Robotic Aid and Care for Senior Citizen with Dementia

Tamanna Kalra
School - G D Goenka Public School

Abstract:
According to the National Institute of Mental Health, Alzheimer's disease is the sixth most frequent cause of death in the US. Because there are more elderly people with dementia, there is a demand for alternative care options.
Robotic equipment is also used to assist disabled people by providing them with a sense of security and companionship. The first thorough examination and evaluation of how robotic technologies facilitate independent ageing while addressing people's physical, emotional, and medical requirements are provided in this report.
The goal of this review is to address research questions on the significance of replacing humans with robots as well as older adults using robots for amusement, recreation, and treatment. Seniors like tinkering and playing with robots since it keeps them busy and out of trouble. The field is still evolving quickly and will only get more valuable with time. We will also talk about the lessons that may be gleaned from using them to guide robot design and implementation in the future. To better understand the user experience of a patient and the correct kind of Robot, more research is still required. We want to give stakeholders and researchers a route map.

Keywords: Robotic aid for dementia, Humanoid robots, Daily chaos dementia, Aging with Robots.

1) Introduction:
A person is required for full-time for a dementia patient. Physical and mental health decline, psychological morbidity, social isolation, physical morbidity, financial difficulties, wandering, incontinence, agitation, and repetitive talking are common challenges that a person taking care of dementia patient face. As they can converse with robots, elderly people with dementia may see an improvement in their cognitive ability. A variety of communication channels are made available by technology so that people with dementia can stay in touch with their loved ones. It can help people maintain significant ties and bring the world inside their home.

As the world's population ages, there is a growing need for automated help. The World Health Organization forecasts that there are more than 1 billion persons over the age of 60, and that number will increase to 1.4 billion by 2030, or one in every six people, necessitating the hiring of an additional 6 million nurses.

Since 2015, the government of Japan, where roughly one-third of the population is over 65, has offered incentives to care institutions for the acquisition of robots. These include robotic baby seals that help calm dementia patients as well as exoskeletons that assist workers in lifting patients. It is intended to improve how people care for one another, not to take the place of individuals. A hospital robot with sensors that can record patients' vital signs and link them to electronic health records is the subject of the four-year, €1.1 million ($1.25 million) ENDORSE project, which the European Union has funding.

The field of robotics is evolving swiftly. Systems with artificial intelligence are made to communicate with people and satiate their need for connection. Socially assistive robots (SARs) with auditory, visual, and mobility capabilities can aid and interact with people by fusing assistive robotics and socially interactive robotics.(1). Additionally, SAR therapies have improved sadness, boosted social contact, and encouraged communication. (2) Social robots offer workable substitutes for meeting care needs, reducing workload for care givers, and offering advantages including entertainment, companionship, communication, education, and emotional support. (3-5).
The size of the global robot market was estimated at USD 29.81 billion in 2021, and it is anticipated to grow at a CAGR of more than 17.84% over the forecast period to reach USD 94.06 billion by 2028. (2022-2028). (6) Japan, a pioneer in the robotic service business, anticipates that its domestic market for senior nursing robots would reach $3.8 billion by 2035, when a third of the country's population will be 65 or older [7]. A thorough assessment of the research on the effects of assistive social robots in elderly health care, particularly in the role of serving as patients' companions, was published in 2009. (8) The key findings were that the majority of elderly people enjoyed the robots and that they can enhance communication, happiness, and health (by reducing stress levels and boosting immune system response). In addition, several studies found that the robots reduced the degree of dementia as determined by particular scales.

2) Types of Robots and their uses for dementia patients:

Care robots are embodied machines in that they frequently take the form of human bodies. They might also possess some form of agency that allows them to behave somewhat independently. They could resemble humans, animals, hybrids of the two,
robots, and so forth. Some care robots might be equipped with AI-enabled features that let them converse with people or engage in other "social" activities, like the capacity to recognize human emotions and comprehend natural language. While some people are optimistic that machines will one day become sentient and experience feelings, thoughts, and other extraordinary things in the same way that living things like humans and some animals do.(9,10)

(2. a) Types of Robots:-

The use of pet-like robot systems in long-term care institutions for dementia care appears to be a possibility. Paro, KASPAR, PaPeRo, AIBO, iCat, etc. all work to give people with disabilities social support, involvement, and independence. (Fig. 1)

1) Robotic cat JustoCat is powered by batteries. Its weight and size are identical to those of a genuine cat, and its fur is washable. JustoCat can communicate with the user by purring, shaking its body, and lifting a paw.

2) Robotic seal named PARO is powered by batteries and has white faux fur on him. Mass of 2.7 kg. The PARO features built-in sensors for temperature, posture, light, sound, and touch. By producing noises and adjusting its neck, flippers, and tail, it can communicate with the users. However, PARO is unable to proceed.

3) A 1.5 kg battery-powered robotic dog named AIBO. The material is metal. Features include the ability to shake its body, stretch its paw, and bark at the user. Additionally, AIBO is equipped with artificial intelligence, which enables it to grow its own "personality" through interactions with humans. It also includes a built-in camera to support the shooting of pictures feature.

