A1: Domain Research

Domain

The domain that will be explored is “technological advancement for elderly care”. Not only is the general consensus that the amount of aging population has increased much more rapidly that in the past, but from experience and having lived with elderly, technology is not considered to be convenient for the current generation of elderlies. However, there are still potential for technology to greatly enhance health and life expectancy for not just the current generation but future generations to come. This domain research aims to discover the types of technology that have been deployed to see whether there are opportunities for improvement, iterations, or aspects that have been successful in addressing a possible dilemma. The vast majority of current health related technology are huge machines that are not particularly social or mobile, but rather requires the patient to interact with it at a particular venue. The reliance put onto technology by society has drastically increased over the past few decades, and with the rapid motivation for innovation, technological advancement is at its highest peak. Technology can be seen to be much effective and efficient at doing jobs that humans do, which can bring many benefits as well as disadvantages. However, the general consensus is that as long as technology is used responsibly, there will be nothing but benefits, and I believe the healthcare industry has tried to implement several strategies to incorporate technology for more accurate readings of data as well as reducing the timeliness of diagnosing symptoms.

Overview

Overall, there is a consistent concern regarding the rapid aging of the world’s population and whether there is enough attention from healthcare providers and society. All five research papers explored the benefits and dilemmas current technologies can bring to providing elderly care, which has validated the validity of the domain being explored, “technological advancement for elderly care”. Furthermore, it can be seen than each individual research incorporated either social or mobile possibilities for technology, however none were executed such that both social and mobile possibilities were present. This is arguably justified due to the limitations of current technologies for health. Since health requires high precisions and accuracy, most sensors and health instruments tend to consume space or requires the patient to be in a prolonged environment of confinement.

The techniques and methods used throughout the research papers included primary and secondary research. Primary research consisted of interviews and user testing, whilst secondary research consisted of previous experiments conducted within the same domain/problem space. These techniques and methods are fundamental in providing validity to disprove any vagueness within the domain/problem space in order to ensure high quality of data will be obtained for future purposes.

There currently exists a void for social and mobile technologies for elderly care. Infrastructure was seen be an issue due to heavy dependencies on third party social and health entities, whilst elderly behaviours and perception of technologies for elderly care staggered the advancement of technologies into the healthcare industry. Socialising was an aspect elderly people valued the most, however the use of sensors for early detection for disease or accidents limited the mobility of the elderly, which in turn limits socialising.

Research Articles

Li Bing, Wang Minrui and Wang Yao. 2020. The Construction and Dilemma Exploration of District and Social Cross-border Linkage Support System of Chengdu Smart Elderly Care. In *Proceedings of ACM ISBDAI conference (ISBDAI 2020). ACM, Johannesburg, South Africa, 5 pages.*

https://doi.org/10.1145/ 3436286.3436310

**Abstract: Objective:** to provide countermeasures and suggestions for the sustainable development and better and higher-level service of the smart elderly care service model by analyzing the difficulties faced by various social support subjects in the different service stages of the smart health care communities in Chengdu. **Method:** based on the perspective of service chain theory, field interviews and questionnaire surveys are conducted in smart health care demonstration bases in Yulin, Jinyang, and Jinhuaqiao communities of Wuhou district, Chengdu, and relative problems are analyzed. **Result:** in the service supply stage, the Wuhou Civil Affairs is facing financial pressure, and platform operators are facing the dilemma of talent shortage, backward technology, and hindered publicity; in the service delivery stage, there are problems of simplification of service methods, modularization of content, and conflicts between public welfare and profit; in the service utilization stage, there are problems in which the needs of the elderly cannot be effectively met, family income and Internet use and smart elderly care services are conflicted, and there is the phenomenon of focusing on "material" over "spiritual" services. **Conclusion:** the sustainable development of the smart elderly care service model in Wuhou District depends on the service nodes, that is, the roles played by the various social support entities at different service stages. Strengths should be utilized to avoid weaknesses, cooperation should be strengthened, and their advantages should be fully utilized to achieve mutual benefit and win-win results.

