

Assisting People of Determination and the Elderly Using Social Robot: A Case Study

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Abstract

A technological innovation that has recently garnered attention in the literature is social humanoid robots' applications. Since their commercialization, social robots have been perceived as a valuable tool to assist individuals in their daily activities. As people grow older, their capabilities to accomplish everyday activities gradually deteriorate. Consequently, there is a pressing need for research on the positive benefits offered by humanoid robots. This paper explores the implications of a social robot, Zenbo, in the United Arab Emirates (UAE). We propose that the Zenbo help to assist vulnerable elderly populations, ordinary citizens, and People of Determination. This study can guide the UAE policymakers to allow elderly people and disabled individuals to use Zenbo to ensure their safety and well-being. Hopefully, this technological advancement will go a long way in transforming the traditional support systems offered to the vulnerable populations in the Middle East.

1. Introduction

Humanoid social robots can interact with people and serve as helpful aids in daily routines. Their emergence has caused the human workforce's replacement in several sectors [1]. Through technological advancements and innovations in Artificial Intelligence (AI), robots are now considered ready for engaging with us at work, at home, and in the public spaces [2]. A humanoid is a robot with its body shape constructed to resemble the human body [3]. For instance, its design can be used for functional, such as interacting with human tools and environments, and experimental, such as studying bipedal locomotion and other purposes [4]. Similarly, social robots are defined as autonomous mobile machines that are designed to interact with

humans [5]. This interaction process entails demonstrating social behaviors such as recognizing, following, and helping their owners in conversations [11].

This project's central focus is to work with a humanoid robot called Zenbo, designed by the ASUS company in Taiwan [2]. Research suggests that this robot has been proven to be successful [2]. It can assist with household chores and help the elderly and people of determination needs in multiple scenarios [9]. The term People of Determination was introduced in 2016 by the Vice President and Prime Minister of the UAE, HH Sheikh Mohammed bin Rashid Al Maktoum [21]. It describes people with special needs [21]. Social robots play an essential role in society because they are commonly thought to assist people in their daily lives [11]. This project explores the implications of the Zenbo robot in the UAE context, which has a distinct culture and Islamic traditions. In the UAE, individuals tend to live in a joint-family system, where elderly populations and people with determination receive constant attention and care from the family members [8]. However, as technologies have proven to improve further care provided to humans over the years, through this research, we seek to explore features that could better assist elderly people and the People of Determination needs. As they grow older, elderly people's lifestyles tend to become more challenging over time. Despite experiencing physical changes, they cannot manage simple everyday activities, which deteriorates their life quality [2]. To make matters worse, they develop bad habits of forgetting about medication which ruins their health [2].

With aging, one can accomplish daily activities involving social, mental health, and physical tasks steadily deteriorate [15]. Elderly individuals experience

several problems such as difficulty moving, contacting people, and forgetting important tasks, including taking food on time [15]. Therefore, the elderly and People of Determination need to receive personal assistance and support. Elderly individuals and those with determination needs require constant assistance in their daily routines [9]. However, finding a human helper is often not feasible from an economic and safety perspective [6]. Therefore, we explore the idea of using social robots, such as Zenbo, for this purpose.

A social robot usually comprises an AI system constructed to interact with individuals and various robots [2]. However, we acknowledge that this may not be true for all social robots. It interacts with humans on both social and emotional levels [11]. Not only does it build social resonance, but it keeps individuals busy in their daily lives. In order to be easily readable and understandable for humans, the robot's conduct is lifelike. For instance, the robot delivers pictures of people by employing cameras [11]. This holds when it comes to various algorithms. These algorithms must communicate with people, assemble social connections, adapt to their current environments, learn throughout their lifetimes, and incorporate new experiences into their understanding of the world and themselves. In order to assist family members, social robots must be functional and purposefully designed with unique personalities.