4) NeCoRo is a robotic cat with grey fur that runs on batteries. Mass of 1.6 kg. NeCoRO may respond verbally (such as meowing) and nonverbally (such as moving its paws or waving its tail) to other people. NeCoRO may answer when called by name. It is able to form its personality thanks to its artificial intelligence capabilities. Though NeCoRO can't walk.

5) Daisy has fun with me. The robotic cat Kitty weighs roughly 0.45 kg. Her eyes and body include touch and movement sensors, respectively. She responds to touch on her forehead and body by moving, jumping, purring, or meowing.

6) Pleo is a 1.6 kilogramme robotic dinosaur that runs on batteries. It includes several sensors that allow it to see, feel, touch, and detect items. It also has sensors that can track moving objects and sense motion. Pleo allows users to communicate with it verbally, physically, and tactiley.

7) Hasbro Joy for all companion robots are battery-operated robotic canines and felines that resemble genuine canines and felines. Their in-built sensors react to touch and motion. They can be petted and hugged by users to engage with them. They can roll over, move, nuzzle, meow, or bark.

8) Robot Hybrid-Face is a teleoperated humanoid. A tablet running Hybrid-Face software and a 3D faceplate mounted on a stand make up the device. A laptop with an internet connection is required for remote control. It can use facial features (lifting an eyebrow) to convey emotions (anger, sadness, fear, happiness, surprise, fear, and disgust).

9) Giraff is a human-sized, wheel-based robot featuring a sizable video LCD screen, a video camera, a speaker, and a microphone. 14 kg in weight. Giraff can be teleoperated by a care taker, who can move the Giraff to make social gestures to engage a person with dementia (such as moving the video display up and down to nod). It must be used inside where there is a WiFi signal.

10) Lugwid is a 61 cm tall humanoid robot that looks like a young child. It can speak and move in a variety of ways to connect with users. It has the ability to wave, grin, and create audio cues using text-to-speech technology. It has the capacity to imitate many emotions. It can be controlled remotely by an operator or automatically by a rule-based dialogue engine.

11) Kabochan, a 28-cm humanoid robot, resembles a 3-year-old kid in terms of voice, appearance, and movement. The lips, limbs, and torso all have built-in sensors. It talks, sings, and nods in reaction to users striking, shaking, and speaking.

12) Robot VGO stands 122 cm tall, weighs 9 kg, and has wheels. Compared to Giraff, VGO is more streamlined and has a smaller screen. With VGO, the remote user can communicate with the person with dementia and move around the house. It must be used inside where there is a WiFi signal.
13) A gaming laptop serves as the head of the 3DX robot, while the body is made up of a wheel-based stand. Features include the ability to communicate, navigate, and identify faces and sounds. It has search and approach monitoring message notification and 'phone-call' functions. It can be used to inform care taker if a person with dementia leaves the house and to remind them to take their prescription.

14) Ed stands at 102 cm. It has a separate head and body component and has an appearance that vaguely resembles a human shape. Ed's body parts have speakers, video cameras, and microphones, while the head portion of Ed has an LCD screen display. It may direct the robot's movement and issue brief movies of easy instructions to help the dementia patient execute a homecare chore. The status of the task and Ed's mood can both be tracked.

15) In terms of look, MARIO resembles a human with a head, a body, and a tablet computer. Features: Using the tablet, users may speak commands and utilise the touchscreen to operate the robot. MARIO can perform the following tasks: 1.) Reminding people of their everyday schedules 2.) Making music available, 3.) Displaying images 4.) Reading news 5.) Games that stimulate the brain 6.) telephone call features 7.) Evaluations.

16) Guide is a 160 cm tall wheel-based robot with a sizable touch screen. The guide may speak to users and show messages, images, videos, and text on a screen. It can be programmed using a variety of software programmes: taking a blood pressure reading 2.) offering amusement (playing music and images), 3.) using Skype to make phone calls, and 4.) playing brain-training activities.

17) The identical robots Jack/Papero and Matilda/Betty/Sophie have different names in different research. It stands 39 cm tall, weighs 6.5 kg, and resembles a newborn face. Features: The following services are offered by it: 1.) Bingo, games, and quizzes on YouTube, 2.) Dance and music 3.) Narrating, weather forecasting, and reading the news. The user is reminded of their daily agenda and 5.) Sending SMS messages or Skype calls.

18) The wheel-based robot Silbot stands 114 cm tall and weighs about 25 kg. Silbot has the ability to communicate with users using speech and touch interfaces. Activities carried out by Silbot P include waking someone up, checking on their mood, checking on their safety, reminding them to take their medications, and carrying out therapeutic interventions (such as playing games to improve cognitive function).

19) Robot NAO is a humanoid. It is 58 cm tall, weighs 4.3 kg, and has sensors on its head, hands, feet, and torso in addition to a camera, microphone, and speakers. NAO is able to talk, sing, dance, move its arms and neck, and walk.

20) A touch screen is located on the robot Pepper's 120 centimetre humanoid body. For multimodal interactions with people, it has sensors, a camera, microphones, and a touch screen. Pepper can communicate with humans using touch screens and discussions, and it can identify faces and human emotions.

