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Integration of Robotic Process Automation & Artificial Intelligence in Healthcare Especially for Elderly Citizens in South Asian Region

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ABSTRACT

Worldwide there is an increase in life expectancy, due to better and advanced medical consciousness. Thus, today's pandemic situation has again pinpointed the crucial fact of prioritizing the medical and health services in every respect, especially for the most respected, vulnerable and helpless citizens of our society, the elderly population. Ageing issues automatically bring in factors such as health care and human rights. An increase in the elderly population brings in a demand for increase in health services, both physical and mental health. Nowadays, the elderly also want to preserve their independence and live on their own. This research study perceives assistive robotic use to be a good solution to the problem of the aged which can be achieved through implementing Robotic Process Automation [RPA) along with Artificial Intelligence [AI). RPA is related to process management and AI, particularly machine learning and robotics. Research work in developed nations in Europe and even in China and Japan, are exploring the use of AI along with RPA as a solution to address the needs and miseries of the elderly population. As such this study probes into the specifications that will meet the requirements, be acceptable and cost effective for the senior citizens of the global village, considering both the developing and overly populated South Asian nations as background.

Keywords:-*Robotic Process Automation, Artificial Intelligence, Intelligent Process Automation, Healthcare Services, Elderly Population*

INTRODUCTION

Worldwide the elderly population, comprising age 60 and above, is increasing quicker than all other groups of people of younger age. As is anticipated in the World Population Ageing Report, the population of elderly people [age 60 years or more) is likely to be more than doubled by 2050, with a global increase from 962 million in 2017 to 2.1 billion in 2050 [1]. In USA context, it is estimated that the elderly population will increase by 26% by 2050 [2]. By 2050, the population of people over 80 is predicted to be more than 11% of their total population on average in many countries [e.g. Japan 17%, Spain 15%, and Germany 14.5%) [3] The prevalent Covid19 situation might tip this balance a bit, but the researchers of this paper feel that the difference will not matter significantly.

Elderly people suffer from various health complications affected by various chronic diseases, such as diabetes, cardiovascular diseases, chronic respiratory diseases, Alzheimer disease [causing Dementia], depression and cancer [4]. Fortunately, modernization of medical science has been helping them to survive from such diseases and increase their longevity and total population ratio. Then again, elderly people become frail with longevity, and face various forms of physical limitations

which relate to sensory, cognitive, mobility and self-care[5]. Yet again, they have less income which becomes even less as they get older. As a result, they rely heavily on health insurance and social security packages for their treatment and healthcare that can cause economic burden on a government [6]. Social isolation and loneliness are also associated with health deterioration in the elderly. Thus physical, emotional, medical and financial considerations are involved in the elderly healthcare support system.

Healthcare Service Concerns for Elderly Population

In general, an individual who is matured 60 years or more is considered as an old individual [7]. As the life span of individuals expands, it provokes a tremendous interest of care needs for the old. In most developed nations, this issue of high ageing populace with a low number of care givers is noticeable, with a lack in both formal and casual care givers of old individuals. In the majority of the industrialized countries [for example Germany, Japan, Korea], such demographic change would cause over-burden for the nursing care framework [8]. For example, in the Asian nation Japan, a deficiency of around 1 million care givers by 2025 is projected in such manner [Muoio, Japan is running out of individuals to deal with the older, so it's making robots rather, 2015]. Likewise, a deficiency of local perceived medical attendants is normal in developed nations like Germany. In Canada, the UK, and the U.S, foreign-born care givers comprise up to 19%-25% answerable for exorbitant care administration [9]. With regards to African nations, the nursing care framework is very unstructured and immature [10] and can't as expected give nursing care to the older. Subsequently, the medical care specialists from one side of the planet to the other are devotedly seeking after for developing and giving robot-helped services as the option of care providers to make the old individuals equipped for performing their day by day activities as much as is possible.

