Aging-in-Place:
The Journey Ahead

Abstract

Increasingly, elderlies are aging-in-place and leading more independent living[1]. This has prompted an exploration of instrumented homes for ambient assisted living care. With the Novel Coronavirus impacting countries worldwide, it now becomes even more critical to have a good aging-in-place technology solution for the well-being of our elderlies.

In line with the Smart Nation initiative in Singapore, TCS and Singapore Management University (SMU) had collaborated to start the initiative on Smart Homes and Intelligent Neighbors to Enable Seniors (SHINESeniors) in 2014[2]. In the SHINESeniors project, the team studied the feasibility of using non-invasive sensors to derive useful insights into the cognitive and physical well-being of elderlies in the community. The data collected threw up useful insights into the daily activities and living habits of elderlies and was channeled back for further review. This, in turn, has been used by voluntary welfare groups for reactive care provisioning. A further analysis of the data enabled the possibility of more pre-emptive caregiving through early detection of social isolation and depression.

In this paper, we discuss the key success factors from the project and share insights regarding the next evolution of such solutions, and the potential value of this envisioned technology service on elderly care.

Key Success Factors

It is of critical importance to involve stakeholders from the entire spectrum of aged care in designing and developing the technology and care-giving intervention processes in the solution. Rather than creating just a technology-centric solution, it is important to build an ecosystem around the technology solution to support a more holistic, active aging-in-place network comprising elderlies, caregivers and welfare organizations, healthcare service providers, and technology companies.

Dealing with privacy especially in elderly care aging-in-place services can be difficult and tricky[3]. It is important to ensure consistent communication with stakeholders, especially elderlies and welfare volunteers, to assure them that privacy is fully preserved in the technology deployed with data privacy guidelines.

While the user experience needs to be kept relatively simple and straightforward for each stakeholder, the simplicity is supported by advanced back-end sense-making techniques to extract value from the data collected. The right user experience is determined by user journeys for each stakeholder group using the solution. Offline surveys and interview data also helped to provide useful insights to improve the quality of living for elderlies.

In summary, the three key success factors (see Figure 1) from the SHINESeniors initiative are:

- Build a holistic ecosystem in which individual stakeholders facilitate and complement each other to increase the overall value-add of the technology solution.

- Address privacy concerns by being transparent about solution deployment in terms of data capture and usage.

- Ensure user interface of the technology solution is kept simple for higher user acceptance.
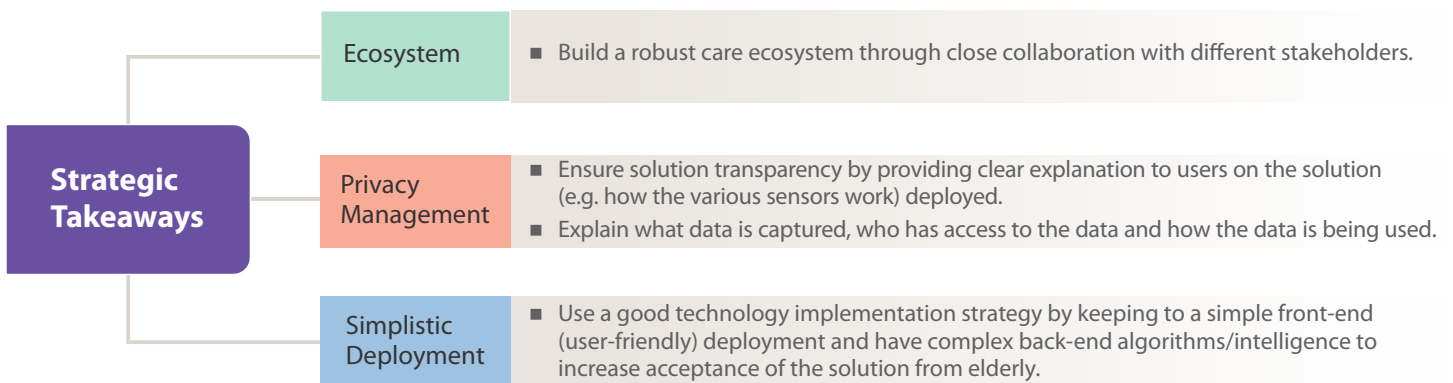

Strategic Takeaways

Ecosystem
- Build a robust care ecosystem through close collaboration with different stakeholders.

