A Social IoT Hybrid Scenario to Promote the Physical, Psychological, and Social Well-Being of Elderly

Imran khan[1(✉)] and Lidia Oliveira[2]

[1] Wenzhou-Kean University, Wenzhou, China
imkhan@kean.edu
[2] University of Aveiro, Aveiro, Portugal
lidia@ua.pt

Abstract. The investigation aimed at an IoT-based social hybrid scenario model for the promotion of psychological and physical well-being amongst older adults. Owing to the ever-increasing elderly population, elderly adults face certain psychological, physical, and social well-being challenges that may lead to mental problems and frailty. Through this research, we seek to create a model that enables caregivers, doctors, and family members to monitor elderly adults' physical data remotely. Additionally, the model enables environmental influence control to promote intentional communication such as online text, audio, video interactions and picture sharing. Furthermore, the model facilitates outdoor activities in the company of peers and friends. The model aims to involve an extensive array of parties that can contribute towards its development and validation, including government bodies, healthcare service providers, primary and secondary care providers, and pharmaceutical companies. This study results indicate that this model results in a paradigm shift in the healthcare delivery system for elderly adults and serves as a deducible step towards enhancing the quality of their lives by developing well-being and removing social isolation.

Keywords: Older adults · IOT · elderly Well-being · elderly isolation · social model

1 Introduction

The modern society's population is ageing. Gradually, ageing is becoming a complicated situation for developed nations to ignore the rapid growth of older adults and the decrease in birth rates in societies. The rapid growth of older adults indicated that Older adult numbers are competing with youngster numbers. If the situation remains; soon, Older adult numbers will be more than young people in developed countries. More Older adults in society means reducing the workforce, and a huge number of older adults will be a burden on the state economy because, in developed countries, after retirement, the state takes the responsibility for taking care of older adults' healthcare and economic issues.

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According to a United Nations report in 2017, a huge number of older adults' population will increase by 2050. There is another report that reveals UN databases (United Nations 2017) predicted that older adults would double between 2017 to 2050. Thus, the growth of older adults in society causes many healthcare and social challenges, and it is impossible to deal with all these challenges at the same time. Therefore, the Older adult population has many social, psychological and physical problems (Partridge et al. 2018). There are several reasons behind physical and psychological health issues such as social isolation, reduction of social contacts, less interaction with the public, and fewer outdoor physical activities, likewise, these severe reasons can cause a high level of depression and amount of sudden death (Storrs 2016). Although the Older adult population needed health care facilities on an emergency basis. However, there are many countries' governments, the private sector, and institutes that neglect Older adults' physical and psychological health issues and there is no determined effort visible that highlights and resolves Older adults' issues (Partridge et al. 2018).

In Older adult health care regards, information, and communication technology (ICT) replaces the traditional healthcare system and offers innovative healthcare systems based on the Internet. ICT is improving human life quality. Therefore, many novel concepts are emerging into our daily lives, as is the case with the idea of the "Internet of things" (IoT). In a smart world, IoT is an innovative and growing concept, in which digital things relate to computers, mobiles, actuators, vehicles and everyday objects (Tamrakar et al. 2022). The IoT is a concept that represents a mixture of different networks, where physical objects and sensors can connect through electronic devices, and software applications, that allow the physical objects to gather data from various destinations, such as browsing websites and sending email, and multimedia content. Due to the importance of IoT applications in many developed countries, such as the United States of America, Japan, and Europe, IoT is a field of novelty and development, both at the academic and commercial levels. Therefore, numerous universities and industries are researching IoT technologies (Da 2022).

The IoT is a unique and suitable concept to design an environment in which it is possible to promote the social and physical well-being of older adults as this study proposed a social hybrid scenario model that will help to improve older adults' life quality. After considering extensive aspects of IoT technologies, this study will propose a design of a social hybrid scenario model, to be validated. The model of the social hybrid scenario will provide two types of communication services, namely passive communication, and intentional communication.