By developing elderly care robots for helping elderly people to overcome their functional limitations, keep them independent and provide companionship, today's health researchers are keen to address the unmet demand of professional[7]. Therefore, the aim of this study is to review the scope of the robot-assisted services, with their use cases and barriers in adopting care robots; it would not only contribute in improving the quality of lives of the elderly people, but also help in development and adoption of robot-assisted healthcare services in various contexts and countries.

Technological Basis: Intelligent Process Automation

Robotic Process Automation [RPA] + Artificial Intelligence [AI] = Intelligent Process Automation [IPA]

Artificial Intelligence [AI] and Robotic Process Automation [RPA] are two of the best advancements for technologies to accomplish the apparently incongruent objectives of expanding consumer satisfaction and worker resolve while lessening operational expenses. "Robot" in Robotic Process Automation doesn't allude to an actual robot or an AI robot. It's a product robot, or bot, that computerizes every day, dull assignments and cycles, disposing of human blunder and expanding usefulness and productivity to a huge degree. While they share a ton practically speaking, Artificial Intelligence and Robotic Process Automation are two unique advancements. RPA is extraordinarily productive, however it does just what the user or software engineer advises it to do, while an AI can educate itself. RPA can mechanize all the standard based undertakings, and AI can overcome any barrier where RPA misses the mark.

The impediments of RPA can be tended to as, the RPA robots will do precisely what the user will advise them, that is their most noteworthy strength, yet in addition their most noteworthy shortcoming [12]. The user can depend on the robot to execute a distinct code as long as it covers every single imaginable occasion. Issues emerge if the robot experiences circumstances or information designs that are new or unclear for the robot. An illustration of unstructured information could be a situation where applicable information focuses are installed in a group of text rather than arranged in cells. The standard based calculations for RPA robots accordingly set its impediments on the undertakings that are dependent upon mechanization. It seems like this issue has been distinguished by both scholarly world and the market, which has empowered the ascent of Intelligent Process Automation [IPA]. IPA is the mix of RPA and AI [12]. By using Machine Learning calculations and approaches, there has been a widening of errands that can be done by machines to moderate the human blunder factor, and accelerate the interaction [13]. This potential has essentially expanded the interest for mechanization as the more extensive space of potential applications draws in a more extensive scope of clients and spaces of use. In the book by Burgess [2018], Dr. Will Venters, from the Information Systems office at LSE, proposes that: "Mechanical Process Automation is incredible for managing measures that are spotless and organized – when it [the data] becomes more chaotic, then, at that point AI can step in and defeat that". LeClair [2018] features the significance of developing RPA to IPA, by contending that the main boundary of RPA programming achievement will be joining of AI examination in their foundation. IPA tends to two significant imperatives of RPA robots as expressed by Mohanty and Vyas [2018]. First and foremost, that unstructured information can't be prepared by normal RPA robots. What's more, furthermore, that higher-request dynamic is incomprehensible in normal RPA-robots. Both of these can be taken care of by techniques inside the field of AI, for instance using Neural Networks. Mohanty and Vyas [2018] further contend that RPA is a decent starting advance in the journey for full IPA execution.

RESEARCH METHOD

The methodology used in this research consists of an Integrative Literature Review [8] that entails integrative synthesis of secondary data of research topics of the interested fields of this study, to find various perspectives on it. In this process, the authors searched for articles published since 2010 on the journal database namely: PubMed, Google Scholar, MEDLINE, Scopus and EBCSO host. The key words used were ‘elderly’, older people’, ‘Assistive technology’, ‘Robot’ and ‘Robotics’. Additionally, search was conducted manually following the references in the selected articles to find more relevant articles, even older articles published before 2010 when deemed significant. The inclusion criteria chosen were: [1] articles published in English only, [2] primary studies, [3] review studies and [4] articles that were published between 2010 and 2019. On the other hand, articles were excluded when: [1] the articles were not methodologically studied, [2] not relevant to elderly care, [3] articles related to surgical robots, [4] articles related to non-robotic assistive technologies, [5] redundant articles, [6] articles did not focus on any robotic intervention and [7] the articles on same intervention by some older authors but after screening through inclusion and exclusion criteria, a total of 24 articles [table] were finally selected for review. The EndNote reference management software used for screening the articles was based on abstracts of the articles. Wherever an abstract of an article was