**Critique:** In this research article, the Authors explored the construction and dilemmas of District and Social cross-border linkage support system within the Wuhou District, which is in the forefront of smart elderly care in Chengdu. The catalysts for this exploration seemed to have come from data suggesting the number of elderlies is dramatically increasing year by year, and that China has successfully introduced policies to support the development of smart elderly care services in various regions from a strategic level. With that being said, the Authors conducted investigation and in-depth interviews, to provide knowledge and information for future decision-making. The authors decided to use the service chain theory to analyse construction of the social cross-border linkage support system of the smart health care community, as well as the difficulties faced by various social support entities at different service stages. The theory divides the entire service process into three stages, and in the case in Wuhou District, these three stages are divided into: service supply stage, service delivery stage, and service utilization stage. This paper is relevant to my research domain of “technological advancement for elderly care” as it illustrates the difficulties in the implementation of a full-fledged smart health care system, with heavy dependencies on other social and health entities, as well as the uncertainties regarding the notion that “only when the elderly are willing to put a portion of their income into smart elderly care, can a virtuous circle mechanism be established”. Overall, it provides insights that gathering further understanding about elderly behaviours could benefit with the integration of these health care systems, and I believe that wearables form an important foundation in improving the trust of the elderly people with technologies, as starting small rather than large could cut down the concerns of costs and shine light on the effectiveness of technologies when dealing with health issues.

WenlongWu, James M. Keller, Marjorie Skubic,Mihail Popescu, and Kari R. Lane. 2021. Early Detection of Health Changes in the Elderly Using In-Home Multi-Sensor Data Streams. *ACM Trans. Comput. Healthcare* 2, 3, Article 22 (July 2021), 23 pages.

https://doi.org/10.1145/3448671

**Abstract:** The rapid aging of the population worldwide requires increased attention from healthcare providers and the entire society. For the elderly to live independently, many health issues related to old age, such as frailty and risk of falling, need increased attention and monitoring. When monitoring daily routines for older adults, it is desirable to detect the early signs of health changes before serious health events, such as hospitalizations, happen so that timely and adequate preventive care may be provided. By deploying multi-sensor systems in homes of the elderly, we can track trajectories of daily behaviors in a feature space defined using the sensor data. In this article, we investigate a methodology for tracking the evolution of the behavior trajectories over long periods (years) using high-dimensional streaming clustering and provide very early indicators of changes in health. If we assume that habitual behaviors correspond to clusters in feature space and diseases produce a change in behavior, albeit not highly specific, tracking trajectory deviations can provide hints of early illness. Retrospectively, we visualize the streaming clustering results and track how the behavior clusters evolve in feature space with the help of two dimension-reduction algorithms: Principal Component Analysis and t-distributed Stochastic Neighbor Embedding. Moreover, our tracking algorithm in the original high-dimensional feature space generates early health warning alerts if a negative trend is detected in the behavior trajectory. We validated our algorithm on synthetic data and tested it on a pilot dataset of four TigerPlace residents monitored with a collection of motion, bed, and depth sensors over 10 years. We used the TigerPlace electronic health records to understand the residents’ behavior patterns and to evaluate the health warnings generated by our algorithm. The results obtained on the TigerPlace dataset show that most of the warnings produced by our algorithm can be linked to health events documented in the electronic health records, providing strong support for a prospective deployment

of the approach.

**Critique:** The research experiment article explores the capability of in-home sensors to detect early symptoms of health changes among elderly. The experiment uses complex algorithms to sense the changes in behaviours of the resident living in the homes and pre-existing health issues to send warnings. The experiment is social in a way as after detection, the health alert system sends the data to healthcare providers, elderly and their family. However, despite clarifying their design process to deviate from wearable technologies, in-home sensing has its own flaws. As seen from the case analysis conducted, resident I passed out when he was out with his daughter, that at the time of passing out the sensors were unable to detect the resident’s current state. Visitor activity and extended absence were seen as possible outliers in the sensor data, suggesting that the patient must be present at home for the majority of the day, confined within their home without any other human presence. This prompts whether wearables could have helped through immediate response to inform the resident that he may pass out any moment, preparing his daughter to act with further caution. Furthermore, despite being an elderly, most still enjoy socialising with friends and family. Whether or not wearables can replicate the experiment is still uncertain, however as technologies advance so do humans, behaviours and beliefs may change as we adapt to newer technologies.