Intentional communication includes social interaction, participation and sharing of ideas, namely through social media, and outdoor activities. At the beginning of Internet services, interactive media (social media) communications were minimal, because users had only email or message services, allowing them to communicate with a limited number of people. However, over time, people integrated social media into their lives for different purposes, such as education, communication, knowledge exchange and the development of opinions about an issue (Boyd and Ellison 2013). Due to secure access to the latest technologies, isolated communities, such as the Older adult population, are becoming active members of the digital world, through smartphones, laptops, and

computers (Sixsmith et al. 2022). The latest smart devices are equipped with multimedia content that persuades the Older adult population to use these devices in a different context. According to Na-Songkhla (2011), "The interactive media is a so-called white road", in which we can design anything that interacts with people according to their desires. Many modern societies (Europe, the USA, & Australia) are using interactive content (social media) for interaction, entertainment, education, and cultural sharing. Therefore, there are many people using dozens of interactive media devices, such as a computer, smartphones, and televisions. These smart devices are disseminating interactive media content via new innovative technologies such as the internet. Innovative technologies are providing a different platform for social interaction, participation, and discussion. Likewise, the isolated Older adult population can minimize their physical isolation and loneliness by using these platforms (Facebook, Instagram, and Twitter) and interacting with other people (Kim and Jasmine 2020).

The IoT can make devices and objects smart with the help of different application domains that help to improve passive communication in the context of healthcare and medical services. Due to IoT technologies, it is possible to design modern healthcare and social environments that will make it possible to provide intentional and passive communication scenarios (Punj and Kumar 2018). Passive communication is important for health care personnel and doctors because they can receive physical data of the patient and real-time monitoring, such as information about heartbeats, level of oxygen in the blood, body temperature, heart pulse or how many steps patients walk per minute, hours, or a day. Moreover, through these IoT devices, relatives, friends or loved ones, can also get information about older adults, such as information about geographical positioning and daily activities.

This study will design and validate a social IoT hybrid scenario model, intended to promote the physical, psychological, and social well-being of older adults. The prototype will support both intentional and passive communication: functionalities for intentional communication will help the older adult to communicate with relatives or other community people for social interaction, participation, discussion, and outdoor activities; features for passive communication will take care of the patient's physical health condition. We believe that the study findings will help to promote the psychological, physical, and social well-being of older adults.

2 Research Method

In the present study, a quantitative approach has been adopted to collect data and analyze and interpret the perception of older adults on their social and psychological well-being. in this sense, a questionnaire has been developed and used for the online survey. it is possible to verify the flow of construction of questionnaires by online surveys based on general and specific objectives which are defined for the investigation. The flow of questions was adjusted to discourses found and adapted up to the responses of participants in this sense that it is possible to select the right option from the questionnaire and provide as much information as possible. With regards to collecting the data, a completely online data collection was planned. Therefore, the data collection and online survey were carried out between March 4th to March 29th of 2022. For the online survey, the first email was

sent to senior Universities on 7th March 2022 and a reminder email was sent on 21st March 2022 to get more participants, as many as the study can. The reminder email worked perfectly, and the study got more participants which enhances its authenticity level. The study defines the following phases to execute the model validation methodology.

2.1 Target Population

Commonly, the target population in qualitative research is key when the research population is significant. The study portrays the research objectives, assumptions, and backgrounds that can dictate the selected community's material and concentration in the qualitative research (Asiamah et al. 2017). The study's target population will be individuals, and older adults aged more than 50 years. In general, people who are retired from their jobs have physical, psychological, and social issues. Gradually, their social circle becomes smaller and smaller, impacting their psychological immune system and making them fragile within the community. Due to this reason, this study selected more than 50 years old or more as the target population**.**

2.2 Sample

Thus, to define the sample of the proposed study, procedures related to the demographic composition of 411 senior Portuguese Universities were considered. These 398 universities are in eighteen different districts of mainland Portugal. The remaining 13 senior universities are situated on two different Portuguese islands, namely Azores and Madeira. A total of 179 participants have participated in the sample, 64.2% or 115, are female and 35.8% are 64 males. Regarding the age group who participated in the sample, 11.7% are aged between 55–59 years, 14.5% are aged between 60–64 years, 22.3% are aged between 65–69 years, 30.7% are 70–74 years, 16.8% are aged between 75–79 years, 3.4% are 80–84 years and 0.6% (one participant only) is aged between 85–89 years. Regarding the education level of participants in the sample, 19.0% have 1st cycle of basic education (4th class), 2.2% have 2nd cycle of basic education (6th year), 10.1% have a 3rd cycle of basic education (9th year), 22.3% have finished secondary education (12th year), 36. % have graduated with a bachelor's degree, 6.7% have a master's degree, and 2.8% have a doctorate.