found irrelevant, the article was excluded from selection for review. Finally, an integrative review approach was followed to evaluate the selected articles to synthesize information to build various insights on the scope of the application of robot-assisted services, their use cases and barriers in adopting the robot-assisted services or care robots from the existing literature.

Existing Assistive Robotic Healthcare for the Elderly

The present medical services industry has been seeking after for a monstrous change in the manner that they give care to the old individuals by presenting robot-helped care progressively. With the headway of automated industry, many accept that robots could be utilized as an option of clinical staff and parental figures as a rule. As indicated by Kachouie's audit, assistive robots utilized for older consideration bring prosperity as well as diminish responsibility on parental figures [15]. In such manner, Japan, as a pioneer country in the medical services mechanical industry, is vigorously putting resources into AI to adapt to the basic lack of guardians in the nearby market [16]. Exploration shows proof that assistive robots are useful in older consideration [17].

Presently, robots are utilized for helping the old individuals in the events of giving friendship to lessen the sensation of forlornness and segregation [18], nursing [19], restoration [20], help for older folks with psychological impedance and incapacity [21], telemedicine [22] and tele-presence [23]. Generally, the three fundamental kinds of regions where assistive robots can be utilized are when there is a requirement for: 1] checking older individuals' conduct and wellbeing, 2] supporting old individuals in their everyday assignments, and 3] giving companionship [24]. Various health issues that the elderly people have in their daily life create ample scope for introducing the use of assistive robots for elderly care. The table below describes the practical functionalities & limitations of existing assistive robots developed for aged care.

Robot name	Country	Processing Mode	Functional capabilities	Limitations
 EMOX robot [9]	France	Combination of RPA & AI Systems	A companion robot for human-robot interaction to improve the socio- interactional ability of the lonely elderly people and help them to give vocal commands to the robot to control the Smart Home environment.	Requires ethical considerations
 RiSH [10]	China	Combination of RPA & AI Systems	RiSH works in collaboration with the smart home environment and can recognize human body activity which lets the home service robot to observe the environment through audio sound. Specifically used to detect and respond to human fall.	Require more testing in real environment and evidence.
 Robot-Era [11]	European Seventh Framework Program	Combination of RPA & AI Systems	Able to move and operate autonomously to accomplish daily housekeeping tasks.	High cost

 Kobuki [12]	Japan	Combination of RPA & AI Systems	Able to detect someone falling near the robot, and then send message of the incident to someone who can help.	Still needs improvement for real life use case.
 TurtleBot [13]	China	Combination of RPA & AI Systems	Allows the elderly to contact to their families and doctors quickly whenever they need. Also, able to detect the target and estimate its pose.	Not mentioned
 iPhonoid Robot [14]	Japan	RPA Systems	Helps elderly people to organize their daily routine plans by providing information on weather condition, the wind speed and the temperature.	Not mentioned
 Giraff [15]	Italy	Combination of RPA & AI Systems	Allows social interaction from home to the outside world	Depends on social participation of other peoples
 Pearl [16]	USA	RPA Systems	Provides reminders for routine activities such as eating, drinking, taking medicine, and using the washroom.	Not mentioned

Table 1: *Practical Functionalities & Limitations of existing assistive robots developed for aged*