Privacy Management
- Ensure solution transparency by providing clear explanation to users on the solution (e.g. how the various sensors work) deployed.
- Explain what data is captured, who has access to the data and how the data is being used.

Simplistic Deployment
- Use a good technology implementation strategy by keeping to a simple front-end (user-friendly) deployment and have complex back-end algorithms/intelligence to increase acceptance of the solution from elderly.

Figure 1. Summary of the Strategic Takeaways

Future Landscape of Elderly Care Aging-in-Place Solution

The Singapore project focused on elderlies living alone (65 years and above), who were less tech-savvy wanted little disturbance to their lives, and sought real, human-touch in care through voluntary caregivers.

Given the varying needs of the elderly seeking assisted living care, even within Singapore, the number of potential new features that can be added to such solutions is infinite. And such a solution need not be simply limited to monitoring activities of daily living using a variety of sensors, but can encompass many more services and domains -- everything which matters to a citizen's life. Essentially, we could refer to it as a Smart City service for Smart Citizens.

Figure 2., as a matter of example, shows a few dimensions in which the needs of the elderly vary in Singapore. The choice of technology and response protocols depend on where a senior citizen fits within this framework.
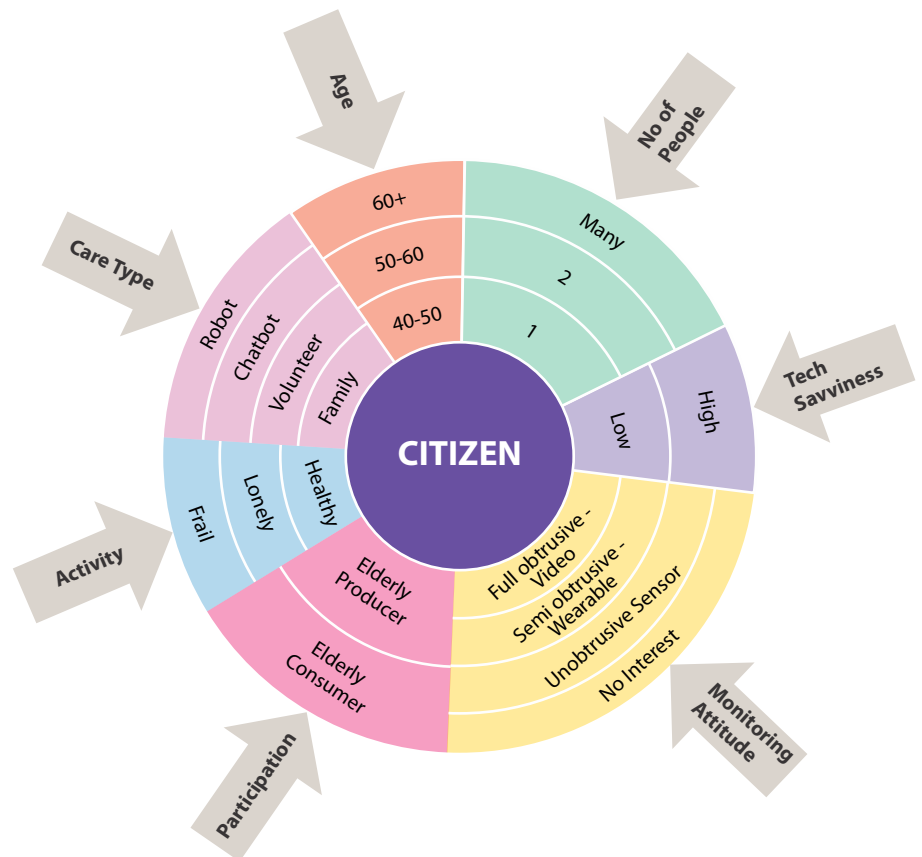

Figure 2. The Elderly Demand Continuum

Let us take a few key examples from the above chart to illustrate how such a solution will expand to adapt to the local cultural context.

Demographics/Age

Although technology does play a major role in an elderly monitoring system, it is also necessary to ensure the creation of a holistic ecosystem by keeping the needs of further segments of elderlies in mind. This includes "younger" elderlies or seniors who are over 50 years of age and more tech savvy (more comfortable with mobile phones and wearables). It is important to anticipate these seniors' potential usage to value-add to such a technology solution.

In order to keep the implementation simple for seniors, it is important to tap into their daily habits and lifestyle. In recent years, smartphone and smartwatch apps have gained popularity. We have seen many instances of such apps providing health information like heart rate, calorie count, medication reminders, and importantly, fall detection alerts that can enable families/caregivers to render the right support in assisted living for the elderly.