2.3 Study Instruments

Defensible inferences to be made based on the data, and research tools used (such as questionnaires, interview schedules and observation schedules) must be internally valid and reliable (Gray 2013). An instrument's validity must be designed in a unique way to simplify the analysis of sample data. The primary tool used to collect data from older adults; is the IoT social hybrid scenario validation questionnaire. The study designed a questionnaire that contained 45 questions and five major parts. The first part of the questionnaire has 7 questions that require a declaration of informed consent, age, education, employment, household, and a list of smart devices that an older adult is using. The second part questionnaire has 14 questions designed to model social interaction

with family and friends. The third part of the questionnaire has 11 questions about the medical follow-up of the model. The fourth part contains 8 questions 'Your opinion about the system's advantages and disadvantages about model design. The fifth part of the questionnaire has 12 questions about 'Your predisposition to use or not use a system of this nature model. The questionnaire was validated by three senior researchers from the University of Aveiro and five respondents from different parts of Portugal. This process led to the reformulation of some aspects, namely: changing the nomenclature of a level of the scale (from 'No opinion formed' to 'Neither agree nor disagree,' to be more in line with the lexicon of the remaining items).

2.4 Survey Procedure

The presented study gets data through the survey, that participants answered online. To facilitate the understanding of the model, the participants were invited to watch an animated video before starting the answer (https://youtu.be/kLuvZJP-uck.) and prototype Figma App to report their feedback. The Animation video describes the main functions, characteristics, and scenarios of the proposed model in motion graphics format, but Figma prototype features allow a user to explore the different scenarios and interact with the proposed design. Figma prototypes are a fabulous way to preview interaction and user flows. Through, the Figma prototype people can understand, what the proposed model application looks like for example what colour, font size, and icon and what Figma application gives a response if they click on different icons and buttons. The Figma prototype also lets them know how they can interact with family and doctors and what kind of physical and social activities they can perform through the proposed model. For more information regarding the Figma prototype app please follow the link https://www.figma.com/proto/gcoX09Xuqn4AQKFrX5PwVe/Prototyping-in-Figma?node-id=0%3A2&scaling=scale-down&page-id=0%3A1&starting-point-node-id=0%3A2&show-proto-sidebar=1.

3 The Social Hybrid Scenario Model

The model's sketch contains these passive and intentional layers (Fig. 1 A layer passive, and B layer intentional) that depict the social hybrid scenario's primary character and how combining passive and intentional layers offers an environment where older adults spend their healthy autonomous lives. If you look at Fig. 1, two layers are mentioned. On the left side is a layer, which represents the passive layer. The passive layers can predict, notify, suggest, make appointments, memories sharing, and live and real-time health data for its management and allow the patients to call their doctors and family members. The B side of the model offers an intentional communication service in which older adults can make invitations: invite people to outdoor and indoor activities, make audio/video calls, show: multimedia comments, participate in city tours, hiking, and cultural activities: watch movies with friends and family members, play: outdoor and indoor games and log on to online classes and workshops. However, the systems offer health care and social communications platforms; systems must use Wi-Fi internet, cellular data internet, or IoT cloud service. Unlike family members and medical doctors, they

need to install the system on their mobile phones and monitor older adults' physical data. The system provides live data on older adults' physical health, in which doctors can analyze the older adults' physical data and suggest how to improve their physical well-being. Likewise, the older adults' family members will take care of older adults' daily activities, such as how many steps They walk per day and their geolocation, but in a critical situation, they will also receive the notification in the same manner and while doctors receive it in cases such as heart attack and fall detection.