User Acceptance & Barriers in Robotic Technology Adoption

Older individuals are apathetic with respect to robotic consideration in general. The adoption of Healthcare Robots can be adversely influenced because of the ownership of pessimistic demeanor by older individuals [17]. An examination shows that gender, culture, context, related knowledge, educational foundation and type of use can adversely influence the demeanor of the old individuals towards robot [17]; [18]. To build the agreeableness of the companion robots that collaborate with people, analysts have suggested for in depth understanding of the human social nature first, particularly of the older people [19]. Such

comprehension of human social nature additionally contrasts as a result of various culture and segment factors. Along these lines, in future Artificial Intelligence [AI] will be utilized to comprehend user conduct from long haul connection with robots [20]. Considerably more excitingly, it is expected that in future the body of the robots will be made out of liquids, gels, and elastomers, so the organic properties of the human skin is felt, which will at last build the acceptance of the robots for older care [21]. Moreover, user focused advancement is accentuated being developed of the old care robots for better acknowledgment [22].

As per the examination by Pino, Boulay, Jouen and Rigaud, a robot's appearance, highlights and social intuitive abilities are significant components for their acceptance [23]. Similarly, consistence additionally assumes a significant part in receiving robotic care. Accordingly, analysts are giving significance on the arising delicate robotic advancements to keep up better consistence [24]. Likewise, Wu et al. [2014] track down that social impact is a huge factor in robot acceptance for older care. In like manner, technology unease due to perceived intricacy of technology in older individuals can be a significant explanation of obstruction in receiving robot- helped old care [25]. In this manner, Hosseini and Goher [2017] recommend that automated proficiency among old individuals is a necessity.

Cost, Operational and Maintenance Concerns

Cost is consistently a major factor in embracing the robots for older care since the old individuals have low pay. In a survey on nursing robots by Jiang et al. [2018], the expense and unwavering quality were featured as the fundamental hindrances in nursing robot appropriation. Essentially, Robot-Era for instance was accounted for as substantially less prone to be embraced by the older in light of exorbitant cost notwithstanding palatable execution [11]. Other than cost, inefficiency is likewise an obstruction in embracing robots for older care. For example, while utilizing robots, the shortcoming, for example, consistent utilization of power is accounted for as a significant hindrance when the sensors of the robot need to follow human development consistently [12].

To address the expense issue, Koceska et al. [2019] fostered a minimal expense assistive tele-presence robot and revealed uplifting outlook and ability to receive their designed robot. Likewise, Zhou et al. [2018] likewise fostered a tele-presence robot known as TurtleBot that they professed to be minimal expense and detailed positive result while testing the robot for its expected reason. Also, the sensors utilized in the robots are getting more reasonable step by step, which can lessen the expense of robots in future.

Ethical and Privacy Considerations

There is always the involvement of ethical concern that robotic care should be a supplement to human care for elderly people, not a replacement [26] [27]. It is reported that about 28 highly cited articles were published between 2002 and 2016 to address the ethical concern on using robots for elderly care [19]. Hersh [28] in his review on service robots for elderly people, has pointed out the necessity to use assistive robots sensitively and appropriately. The studies by Tanioka [29] and Coco, Kangasniemi and Rantanen [30] also show that the ethical debate regarding the human-to-robot relationship is a significant consideration ignoring which can impede the adoption of nursing robots.

Effectiveness of Assistive Robotic Technology

Effectiveness is an important factor in the adoption of robots for elderly care. A study

shows that elderly people's perception of usability of robot-assisted service is formed based on four main factors, namely safety, controllability, efficiency and satisfaction [31]. In this regard, rehabilitation robots are often not so effective in accomplishing their purpose, and hence still have low adoption rate. Most of the time rehabilitation treatment requires specialized and human interaction intervention. Thus, often rehabilitation robot assisted therapy is less useful in comparison to conventional therapy, especially in the case of post-stroke rehabilitation [Bodenhagen, Robot technology for future welfare: meeting upcoming societal challenges–an outlook with offset in the development in Scandinavia 2019]. On the other hand, although studies show that elderly people have the capacity to use new technologies, the complexity in using assistive robots can arise when an elderly person has trembling hands, mobility problems, low vision capacity and acoustic impairments, mostly because of various disease like arthritis and Alzheimer's disease [32]. Therefore, the use of a convenient and bigger and more tangible user interface for elderly users is suggested. However, it is also found in a survey that the general population's pessimistic attitude regarding elderly people's association with technology might prevent elderly people from adopting new assistive technology [33].