Zenbo is a popular social robot with the power to perform simple functions at home. It is intended to make the home tasks of a family comfortable and easy to perform. Furthermore, it is designed to interact with children, adults, and the elderly population. For example, it can display pictures and tell children their preferred stories [5]. Moreover, it can also be used for controlling your home appliances and perform surveillance tasks [11]. These robots have sensors that can detect when people fall or send messages for other members of the family to assist [11]. Since it behaves more like a human than a robot, its ability to adapt to the environment makes it appropriate for families [5].

Furthermore, people on their smartphones can easily access Zenbo and keep track of events using the built-in camera. For illustration, such events could include reminders for mediations, exercise schedules, and doctors' appointments. Social robots can also perform general tasks such as administering video calls, managing smart home systems, social media interactions, and interactive communications [5].

As suggested in a prior research study, humanoid robots can assist the elderly and People of Determination [6]. This phenomenon translates into enabling governments and health authorities to become more efficient and holistically transform the traditional medical system. This can bring efficiency and convenience to the health care sector. Furthermore, using a social robot like Zenbo tends to be less costly and more beneficial for governments. Several governmental agencies in the UAE operate in diverse areas, such as oil and gas, law enforcement, and the financial sector, to support individuals with special needs. Since these organizations care deeply about special needs people, they strive to improve their working environments. Similarly, several other organizations in the health sector also assist elderly individuals in addressing their needs.

To advance this agenda of utilizing new generation technologies in the UAE for the betterment of the citizens, we explore these two questions:

1. How can Zenbo assist elderly individuals and People of Determination who reside in the UAE [9]?
2. Which human factors influence the success of social robots for the vulnerable population [9]?

To inquire about these two questions, we need to be informed about the exact needs of elderly people and People of Determination. For example, the following needs of the vulnerable population can be addressed by Zenbo through:

1. Early detection of crisis;
2. Direct connection with the responsible doctor for saving patient's time, effort, and travel fatigue;
3. Advancement of high-quality consumer-driven services that are offered 24-hours a day to the elderly and People of Determination;
4. Dissemination of social services; and
5. Intelligent solution of repetitive issues.

2. Literature Review

Following the robotic industry's worldwide rise, a growing need has emerged for social robots to assist people of determination. Whether it is education levels or degree of trust, research suggests several human factors influence social robots' success [8]. In line with previous research, human factors can contribute towards a greater understanding of social robots' perceptions in

the Middle East [9]. The purpose of the following section will be to discuss these human factors and provide a comprehensive literature review on social robots, especially in the UAE and Middle East regions. Through these outlined human factors, researchers will be better able to comprehend how the Zenbo robot can assist elderly populations in the Middle East.

2.1. Education

Perhaps, the most significant factor that influences social robots' success in the UAE is education. The educational levels of individuals in the Middle East impact attitudes towards social robots and whether they should be implemented in everyday tasks [9]. For instance, in a survey investigating social robot use in Dubai, education significantly affected public perceptions of social robots. Individuals without formal education often express negative attitudes towards robots, whereas individuals with some formal education report an indifferent perspective towards robot use [9]. Similarly, discrepancies in educational levels can impact attitudes towards robot assistance in the Middle East [10]. During a study investigating humanoid robots' perceptions in healthcare, these researchers discovered that college education affected perceptions of robots. As in the previous study, people without a college education showed slight disagreement with their hospital use [10]. In stark contrast, participants with a college education were indifferent towards robot use in a healthcare setting. One possible explanation for these findings is that participants with education are better able to inhibit fears and have an empirical attitude towards applying new technologies [10]. Suppose the Zenbo robot would be potentially implemented in the Middle East. In that case, education must be considered a crucial human factor that could shape public perceptions of social robots [9].

2.2. Trust

Another factor that has been proposed to influence social robots in the Middle East is trust. For Zenbo robots to be successfully implemented in the region, humans need to build a relationship of trust with the robot [11]. Not only have studies found that trust predicts the quality of Human-Robot Interaction (HRI), but it determines whether people are willing to rely on social robots for specific tasks. Trust is a particularly important factor to consider in relation to Zenbo robots because it allows elderly adults and robot care providers to collaborate effectively [12]. For instance, three main themes are crucial in supporting trust in a robot care provider: 'professional skills', 'personal traits', and 'communication' [12]. Professional skills were the most

common factor that elderly adults perceive to support trust in robot care providers [12].

