affect the attitudes of nursing staff. Robotics research in assisted living environments is frequently motivated by staff shortages. Robot incorporation into care was hampered by caregivers' perceptions of robot operation as a burden and extra workload. Research revealed that caretakers prefer preprogrammed tasks to make tasks easier, and one study discovered that making robots easier to use increased their use. Another study described a system that would allow caretakers to control the behaviour of a robot that they could teach to play a game with residents. Some of the research emphasized that nurses should be viewed as an additional means of providing care, rather than being replaced by care robots. Caretakers were free to perform other duties once one of the robots engaged in games with the inhabitants. By performing duties like answering nurse calls and delivering medication, some robots demonstrated the ability to lessen the pressure on caregivers. Surprisingly, though, one study discovered that work satisfaction rose only in the control group which did not get any robot assistance.

4. RESULT AND DISCUSSION

Robust controls were absent from 99 percent of the trials, which compared robot treatments to treatment as usual instead of human-supported controls. Because of this restriction, it is challenging to say whether the improvements were brought about by the robot or by the extra care that study participants received. In order to evaluate the efficacy of robots in assisted living environments, your review concentrated on research that directly contrasted robot-supported interventions with human-supported interventions. According to the study's findings, sessions led by occupational therapists produced noticeably better therapeutic results than sessions led by robots. Although they can't completely replace occupational therapy, the authors proposed that robots could be a useful substitute in environments with a shortage of human resources, possibly bridging the care gap.

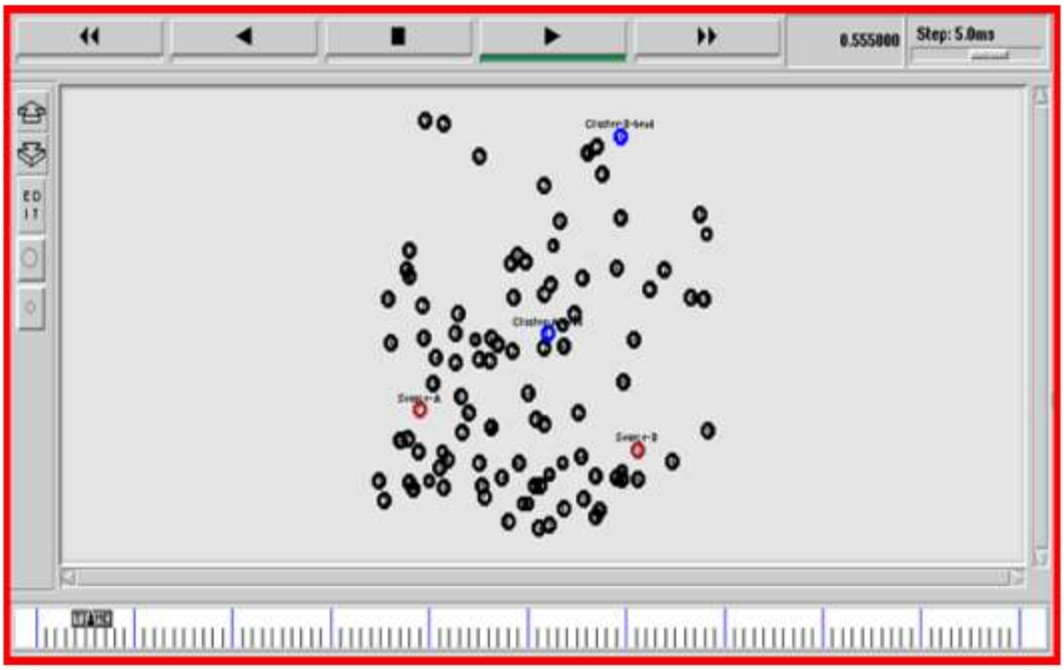

Figure 2: Topology of Robotic Node Distribution

Throughout our review's final sample of papers, several methodological flaws were found. All of the studies in this literature review used convenience samples, and none of them disclosed participant information. The most common techniques for gathering data were surveys, interviews, and observations. The research team, facility-employed caregivers, or the robots' software conducted the observations; little to no details regarding the assessors' training were provided. Finally, more than 20 distinct questionnaires were used, although nothing is known about their validity and reliability as measuring tools.

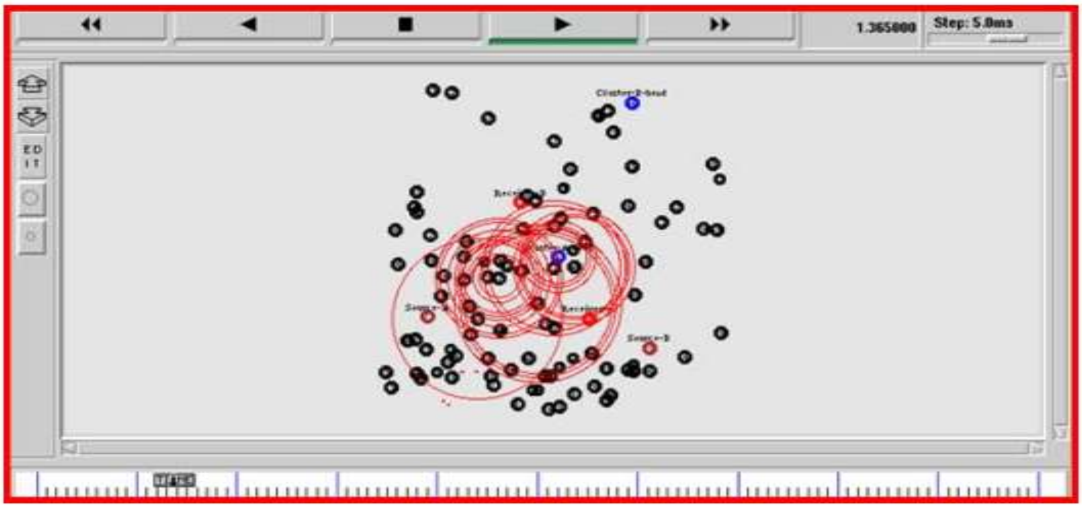

Figure 3: Inter-Nodal Data Transmission and Reception

Results from studies on older persons with robots were varied, with some pointing out advantages and others pointing out difficulties and obstacles to efficient use. Despite the fact that care robots have many therapeutic benefits, the study's findings' internal and external validity were jeopardized by methodological errors. mainly 26% of research took into account the larger care context, with the majority (70%) concentrating mainly on care recipients, staff, and family members. This constrained viewpoint could ignore significant systemic and environmental elements. Large sample size, longitudinal, theory-driven study designs were rare. Inconsistencies in methodological quality and reporting across the authors' fields make it challenging to compile and assess care robotics research.

5. CONCLUSION

There is conflicting evidence regarding how age and cognitive decline affect care robot efficacy. Younger people with less cognitive decline responded better to some therapies, while older participants with more cognitive decline might benefit more from others. Additionally, there was inconclusive evidence on the impact of gender on care robot effectiveness. The ease with which the voices of resistant care robot recipients can be obtained is limited by the convenience samples. To better understand the elements influencing geriatric robotic care and to ensure more reliable and generalizable findings, future research should focus on representative study samples and examine the effects of novelty on staff and residents. The limited capabilities of most modern robots would have probably helped produce novelty effects. One of the most effective ways to counteract the impacts of novelty may be to expose students to robots beforehand. Additionally, the results suggest that robot-mediated therapies should be customized rather than standardized. The study's research centered on customizing robot services to engage senior citizens and arouse positive memories, which could improve their experience receiving care.

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