Challenges of Using Robotic Technology in Developing and Overly Populated Countries in South Asia

Unlike the developed and first world countries, the South Asian nations like many other developing and under-developed places of the world, lacks from several crucial factors for practically implementing the assistive robotic technology or the Healthcare Robots; thus the need for feasibility analysis arises here in case of real-world implementation.

Technological backwardness: Starting from production, manufacturing, assembling, and aligning the robots with different hospitals, doctors and health care providers, the entire system is very complicated and sophisticated. Introducing it in developing nations like Bangladesh for mass people is really a very challenging task which requires advanced technological knowhow and skilled and trained manpower.

Educational backwardness: There is lack of technological education in senior citizens in the cities and more so in the rural areas. Robots are very sophisticated devices, which need to be controlled and monitored properly for effective result. Not all elderly people will be able to understand and operate it successfully.

Financial limitation: Another hurdle is the cost which has to be within affordable range. Due to availability and cheap pricing, mobile phones and internet services are widely used in countries like Bangladesh, India etc. at various levels, both in the cities as well as in the villages. In the same way the health care robots have to be available at affordable prices within the range of common people.

Requirement of training-both in production and maintenance sector: For vast scale production and implementation, trained and highly skilled workers are needed. Hospitals and other health service providing organizations need to be connected and networked with the health care robots, so that they can offer adequate health services at the time of emergency. The users, i.e., elderly citizens also have to be trained and explanations given on how to handle, operate, monitor and maintain the robots. Robots are very high-tech man made machines which need to be maintained and operated by man only. There is a lack of this kind of facility in rising economies.

Robot customization: Robots may need to be specifically tailored to needs due to a skeptical attitude of robot use or reluctance

to use them because of the great jump in technology the robot represents. To do this older people need to be included in the development of robots. Older people have to be engaged in the design process and research needs to be conducted looking at the older person as a user of healthcare robots. If possible, while assembling the robots there should be the option for specific customization according to the likes and dislikes and mentality of the particular user. The consciousness of their requirements is often found missing especially in the not too well educated population of these nations.

Lack of power supply: The developing countries have limited stock of power supply and frequent power failure is a common scenario there. Already in the cities and especially in villages there is shortage of power supply for the day-to-day life equipment such as electric stoves, computers and so on. Robot is a machine which needs continuous power-supply for executing any task and has to be charged for a certain time of the day on a regular basis. For that availability of uninterrupted electricity is a requirement.

Emotional attachment: Lastly but not the least comes the emotional part while using robotic technology. The robot's appearance influences how people appraise the abilities of the robot and it can also have profound effects on its accessibilities, desirability and expressiveness. Older people recognize the potential usefulness of a robot in the house, but worry about privacy issues and the way the robot would operate in the home environment. Robots can help and support elder citizens to some extent but can never be the replacement of dear ones and the warmth of human interactions.

But, as mentioned earlier in this study, mobile phones and internet services have bloomed worldwide at various levels, both in the developed as well as in the rising nations, leaving behind all technological, educational and financial limitations, in the same way it is hoped that one day, the *Healthcare Robots* will be able to serve all senior citizens worldwide to live a better life!

DISCUSSION AND FUTURE DIRECTION

This study objectively reviews the non-technical aspects of the robotic solutions, use cases and barriers in elderly care to provide a contemporary understanding of these. This research informs that although since the last decade scientists and researchers have been continuously integrating newer and innovative technologies [e.g. IoT, Smart Home, Augmented Reality, Artificial Intelligence and Machine Learning] with the assistive robots used for elderly care, the results are mostly concluded with conspicuous barriers of various types in adoption and lack of clinical evidence. The study indicates that the assistive robot industry for elderly care will need a long time yet to meet user demand efficiently. Also, from this research it is a significantly noticeable fact that though in developed countries there has been some success in the adoption of robotic technology for elderly care, hardly any assistive robot project was initiated in any developing country.