Similarly, trust is a crucial factor for human-robot interactions to prosper [13]. On the other hand, a lack of trust in interactions between human beings and robots can misuse and abuse this technology [13]. Consequently, it is important for social robots to be trustworthy to build meaningful relationships with elderly UAE populations.

2.3. Gender

When it comes to human-robot interactions, another important factor to consider is gender. Research indicates that substantial gender differences impact public perceptions towards social robot use in the Middle East [14]. Gender is an important variable in human-robot interactions and affects how users react to robots in specific scenarios [14]. In comparison with females, males perceive robots as more useful, show higher willingness to use them in the future, and are more open to accepting these robots into their lives [14]. Similarly, gender is an essential factor that affects user acceptance of healthcare robots [15]. In general, men tend to show greater desirability towards robots in cooperative tasks, indicating higher acceptance levels [15]. Finally, studies have shown that the gender of robots can affect user's reactions towards robots. Male robots with stereotypically masculine traits are perceived more favorably by males, whereas female robots with stereotypically feminine traits are considered more suitable for women [16]. In this regard, gender typicality in tasks is an important factor to consider when implementing robots in the UAE.

2.4. Age

The final factor that influences social robots' success in the UAE is age. Research suggests that age differences affect the perception of humanoid robots for domestic use in the Middle East. Elderly seniors display more negative attitudes towards robots than younger individuals [17]. For instance, young adults between the ages of 18 and 25 exhibit more positive attitudes towards domestic robots than older adults in Saudi Arabia [18]. One possible explanation for these findings is that cohort is a factor that can influence decisions to use new technologies [19]. Elderly adults belong to a generation unfamiliar with and accustomed to adopting new technologies [19]. Therefore, older individuals are less conformable to technology usage than today's tech-savvy generation.

Researchers must overcome this age-related barrier to robot acceptance given that the Zenbo robot's target audience is elderly individuals. In light of this issue,

several factors can improve older adults' acceptance of robots [20]. In a study investigating features that improve the acceptance of robots, these researchers discovered that older adults prefer human-like service-oriented robots [20]. Hence, the researchers recommend designing robots with human-like qualities to carry out daily services for elderly populations. Ultimately, following these recommendations would go a long way in designing user-friendly social robots to assist elderly individuals in the Middle East.

Besides factors discussed previously in the literature, we extend our investigation to understand human factors that influence the success of social robots for vulnerable UAE populations [9].

3. A Study Design

We conducted three surveys to gather perspectives from different stakeholders. Our targeted populations included People of Determination needs ($n = 15$), elderly individuals ($n = 14$), and the general public ($n = 83$). Drawing inspiration from crucial human factors in prior literature, we elicited factors in designing survey instruments [9]. In order to ensure the validity of our surveys, we consulted two international scholars that work in the field of social robots.

The survey questions were distributed towards populations with disabilities in the Zayed Higher Organization for People of Determination. Moreover, we also received responses from other universities and organizations in the UAE. Finally, the remaining two surveys were distributed to students at Zayed University in UAE and a government agency's employees [5].

In the following section, we discuss descriptive statistical results of three survey responses. Based on these results, we propose the next steps for making human-robot interactions possibly more meaningful, especially in the context of vulnerable UAE populations. We use the survey results to develop a mobile application, which interacts with Zenbo and seamlessly integrates with society.

In conducting our survey design, we draw on previous literature regarding the importance of essential human factors to gain a comprehensive understanding of social robots' public perceptions [9]. For each survey question, we relied exclusively on previous literature on the role of human factors in shaping public perceptions of robots. Human factors that differ based upon gender, age and culture can allow researchers to better understand how the public perceives social robots in the Middle East context [9]. Through outlining these various influential human factors, we hope researchers will achieve a comprehensive understanding of social robots' perceptions in the Middle Eastern region.