21) Ourpuppet ELISA is a robotic doll that looks like a puppet. Function: It may keep tabs on dementia patients' mental well-being and physical health. The robot will calm dementia patients if they are in any uncomfortable situations, such as when they are agitated. The robot will warn the carers if things get out of hand if it does.

22) The RIKEN-SRK Collaboration Center for Human-Interactive Robot Research and the Sumitomo Riko Company in Japan developed the Robear robot, an experimental nursing care robot. Robear wanted to help individuals get out of bed, get into wheelchairs, and even stand up.

---

**Fig. 1**

(a) Kabochan  (b) Pepper  (c) NAO  (d) Ryan  (e) PALRO
2. b) **Robots can help Dementia patients with all these activities**:

Humanoid robots can be utilized for different purposes including improving communication skills, assisting individuals with their daily life, engaging and involving individuals with various kinds of activities such as exercising, listening to music or entertaining them (11).

- To aid them with small tasks such as eating or fetching things, bathing, etc.
- To help with mobility and transport, including getting out of bed or moving around
- To reduce loneliness and help them with social and emotional needs
- To set reminders for medicines, meals, and appointments

2. c) **Challenges of adopting robots in healthcare**:

1) Emotional Support and Development - Humans are emotional beings. This is the main issue when dealing with cases as they are more sensitive or vulnerable due to their effects of disease. While robots are able of taking over nearly all tasks as a caregiver, they are unfit to provide all the emotional support.

2) Lack of Consciousness in current robots and AI - Humans don’t understand their own complex self-awareness and consciousness. So, it becomes difficult to even be able to program robots for it.

3) Social Acceptance - Using robots in public will laterally announce their disability or conditions to the public. While some might be okay with it, however there will be some people who are displeased with being the point of attraction thus causing them to refuse to continue using the robots.

4) Privacy and Security - Robots use in healthcare involves a lot of data collection through cameras, sensors, etc. The data can be misused by hackers for various cybercrime.

5) Power Sources - The main advantage of robots is that they can serve and carry out repetitive tasks without getting tired. Also, the development of power sources for robots is lacking as the robots still depend on the old ways of power generation and storage ways. As a result, robots are not good in terms of energy consumption.

2. d) **Cost of Robotic pets**:

Each unit of the Justocat costs about US $1350, an AIBO costs US $3000, and a Paro costs around US $6000. Cost and affordability can thus impact equal access by older adults with dementia. Also, the high cost of social robots may make it difficult to own for older adults. Instead, they might be often shared among users. This also raises doubts about hygiene and infection control.

2. e) **Key Players in Global Robot Market**:

- Panasonic Corporation
- ABB Ltd
- Denso Corporation
- Yaskawa Electric Corporation
- Fanuc Corporation
- Kawasaki Heavy Industries Ltd
- Toshiba Corporation
- Nachi Robotic Systems Inc.
- Staubli International AG
- Yamaha Motor Co. Ltd
- Comau SpA (Stellantis N.V)
- Intuitive Surgical Inc.
- Kuka AG
- Seiko Epson Corporation
- Omron Adept Technologies Inc.

2. f) **Care Bots**:

Carebots are a new breed of robotics designed specifically for providing specialized care for the elderly and anyone who are experiencing cognitive or social decline. These robots perform a wide range of tasks, including as reminding people to take their medications, directing people to the toilet and getting in touch with family members in case of an emergency.

3) **Result**:

In next 20 to 30 years, there would be very less young population left to care for the ageing population. Robotics will play a crucial role in healthcare industry and especially for elderly people – “Estibaliz Arzo-Fernandez” (Project manager and deputy coordinator of the ACCRA joint EU-Japan project).
The researchers discovered that if the robots are to succeed, managing the expectations of potential users is also crucial. According to Arzoz-Fernandez, "Elderly users are expecting activities and conversation that humans provide, and technology is not at this stage yet."

It will take a long time and might be costly to make robots that can learn about people and engage in conversations with a genuine understanding of their interests, she said.

It’s pivotal to comprehend relations of human and robot. According to Prof. G. "the future of humanity's existence, comfort, ease, and joy of life is at stake."

Also, "social robots" can to be available on the request as soon as possible in nations with ageing adults.

The good news is that within the coming decade, robots that increase elderly people's capacity for independent living may be commercially available – “Arzoz Fernandez”.

3) Conclusion: -

New strategies for maintaining older individuals' social and cognitive stimulation without direct human interaction become crucial to their general wellbeing during the COVID-19 pandemic. In order to keep older people and the person who care for them safe, numerous adjustments were made to care practices; nonetheless, this reduced older people's access to their social networks and exacerbated social isolation and loneliness. The robots have the potential to significantly lessen burden of care giver and medical personnel workloads while also reduce feelings of isolation along with enhancing psychological wellbeing.

Robots will need a lot of research and development work to be user-ready in these human-centered environments, though, so that they can assist elderly people and their assistant with a variety of chores independently. When implemented they may have negative effects on health and social well-being of older individuals and their care giver.

References: -

1) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8304164/
10) Journal of aging Science Published by OMICS Publishing Group. Online ISSN: 2329-8847
11) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5451499/