CONCLUSION

In conclusion it may be argued that it will be a long time before assistive robots are adopted for elderly care by a large number of people, let alone mainstream adoption, as research on the subject of IPA is currently still in an emerging phase. However, it is obvious that despite being in the nascent stage of adoption, researchers worldwide are eagerly working with the most advanced technologies to make the intervention of elderly care robots significantly useful and evidently imperative. The findings of this research paper also suggests, with a certain amount of surety, that the day will come, in the not

too distant future, when the expediency of this technology will create a great impact globally on the healthcare of the elderly.

REFERENCES

1. *Ageing [Internet]. 2019. Available from: https://www.un.org/en/sections/issues-depth/ageing/*
2. *Parke, K., &Horow JM. Family Support in Graying Societies. 2015;*
3. *Deusdad, B. A., Pace, C., &Anttonen A. Facing the Challenges in the Development of Long-Term Care for Older People in Europe in the Context of an Economic Crisis. J Soc Serv Res [Internet]. 2016;42[2], 144– 150. Available from: https://doi.org/10.1080/01488376.2015.1133147*
4. *Nowson, C. A., Appleton, J., &Grieger JA. The impact of dietary factors on indices of chronic disease in older people: A systematic review. J Nutr Health Aging. 2018;22[2], 282–296.*
5. *National Academies of Sciences and Medicine, E., & Population C on. Future Directions for the Demography of Aging: Proceedings of a Workshop. In: National Academies Press. 2018.*
6. *Keehan, S. P., Stone, D. A., Poisal, J. A., Cuckler, G. A., Sisko, A. M., Smith, S. D., … Lizonitz JM. National health expenditure projections, 2016–25: price increases, aging push sector to 20 percent of economy. Health Aff. 2017;36[3], 553–563.*
7. *Smart home tests first elder care robot. Washingt State Univ. 2019;*
8. *Tan, C. C. L., Cheng, K. K. F., & Wang W. Self-care management programme for older adults with diabetes: An integrative literature review. Int J Nurs Pract. 2015;21:115–124.*
9. *Aubergé, V., Sasa, Y., Bonnefond, N., Meillon, B., Rey-gorrez, J., Schwartz, A., …Nebout F. The eee corpus: socio-affective" glue" cues in elderly-robot interactions in a smart home with the emoz platform. 5th Int Work Emot Soc Signals, Sentim Linked Open Data [p Lr 2014]. 2014;*
10. *Do, H. M., Pham, M., Sheng, W., Yang, D., & Liu M. RiSH: A robot-integrated smart home for elderly care. Rob Auton Syst. 2018;101:74–92.*
11. *Hendrich, N., Bistry, H., & Zhang J. Architecture and software design for a service robot in an elderly-care scenario. Engineering. 2015;1[1]:27–35.*
12. *Sumiya, T., Matsubara, Y., Nakano, M., &Sugaya M. A mobile robot for fall detection for elderly-care. Procedia Comput Sci. 2015;60:870–880.*
13. *Zhou, B., Wu, K., Lv, P., Wang, J., Chen, G., Ji, B., & Liu S. A new remote health-care system based on moving robot intended for the elderly at home. J Healthc Eng. 2018;*
14. *Szeles, J., Kubota, N., & Woo J. Weather forecast support system implemented into robot partner for supporting elderly people using fuzzy logic. 2017.*
15. *Cesta, A., Coradeschi, S., Cortellessa, G., Gonzalez, J., Tiberio, L., & Von Rump S. Enabling social interaction through embodiment in ExCITE. 2010.*
16. *Pollack, M. E., Brown, L., Colbry, D., Orosz, C., Peintner, B., Ramakrishnan, S., … McCarthy CE. Pearl: A mobile robotic assistant for the elderly. Vol. 2002. 2002.*
17. *Hudson, J., Orviska, M., & Hunady J. People's attitudes to robots in caring for the elderly. International Journal of Social Robotics. 2017;9[2]:199–210.*
18. *Nomura, T., Kanda, T., Suzuki, T., & Kato K. Age differences and images of robots: Social survey in Japan. Interact Stud. 2009;10[3], 374–391.*
19. *Bodenhagen, L., Suvei, S.-D., Juel, W.*