Philipp Urbauer, Matthias Frohner, Veronika David, and StefanSauermann. 2018. Wearable Activity Trackers Supporting Elderly Living Independently: A Standards based Approach for DataIntegration to Health Information Systems. In *DSAI 2018: 8thInternational Conference on Software Development and Technolo­gies for Enhancing Accessibility and Fighting Info-exclusion, June20–22, 2018, Thessaloniki, Greece.* ACM, New York, NY, USA,8 pages.

<https://doi.org/10.1145/3218585.3218679>

**Abstract:** Preserving independence is of high importance for aging adults. Information Technology based solutions in the con­text of "elderly living independently" and "ambient assisted living" provide support to increase factors like emotional security, physical activity and general well-being. It is ex­pected that wearable activity trackers positively influence these factors. Hence, this work investigated the integration of wearable activity trackers into medical IT systems from the perspective of technical interoperability, as this is a key feature to improve quality and reliability of both the system itself and the health-related data. Based on a previously conducted market analysis, investigating the most prominent wearable activity trackers on their communication interfaces, a medical interoperability standards-based approach for data integration to medical information systems was pro­posed and prototypically implemented to study feasibility. The prototype was successfully validated with interoperability tests against the specification of HL7 FHIR to align with the Personal Connected Health Alliance (PCHA) guidelines. The results showed that the implementation of the interoperability standard HL7 FHIR for this purpose was possible and could be used as an approach to integrate several manufacturer independent wearable activity trackers in a common system to increase flexibility and extensibility. The quality of the data can be increased as it is syntactically and semantically structured according to the HL7 FHIR specification, which may facilitate more reliable approaches for automated fall detection or emergency alarms as a follow-up. However, to fulfil the requirements of semantical interoperability a value-set was defined. Summarizing, without change of thinking and more effort on the manufacturers side to change proprietary communication interfaces (which still is the case to a very high degree) to standardized ones, the advantages based on using interoperability standards can’t be effective.

**Critique:** This research paper delves into how wearable activity trackers could pave the way for future health related care whilst providing elderlies with the option to remain independent. The papers have significant relevance to the domain being explored as the ultimate notion for the implementation of wearables can be seen as positive. Most importantly, the wearable activity trackers to support elderly living independently is currently under rising interest, with huge potential evidently reinforced as the number of wearables nearly doubling in 2021. Furthermore, the paper provides insights on how wearable activity trackers have successfully and positively influenced many aspects of the lives of elderly, including self-awareness, motivation, and overall physical involvement. These modern wearables also include behaviour change techniques in the user interfaces to a high degree, such as goal setting, self-regulation and social support measures. However, due to the novelty of wearables in the health industry, described as very opaque and complex, its connected systems still require preparation in advance to reduce the patient’s involvement, with substantial drawbacks regarding usability, reliability and content supporting effective behaviour change techniques. This research paper has provided new insights regarding wearables and the applicability of them, suggesting that the market is still niche however the public seems to have high interest regarding convenient (mobile) technologies that can maintain ones independence (social).

PALLAVI RAO and ANIRUDHA JOSHI. 2020. Design Opportunities for Supporting Elderly in India in Managing their Health and Fitness Post- COVID-19. In IndiaHCI ’20: Proceedings of the 11th Indian Conference on Human-Computer Interaction (IndiaHCI 2020), November 05–08, 2020, Online, India. ACM, New York, NY, USA, 8 pages.