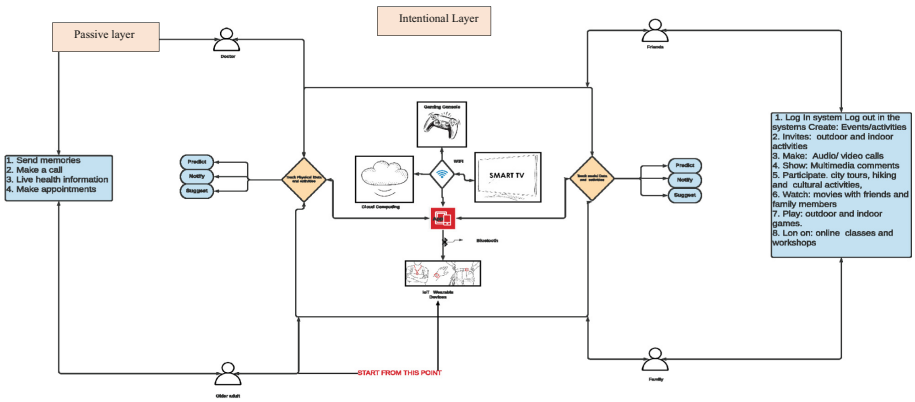

Fig. 1. Diagram of Social Hybrid Scenario model

4 Results

In the sample, 11,7% have 55–59 years, 14,5% have 60–64 years, 22,3% have 65–69 years, 30,7% have 70–74 years, 16,8% have 75–79 years, 3,4% have 80–84 years and 0,6% (one element) has 85–89 years (Fig. 2).

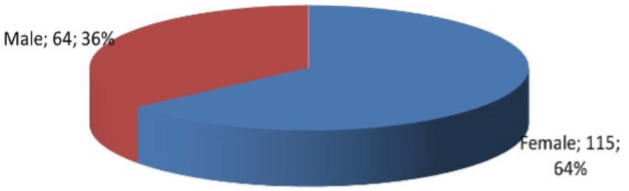

Fig. 2. Frequencies: Gender

4.1 Part 1. Social Interaction with Family and Friends

The agreement is high for all statements, higher for "8. I like the idea of using a system that allows me to contact, by various means (voice, video, messages…), my family and

friends" (91,3%), followed by "11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon)." (85,0%), then by "12. I like to create shared agendas to combine social activities (dinners, outings…) with my friends and family." (76,7%), followed by "10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance…), connecting the camera of my device (mobile phone, tablet, computer…)" (69,8%), then by "9. I agree with the connection of my social networks (Facebook…) to the system." (62,7%), and lower for "13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home." (51,2%) (Fig. 3).

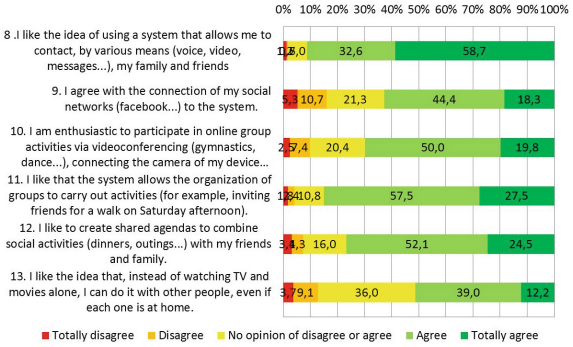

Fig. 3. Frequencies: Part 1. Social interaction with family and friends (without missing answers)

In the sample, the mean for the agreement is higher for "8. I like the idea of using a system that allows me to contact, by various means (voice, video, messages…), my family and friends" (M = 4,47), followed by "11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon)." (M = 4,07) and "12. I like to create shared agendas to combine social activities (dinners, outings…) with my friends and family." (M = 3,91), then by "10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance…), connecting the camera of my device (mobile phone, tablet, computer…)" (M = 3,77) and "9. I agree with the connection of my social networks (Facebook…) to the system." (M = 3,60), and finally by "13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home." (M = 3,47), all items with mean value higher than the scale middle-point.

4.2 Part 2. Medical Follow-Up

The agreement is very high for all statements, in the following order, "17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.)." (90,7%), "23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends." (88,8%), "20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments." (87,5%), "18. I appreciate the idea of

using an alarm system bracelet for emergency situations (falls, sudden illness, etc.).” (86,4%), “22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.)” (85,3%), “24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly.” (85,1%), “15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.)” (84,5%), “21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call).” (83,7%), “16. Knowing that my doctor receives a report with data regarding my health is reassuring.” (83,1%) and “19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television…) that encourages me to do physical activity.” (72,1%) (Fig. 4).