4. Results and Discussion

Our survey results have identified factors related to health, social activities, and environments in which they interact to determine the needs of elderly individuals that seek assistance from Zenbo. The results ($n = 14$) also highlight the importance of meeting UAE senior citizens' needs and interests. Zenbo has the power to assist elderly populations with their daily routine tasks. For instance, when seniors forget to take their medicines, the robot provides daily reminders for accomplishing this basic task. In order to prevent common diseases (e.g., heart disease and diabetes), older people must engage in physical activities on a daily basis to improve overall health. Zenbo robots can provide elderly individuals with daily reminders for activities such as videos from the internet as sources of motivation [9]. Furthermore, if elderly populations experience any emergencies, Zenbo can distribute emergency warnings and videos of the scenario to family members. Figure 1 below outlines responses received from elderly UAE residents.

Additionally, we asked our elderly respondents questions concerning their comfort levels in purchasing Zenbo. An overwhelming majority of elderly respondents approved of Zenbo as a medium that could be of assistance for taking medications, completing household chores, and reminding them about religious meditation.



Figure 1: Identifying the needs of elderly citizens

Our second survey was conducted to identify People of Determinations' needs. Based on the Zayed Higher Organization for People of Determination

survey data, respondents agreed that having technologically advanced support is crucial for integrating into society [5]. The survey's participants indicated that they required personal assistance and support at various levels. For instance, they needed help reading labels on product packages, taking timely medications, and performing household chores. The majority of participants reported that they preferred social robots, such as Zenbo, to assist them [2]. The responses received from the elderly UAE residents are depicted in Figure 2.

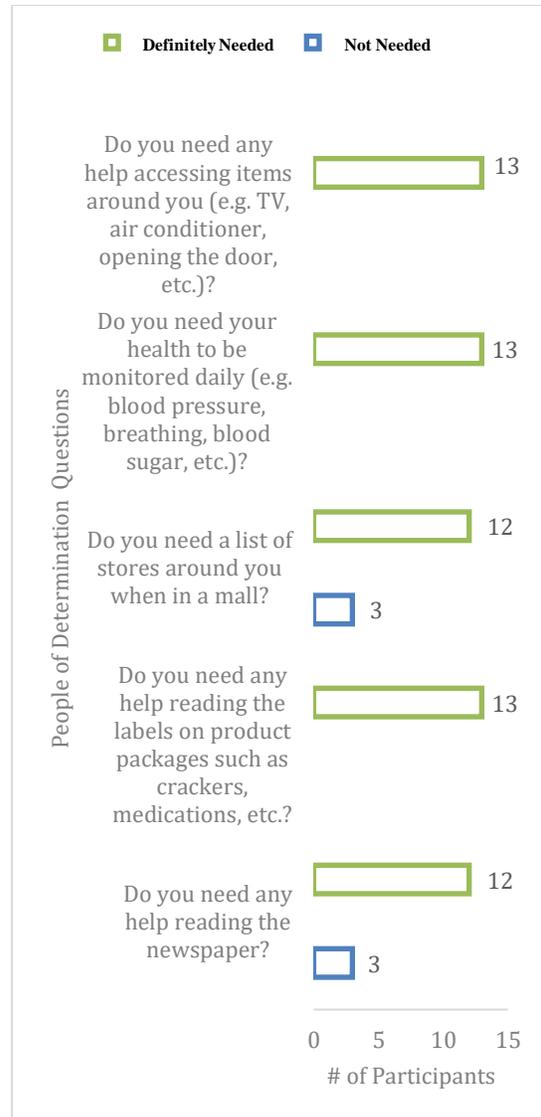


Figure. 2: Identifying the needs of people of determination

The third survey was administered to common citizens (n = 83). Responses received from elderly UAE

residents are depicted in Figure 3. The results also demonstrate that majority of respondents required assistance from technological innovation in their daily routines.