While we recognize that technologies can aid elderlies to age in an independent manner, it is crucial for technology companies to listen to elderlies when designing new technologies. This is because elderlies face steep barriers when it comes to adopting new technologies due to age, plus cognitive challenges such as reading font size and color. Having a good understanding will help speed up elderlies' adoption of these technologies.

Younger elderlies will also want additional services/experience beyond wellness.

Citizen Participation

In the SHINESeniors project, there is a clear differentiation between creators and consumers (elderlies, caregivers, welfare officers, etc.) of the technology solution. As more tech-savvy seniors age, moving forward, it is crucial for us to reach out and listen more to this group of stakeholders – the seniors – when it comes to designing and introducing technology solutions.

How do we leverage the elderly themselves as "producers"? An example could be to tap into their spirit of volunteerism, whereby neighbors and interested seniors can become willing parties in ecosystem, playing the role of "carers". They can be first responders to seniors in their building when an alarm is triggered, and they can notify the community caregivers of the actions taken.

To encourage and capture this spirit of volunteerism, we envisage a system where seniors can commit their time and

skills to fellow seniors, which in turn updates the elderly monitoring system when an event is being assigned to the elderly carer.

While a solution needs to be fully compliant with privacy protection, we understood that the perception of the way such solution handles privacy is of utmost concern especially to elderlies. To address their privacy concerns, basically, these seniors need a clear communication of how the solution stores and uses the data. For example, Passive Infrared (PIR) sensors are unobtrusive. Yet, in our study, a few seniors were distracted by the lights on the PIR sensor and thought it was a video camera. They used to cover the sensor with a towel, until our team went and explained to them about the unobtrusiveness and privacy.

However, with a successful test bedding of the current technology solution using these relatively "simple" yet effective sensors, we think Singapore as well as other nations / societies that are looking to harness the use of technology to improve aging-in-place, can benefit from the "next wave of technologies" (see Fig.3).
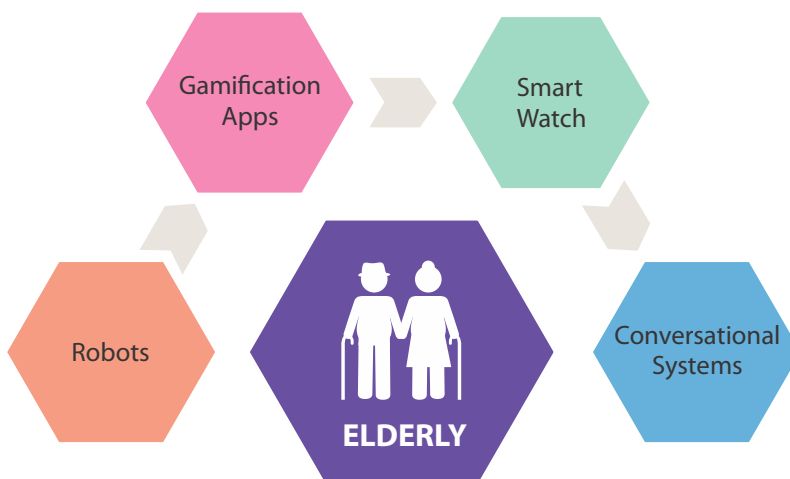

Figure 3. Next Stage of Elderly Care Aging-in-Place Technology Solution

Also, as the key stakeholder in the elderly care aging-in-place ecosystem, elderlies have always been positioned as the "end consumers/users" of the solution. Now, with more "younger" elderlies in the next wave of our solution proposition, can we envision steering the role of elderlies to become the "creators" of simple services instead? Just like young adults learning programming and creating apps, can tech-savvy seniors be encouraged to create simple mobile apps for themselves and their peers? The technology solution providers will provide backbone services and ensure that the basic supporting APIs are