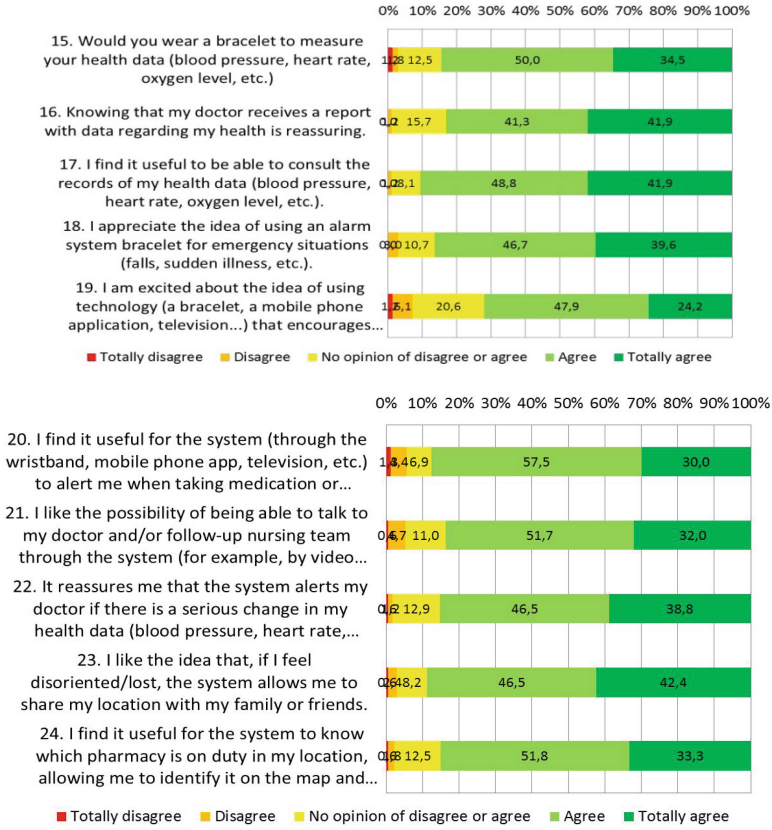

Fig. 4. Frequencies chart: Part 2. Medical follow-up (without missing answer)

4.3 Part 3. Your Opinion About the System’s Advantages and Disadvantages

The agreement is very high for all statements, in the following order, “27. I am reassured by the fact that the system securely restricts access to my personal data.” (88,6%), “30.

I consider it essential to be able to disable some system features whenever you want." (88,1%), "28. It reassures me to be able to customize privacy levels, defining who can see my data and shares." (86,5%), "29. I like to be able to define how each friend and family member can communicate with me through the system." (86,1%), "31. I am concerned that other people may unduly gain access to my personal data recorded in the system." (84,7%), and then "26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.)." (71,8%), and "32. I am concerned that the system constantly monitors my social interactions and health data." (71,0%) (Fig. 5).

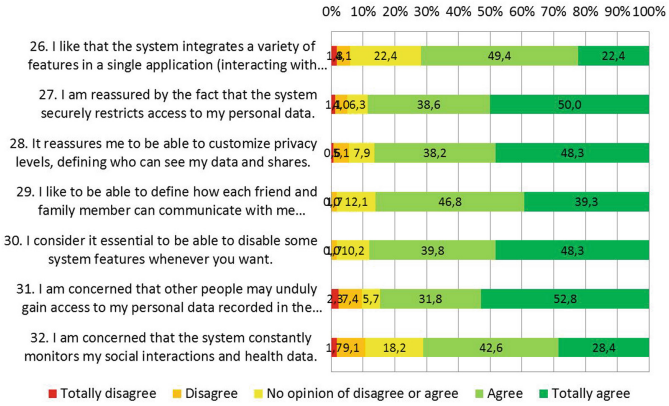

Fig. 5. Part 3. Your opinion about the system's advantages and disadvantages (without missing answer)

4.4 Part 4. Your Predisposition to use or not use a System of this Nature

The agreement is relatively high for some statements, in the following order, "34. I would use the system because it would help improve my physical well-being." (79,6%), "40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system." (78,9%), "35. I would use the system because it would help improve my psychological well-being." (77,0%), "36. I would use the system because it would help improve my social well-being." (71,9%), "38. I would use the system to have a more assiduous and direct interaction with my family and friends." (68,3%) and "43. Being able to participate in activity groups (dance, gymnastics, cooking…) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system." (56,3%), but lower for other statements, in the following order, "39. I give privilege to face-to-face contacts and, therefore, I would not use the system." (44,0%), "41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system." (42,0%), "42. I already use other platforms to ensure social contacts with friends and family and I'm not willing to change, so I wouldn't use the system." (37,6%), "37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I

would not use the system." (33,9%) and "44. I'm not a skilled user of technology, so I wouldn't use the system." (28,3%) (Fig. 6).