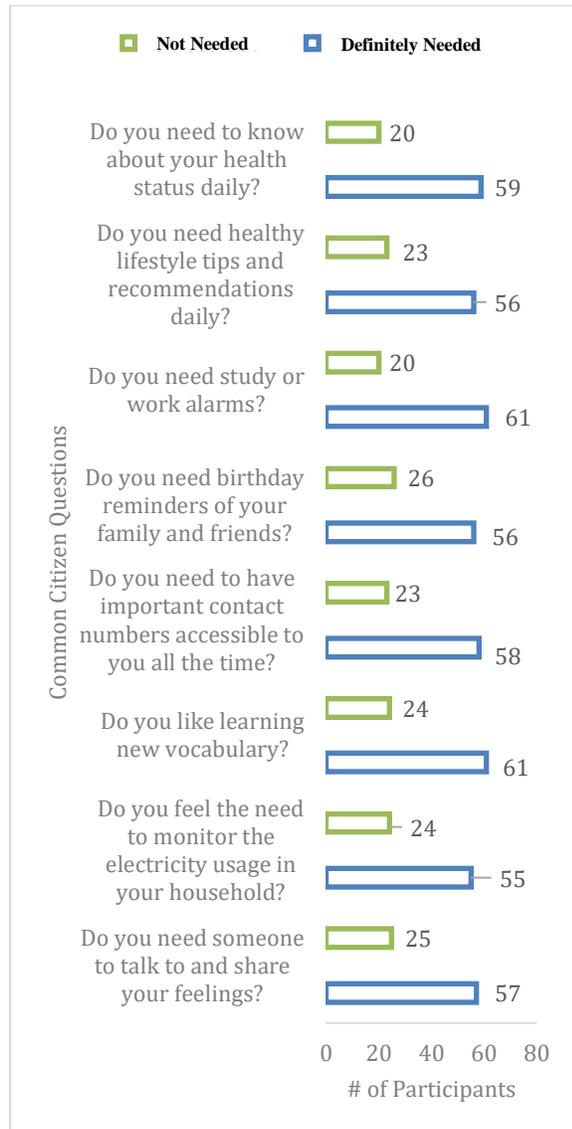


Figure. 3: Identifying the needs of common citizens

5. Advancing Technological Innovation Through a Mobile Application

In this step, we propose a mobile application (app) that complements social robots' integration in UAE culture. Zenbo will assist three main stakeholders (i.e., ordinary citizens, People of Determinations, and elderly

people). Based on survey results' outcomes and exploring existing features of the Zenbo robot, we have assimilated the following list of mobile app features:

1. Finding the location of a person;
2. Providing reminders for medication, meditation (five daily calls to prayers), exercise, and food; and
3. Monitoring various physical actions/motions by a person.

5.1. App Development

In terms of app development, we developed the graphical user interface using buttons, such as adding reminders for medication, exercise, and food, receiving notifications, sending notifications, adding reminders for five prayers, and adding additional reminders. We designed the app by following these steps:

1. List Screen is used for listing the reminders. A single table view develops the List Screen. Each cell on the screen represents a single reminder. By tapping each cell (reminder), it takes the user to the next screen.
2. Detail Screen is used for showing details of the reminder.
3. Reminder Bar is used for adding reminders with a navigation bar. The entered items then move to a new screen to add new reminders. This screen is designed using labels embedded in a scroll view. The process is repeated using the table view with single cells. By tapping Add navigation item, another repeated reminder is added to the list.
4. Table view is then used to take participants to a new view controller. This allows them to select repeat options using a build-in table view. By selecting options, repeat mode is automatically set to the reminder.

5.2. Testing of App

We tested the mobile app by following a systematic testing method and improved the functionality based on the feedback received. We followed these steps:

5.2.1. Functionality Testing. We tested all the app functions, database connections, and forms employed to submit or get information from users. In particular, we tested:

1. The outgoing links from all the pages to the specific domain under test; and
2. All the internal links.

5.2.2. Test forms on all pages. We also test the forms, as they are an integral part of the mobile app. In general, the forms are used for receiving information from users and to develop interactions with them. In particular, we checked:

1. All the validations on each field;
2. The default values in different fields;
3. Wrong inputs in the forms; and
4. The options to create, modify, or delete forms.