K., Brander, E., &Krüger N. Robot technology for future welfare: meeting upcoming societal challenges–an outlook with offset in the development in Scandinavia. Health Technol [Berl]. 2019;9[3]:197–218.

20. *Kiesler, S., & Goodrich MA. The Science of Human-Robot Interaction. ACM Trans Human-Robot Interact. 2018;7[1], 9.*
21. *Rossiter, J., & Hauser H. Soft robotics—the next industrial revolution. IEEE Robot Autom Mag. 2016;23[3], 17–20.*
22. *Gross, H.-M., Scheidig, A., Debes, K., Einhorn, E., Eisenbach, M., Mueller, S., …Wengefeld T. ROREAS: robot coach for walking and orientation training in clinical post-stroke rehabilitation—prototype implementation and evaluation in field trials. Auton Robots. 2017;41[3]:679–698.*
23. *Pino, M., Boulay, M., Jouen, F., &Rigaud AS. ―Are we ready for robots that care for us?‖ Attitudes and opinions of older adults toward socially assistive robots. Front Aging Neurosci. 2015;7, 141.*
24. *Ansari, Y., Manti, M., Falotico, E., Mollard, Y., Cianchetti, M., &Laschi C. Towards the development of a soft manipulator as an assistive robot for personal care of elderly people. Int J Adv Robot Syst. 2017;14[2].*
25. *Iancu, I., &Iancu B. Elderly in the digital era.theoretical perspectives on assistive technologies Technologies. 2017;5[3], 60.*
26. *Rodgers, H., Bosomworth, H., Krebs, H. I., van Wijck, F., Howel, D., Wilson, N., … Cohen DL. Robot assisted training for the upper limb after stroke [RATULS]: a multicentrerandomised controlled trial. Lancet. 2019;*
27. *Parviainen, J., &Pirhonen J. Robot Interactions: Embodiment as Ethical Issue in Robot Care for the Elderly. Vulnerable Bodies Hum. 2017;*
28. *Hersh M. Overcoming barriers and increasing independence–service robots for elderly and disabled people. Int J Adv Robot Syst. 2015;12[8], 114.*
29. *Tanioka T. Nursing and Rehabilitative Care of the Elderly Using Humanoid Robots. J Med Investig [Internet]. 2019;[Vol. 66]. Available from: https://doi.org/10.2152/jmi.66.19*
30. *Coco, K., Kangasniemi, M., &Rantanen T. Care Personnel's Attitudes and Fears Toward Care Robots in Elderly Care: A Comparison of Data from the Care Personnel in Finland and Japan. J Nurs Scholarsh. 2018;50[6] 634–644.*
31. *Moon, M. K., & Kim S-C. Usability Evaluation of Movement Support Service Robot for Elderly.In Advances in Ergonomics Modeling, Usability & Special Populations. Springer. 2017;[pp. 517–526].*
32. *Garcia-Sanjuan, F., Jaen, J., &Nacher V. Tangibot: a tangible-mediated robot to support cognitive games for ageing people—a usability study. Pervasive Mob Comput. 2017;34, 91–105.*
33. *Yusif, S., Soar, J., &Hafeez-Baig A. Older people, assistive technologies, and the barriers to adoption: A systematic review. Int J Med Inform. 2016;94, 112–116.*