https://doi.org/10.1145/3429290.3429294

**Abstract:** The percentage of elderly population in India has been increasing in recent years and so have been lifestyle-related conditions such as cardiovascular diseases. In order to live an active and healthy life, it is important for elderly to manage their routine health and fitness activities such as exercising, following nutrition and diet etc. This need has become pressing after the COVID-19 lockdowns. Though there are many technology artefacts designed to motivate and help elderly people live a healthy lifestyle, adoption of such artefacts remains low for this population. In this paper, we present findings from interviews with 15 elderly people related to their needs and preferences about health and fitness, and their attitudes and knowledge about using technology to support these. Our main finding was that though there is an increase in technology usage by the elderly, much of it is restricted to communication and content consumption and not towards managing health and fitness. After the interview, we demonstrated selected applications and devices to the participants in order to understand their perceptions on existing technology in the market in managing their health and fitness. Based on participants’ perceptions towards technology and their needs related to routine health and fitness, we highlight some design opportunities including smart trackers, wearable bands, localized food and recipe app, language-based personalization and setting up “tech clinics” to help elderly to manage their health and fitness.

**Critique:** The research paper is part of an on-going research about adoption and use of technology to support routine health and fitness of elderly population in India post COVID19. Adoption of said technology remains low for the elderly population due to anxiety towards technology and resistance to change which ultimately persuades elderly to avoid mobile applications for new things. Furthermore, an interesting view was that perceived usefulness, self-efficacy and cost were identified as other barriers for adoption. However, the most notable dilemma was that these technologies were not designed and developed based on the needs and preferences of the ageing population, but rather the younger generations. Improvements to make would be to design and develop these technologies to be user friendly for the elderly to shift their attitudes and perceptions of technology as being “for the youngsters”. This paper provides insight towards the domain being explored as participants valued socialising with friends as a strong motivating factor to go out for regular walks, thus, to live a healthy lifestyle. After experiencing months of COVID19 lockdowns, these participants became more interested in using technologies, however, were still sceptical about learning it. Tracker app based on mobile phones were seen to attract their attention much more compared to wearable fitness tracker hardware. Concerningly, the elderlies were hesitant to go for regular check-ups with their doctors due to fears of catching the disease. This shines light on the void that technology could fill, that even if COVID19 was affecting lifestyles, technology can still find a way to provide a social way to keep people connected even through tough times.

Kobkiat Saraubon, Keattisuk Anurugsa and Adichart Kongsakpaibul. [ICSEB '18: Proceedings of the 2018 2nd International Conference on Software and e-Business](https://dl-acm-org.ezproxy.library.uq.edu.au/doi/proceedings/10.1145/3301761), December 2018 Pages 59–63

<https://doi-org.ezproxy.library.uq.edu.au/10.1145/3301761.3301769>

**Abstract:** Population aging is becoming a pressing issue for society. The number of elderly people, those aged 60 years and over, is increasing dramatically in many countries. A great number of elderly people stay alone at home while young people in their family go out to work. This paper presents a smart system designed and developed for elderly care using IoT and mobile technologies. The features of the system include acoustic-based and accelerometer-based fall detection, real-time remote video monitoring on mobile devices, voice commands and heart rate monitoring. The evaluation matrix shows that the accuracy, precision and recall of the accelerometer-based approach were 93.3%, 92.6% and 94.3%, respectively, while the acoustic-based approach achieved 78.6%, 76.9% and 80.6%, respectively.

**Critique:** This research paper is an experiment conducted by using sensors installed in a home unit to detect and transmit data to mobile devices, and wearable devices for pulse detection. However, the installation was not designed to improve the social aspect of elderly care, but to work as a substitute due to young people unable to care for them 24/7. As for young people, this provides them a venue to remotely care for their elderly, as the installation sends warnings to paired devices so that the most immediate action can be taken. The main detection will occur within the home unit, as this is where elderlies can have their own privacy. The wearable device can be worn without any restrictions of where the user is, however, the detection will be weaker compared to being situated within the home unit. Thus, there exist social and mobile aspects of this installation system, however there is still room for improvement when it comes to making it fully mobile. If the home unit can be compressed into something that is mobile, the elderlies would be able to move around more freely knowing that the detection will still work at maximum capacity.

Poster