5.2.3. Usability Testing. We performed the usability test to measure human-computer interaction characteristics and identify weaknesses in the system before correcting them. In particular, we tested the app to:

1. Have a simple and easy-to-use interface design; and
2. Include clear instructions to guide users.

6. Discussion and Conclusion

In this paper, we studied the adaptability of the Zenbo robot in the UAE environment and integrated important features to assist elderly individuals and People of Determination. Slowly but surely, the lifestyles of senior individuals are becoming harder in society. As they grow older, their eating habits, physical health, and ability to perform everyday activities steadily decline. Moreover, they often forget to take important medications, which has a negative impact on their overall health.

We conducted three surveys to include the People of Determination, the elderly population, and the ordinary citizens. The study results show that the majority of participants from all three stakeholder groups expressed that they need help or assistance from robots. This study also helps in better understanding the personality in human-robot interactions [8].

Following an exploratory survey design study, we developed a mobile app to better understand new generation technologies. We integrated several important features, such as reminders (medication, prayers, etc.) in the app. It also allows sending notifications when required. To enable users to easily understand and operate this application, a user-friendly interface was designed.

The technological advancement in this direction will help transform the medical system, bring efficiencies in the healthcare sector, and provide safety to the most vulnerable stakeholders in the UAE.

We also conclude that Zenbo could play a major role in providing dynamic assistance in the UAE

households and commercial establishments. In future research, we expect to use the mobile app to gather real-life data and gather more in-depth insights about the integration of Zenbo in the UAE community. We encourage researchers to investigate the features listed below to make the mobile app more interactive and effective by:

1. Adding additional features including embedded chips, sensors, and arms;
2. Providing functions to support security and privacy issues; and
3. Allowing other family members to receive notifications in emergency situations when their loved ones face any issues.

Our research has practical implications for policymakers. For instance, the UAE government can formally allow vulnerable communities, such as the People of Determination and the elderly, to use Zenbo for ensuring mental well-being.

7. Limitations

Like other research, this study also has some limitations. Securing substantial participation in our surveys designed for the elderly and People of Determination presented a big challenge. In future studies, we intend to collect qualitative research data through interviews with vulnerable communities to comprehensively understand technological innovation requirements.

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10. References

- [1] Jackson, J. C., Castelo, N., & Gray, K. (2020). Could a rising robot workforce make humans less prejudiced?. *American Psychologist*.
- [2] Wesselman, E. (2016). Social robots. An advisory report prepared by KPMG on 2016's new breed of social robots is ready to enter your world. Retrieved on December 6, 2020 from: <https://assets.kpmg/content/dam/kpmg/pdf/2016/06/social-robots.pdf>
- [3] Kaneko, K., Harada, K., Kanehiro, F., Miyamori, G., & Akachi, K. (2008, September). Humanoid robot HRP-3. In *2008 IEEE/RSJ International Conference on Intelligent Robots and Systems* (pp. 2471-2478). IEEE.
- [4] Reher, J., Cousineau, E. A., Hereid, A., Hubicki, C. M., & Ames, A. D. (2016, May). Realizing dynamic and efficient bipedal locomotion on the humanoid robot