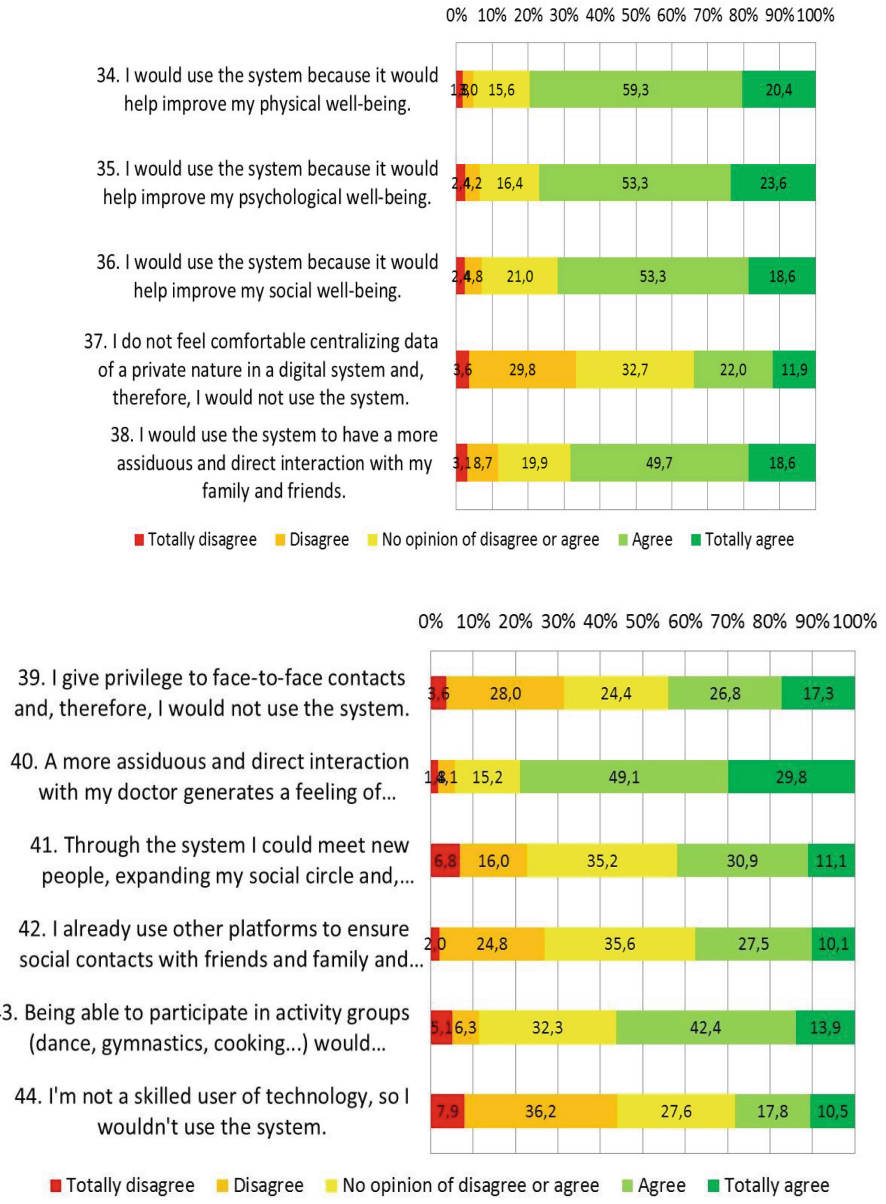

Fig. 6. Part 4. Your predisposition to use or not use a system of this nature (without missing Answer)

5 Discussion and Conclusion

The results discuss the benefit of a social hybrid model for older adults, particularly in improving their social and physical interactions and preventing psychological problems. The model provides a communication platform for older adults to connect with family members, friends, and doctors, and encourages participation in outdoor physical or social activities. The stakeholders agree that older adults have limited opportunities for social or physical activities, and there is a gap between existing knowledge and older adults' well-being.