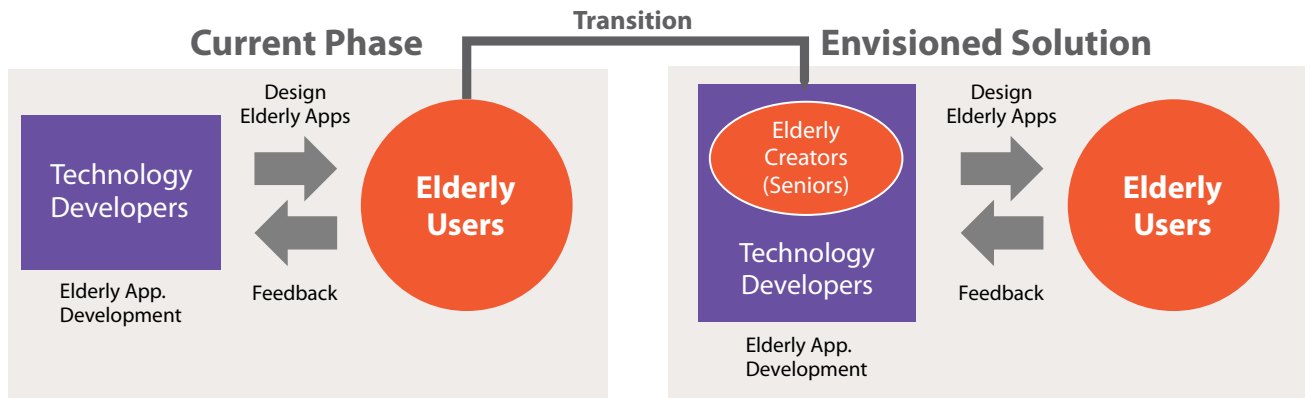available. Figure 4 illustrates this hypothetical "envisioned" elderly care aging-in-place environment.

Figure 4. Transition to Elderly are Aging-in-Place Solution

Carer Type

In the SHINESeniors project, we chose community caregivers to provide a human touch. The use of emergency buttons[2] as social chat requests has indicated that many elderlies living alone still like connecting with caregivers.

With the rise of AI and machine language techniques, one new technology to deploy is robots. Robots are the so-called "future" of elder care services that can perform roles like that of caregivers[4]. When applied in an appropriate manner such as taking on the role as a conversational system (e.g., initiating conversations with seniors), robots can help in preventing emotional detachment and social isolation.

Having robots in an "always-listening" mode implies that it is possible to detect an alarming decibel that occurs when say an elderly scream (as a result of a fall), and this can in turn trigger an emergency connection back to the caregivers and/or hospitals. On the other hand, privacy concerns arising from the "always-listening" mode implies the importance of allowing seniors to opt-in/out of these additional features by robotic systems. Privacy protection must also be built into the robotic systems to carefully address privacy concerns. Robots can also be used to assist seniors with lower mobility (e.g., usage of wheelchairs/walking sticks) to move about.

However, in Singapore, for smaller households such as elderlies living in 1-bedder apartments, further exploration is needed to determine whether it is more effective and feasible to have in-home robots or to deploy them to augment caregivers at senior activity centers.

Tech Savviness

From the SHINESeniors project, we also realized that some elderlies do not use mobile apps at all; they tend to be less savvy in using their simple phones. However, for seniors who are younger, it may be common to own advanced/simple mobile phones, recognizing the need for simple and straight forward user experience, we want to suggest taking a step further to incorporate some "fun" element into the design of the overall elderly care aging-in-place solution.

Research has shown that arousing positive feelings when using a technology can help to increase the "stickiness" of the users to the solution. Hence, for our next step, we think the concept of gamification will help in engaging with seniors better. Also, the gamification can serve as interventions to help seniors improve their mental well-being.

Going further, potentially, gamification apps can record a senior's behavioral responses during the games and evaluate his/her progress in terms of metrics over a duration of time. Doing in-depth analysis of these data may facilitate the assessment of seniors' health conditions (e.g. mild cognitive impairment, frailty and depressive emotions) in a discrete manner, and provide timely alerts to the seniors and/or their family and caregivers.

Conclusion

As highlighted here, there are a variety of approaches possible based on the Elderly Needs Continuum.

Elderly care aging-in-place solutions provide much value-add to elderlies, helping them to embark on an active and independent aging journey. Through effective application of AI techniques, the solution can proactively identify many early warning conditions such as social isolation and nocturnal patterns in elderlies. Other features such as conversational systems may enable these elderlies to stay connected, thereby ensuring that they are kept cognitively stimulated.

In summary, it is critical to offer intelligent, unobtrusive and ubiquitous support in elderlies' daily living so as to enable them to stay active longer, remain socially connected, and to live independently and confidently in their old age. It is important to explore ways in which the needs of the elderly can be better understood, and to design the appropriate technology interventions to meet these needs.

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