- DURUS. In *2016 IEEE International Conference on Robotics and Automation (ICRA)* (pp. 1794-1801). IEEE.
- [5] Leite, I., Martinho, C., & Paiva, A. (2013). Social robots for long-term interaction: a survey. *International Journal of Social Robotics*, 5(2), 291-308.
- [6] Wang, K. Y., Chen, C. S., Chen, H. M., & Chen, I. T. (2020). A Pilot Study of an Innovative Model of Care Delivery: Service Robot for Older People with Dementia in a Rural Community. *Innovation in Aging*, 4(Supplement_1), 927-928.
- [7] Esterwood, C. and Robert, L. P. (2020). Personality in Healthcare Human Robot Interaction (H-HRI): A Literature Review and Brief Critique. In Proceedings of the 8th International Conference on Human-Agent Interaction (HAI '20), November 10–13, 2020, Virtual Event, NSW, Australia.
- [8] Riek, L.D., Mavridis, N., Antali, S., Darmaki, N., Ahmed, Z., Al-Nedyadi, M., & Alketheri, A. Ibn Sina Steps Out: Exploring Arabic Attitudes Towards Humanoid Robots. In *Proceedings Second International Symposium on New Frontiers in Human-Robot Interaction*, K. Dautenhahn, J. Saunders (Eds.). Leicester, U.K., 2010, 88-94.
- [9] Burton, A., Chiou, E.K., & Gutzwiller, R.S. (2020). A Brief Literature Review on Human Perceptions of Service Robots with a Focus on Healthcare. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 64(1), 117-121.
- [10] Mavridis, N., Katsaiti, M., Naef, S., Falasai, A., Nuaimi, A., Araifi, H., & Kitbi, A. (2012). Opinions and Attitudes Towards Humanoid Robots in the Middle East. *AL and Society*, 27(4), 517-534.
- [11] Naneva, S., Gou, M.S., Webb, T.L., Prescott, T.J. (2020). A Systematic Review of Attitudes, Anxiety, Acceptance and Trust Towards Social Robots. *International Journal of Social Robots*, 12(2), 1-23.
- [12] Stuck, R.E. & Rogers, W.A. (2018). Older Adults' Perceptions of Supporting Factors of Trust in a Robot Care Provider. *Journal of Robotics*, 1-11.
- [13] Olaronke, I., Oluwaseun O & Rhoda I. (2017). State of the Art: A Study of Human-Robot Interaction in Healthcare. *International Journal of Information Engineering and Electronic Business*, 3(3), 43-55.
- [14] Graaf, M.M. & Allouch, S.B. (2013). Exploring Influencing Variables for the Acceptance of Social Robots. *Robotics and Autonomous Systems*, 61(12), 1476-1478.
- [15] Kuo, I.H., Rabindran, J.M., Broadbent, E., Lee, Y.I., Kerse, N., Stafford, R.M., & MacDonald, B.A. (2009). Age and Gender Factors in User Acceptance of Healthcare Robots. In *2009 IEEE International Symposium on Robot and Human Interactive Communication* (pp. 214-219). IEEE.
- [16] Kuchenbrandt, D., Haring, M., Eichberg, J, & Eyssel, F. (2012). Keep an Eye on the Task! How Gender Typicality of Tasks Influence Human-Robot Interactions. *International Journal of Social Robotics*, 6, 417-427.
- [17] Hwang, G., Tao, Y., Lee, L., Lan, P., Hong, Y., Hsu, S., & S., C. (2021). Analysis of Technology Acceptance and Flow Experience of Using Companion Robots Among Older Adults in Care Center Environmental Engineering. *Journal of Innovative Technology*, 3(1), 7-14.
- [18] Alharbi, O. & Arif, A.S. (2018). The Perception of Humanoid Robots for Domestic Use in Saudi Arabia. In *2018 CHI Workshop on Exploring Participatory Design Methods to Engage with Arab Communities* (pp. 1-6). CHI.
- [19] Wu, Y. Wrobel, J., Cornuet, M., Kerheve, H., Damnee, S., & Rigaud, A. (2014). Acceptance of an Assistive Robot in Older Adults: A Mixed-Method Study of Human-Robot Interaction Over a 1-Month Period in the Living Lab Setting. *Clinical Interventions in Aging*, 9, 1-11.
- [20] Chu, L., Chen, H.W., Cheng, P., Ho, P., Weng, I., Yang, P. (2019). Identifying Features that Enhance Older Adults' Acceptance of Robots: A Mixed Methods Study. *Gerontology*, 65(4), 441-450.
- [21] Emirates News Agency (2017). UAE PM launches National Strategy for Empowering People with Disabilities. Retrieved on May 10, 2021 from: <http://wam.ae/en/details/1395302609235>