Another discrepancy in the perspectives and needs of older adults in terms of communication, particularly passive and social communication. The social hybrid scenario model is proposed to provide a social environment that prevents social isolation and psychological health issues. The model encourages the use of digital media and face-to-face or online contact to enhance social participation with friends and family. The involvement of all stakeholders, including family members, friends, medical doctors, and older adults, is important for fostering literacy on older adults' well-being and ensuring that passive and social communication activities are without any hurdles and distance problems. The use of popular communication platforms is recognized as pertinent in the context of social and psychological well-being (Nieman and Wentz 2019).

The study offered a social hybrid model that provides opportunities for older adults to engage in social and physical activities through various means such as text messages, audio or video calls, and online gym or dance classes. Physical activity is important for maintaining physical and mental health, especially among older adults (Lee et al. 2022). The model also allows older adults to invite their friends and participate in outdoor activities such as walks or cultural, political, and religious events. Overall, the study shows that older adults enjoy participating in both online and outdoor activities for social and physical engagement.

The model also includes an online health monitoring service that allows for the management of physical health data and quick response times. The study results reveal that older adults want a system in which medical practitioners can monitor their physical health data and communicate with them. The model also includes an online medical appointment and consultation feature that reduces time consumption and is cost-effective. The study design provides an opportunity for older adults to make strong connections with their peers, friends, and doctors through passive and intentional communication for the sake of their well-being development. The scientific community points out that the model's characteristics must be addressed to validate its impact level on different individuals (Strutt et al. 2022).

Regarding he functionality of a model that has three different logs for different types of users (older adults, family friends, and doctors). The model includes features such as proximity, dynamizing and disseminating events, social and passive communication, privacy control options, alerts, and notifications, fall detection, real-time geolocation monitoring, and multiple passive and intentional scenarios to promote the physical and psychological well-being of older adults. The model aims to increase the participation and interaction of older adults and improve their well-being level.

A study was conducted to understand the characteristics of a proposed social hybrid model for the well-being development of older adults. The data was collected through

an online survey from senior universities located in Portugal. The study proposes three major changes in the initial proposed model, which include increasing font size, adding a location-sharing tool, and providing a privacy control tool for older adults to restrict access to their medical or social data without permission. These changes were made based on the feedback received from the survey participants, and the final proposed model aims to remove or decrease the isolation of older adults and increase their physical and social well-being levels (Chadwick et al. 2022).

6 Conclusion

The study discusses the issue of social and physical well-being among the ageing population in Portugal and how the use of IoT-based technology can help to address this issue. The paper presents a social hybrid model based on IoT technology that can improve the physical and psychological well-being of older adults. The model includes features such as remote monitoring, real-time tracking of health conditions, and social interaction. The results of the study show that the model was well-received by older adults and has the potential to improve their social and physical participation and remove social isolation, leading to better well-being levels.

The study investigates the role of IoT technology, passive, and intentional communication in promoting physical, psychological, and social well-being among elderly participants in Portuguese senior universities. The study aims to answer the research question by conducting a literature review, designing, and validating an IoT social hybrid model, and identifying scales to measure the well-being of the elderly.

An IoT social hybrid scenario model that aims to improve the well-being of older adults. The model is based on passive and intentional communication and is designed to identify the physical and psychological health issues of older adults. The model's characteristics are based on the functionalities of IoT-based digital services, and social and healthcare services must be explored in IoT-based services, as well as passive and social communication. The model provides passive and intentional communication opportunities to enhance the physical and physical well-being of older adults. The goal is to provide all the qualities that make up this model with a framework of connection and interconnectedness. The development of a hypothetical IoT social hybrid model gives clues that its characteristics can promote the well-being of older adults and it has the potential for real practical applicability because this model can integrate with new technology via Bluetooth, and it represents the real needs and demands of older adults.

Future research on the scalability and applicability of the social hybrid scenario model approach to promoting well-being. It presents potential applications of the IoT social hybrid model in software engineering development and highlights the importance of developing a physical social hybrid model with working prototype software to promote the well-being of older adults. The film emphasizes the necessity of continuing to develop and validate functionalities of the IoT social hybrid model, as well as robust integration and convergence planning of systems and the dynamics of interaction and communication based on an IoT technology, passive, and intentional communication approach.

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