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Personal Health Promotion Interventions Using Telephone and Web-based Technologies:

Smarter Safer Homes Platform

CSIRO Submission to the Qld Parliamentary Committee

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Executive Summary

CSIRO undertakes research in many areas of health to measure the effectiveness of various interventions to improve health outcomes through the use of technology.

The Australian e-Health Research Centre (AEHRC), an unincorporated joint venture between CSIRO and Queensland Health. One of the focus of the AEHRC is to research and develop innovation to improve aged care needs to address the aging population and its impact on health services, using mobile phone and web technologies. AEHRC has developed an innovative Smarter Safer Homes platform to support the independent home care needs and is undertaking a Queensland based pilot to allow aged Australians to remain safely and longer in their own homes.

The SSH platform is a system of home monitors that allows passive measurement of the Activities of Daily Living (ADL). The system also allows for capture of vital signs. These data give an ongoing view of the individual's health, and their ability to live in their home with community and family support. The SSH platform has been piloted for technology evaluation of its functionality. It is currently undergoing evaluation of its application in residential homes to identify service delivery models that can be enhanced through innovative approaches through ICT.

1 Overview

As per the global trend of the aging population of 60 years and over has increased from 9.2 in 1990 to 11.7 in 2013[1]. This is expected to double by 2050. In Australia, while the population aged 15-64 years (working-age) remained fairly stable, the people over 65 years increased from 11.8% to 14.7%[2]. Similar to the national trend, Queensland's ageing population over 65 years increased from 11.0% to 13.6% in the same period, while the work-age population remained stable[3]. This change in ageing demography is attributed to reduced fertility and increasing life expectancy and the increased proportion of baby boomers (1946-1965) in this older age category.

This trend raises the alarm of increasing prevalence of chronic disease with ageing and increased need of support, particularly to maintain their independence. This is increasingly becoming an issue when family and relatives in the working age more and more have to live remotely due to their jobs. Furthermore, as health and age care workforce are diminishing, it is expected that 1 in 20 people need to be an aged care worker to support the ageing population over 75 years. This is compounded by the additional problem of the lack of residential care being 113 placements for every resident over 75 years.

To address this global tsunami of the aging population and its impact on both the health services, AEHRC has developed an innovative Smarter Safer Homes (SSH) platform using recent advances in information communication lifestyle technologies such as the tablet PC, Internet, sensors and health monitoring devices. The objective of the platform is to promote self-management and support the elderly population to live longer and safely in their home. Moreover, the SSH platform also facilitates the access and engagement of family/friends at a distance in their support, and furthermore clinical services.

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[1] United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Ageing 2013. ST/ESA/SER.A/348.

[2] Australian Bureau of statistics. Australian Demographic Statistics, 3101.0, June Quarter 2014.

[3] Population growth highlights and trends, Queensland 2014, Queensland Government Statistician's Office, Queensland Treasury and Trade.

2 Smarter Safer Homes platform:

Initiatives of the Smart home concept have been attempted previously both globally[4] and in Australia[5][6]. Most of these have not only expected the users' interaction to provide information for support but have been concepts that have yet to be realised in real world application. With the recent success in validating an innovative home care delivery for chronic disease management in Queensland[7] and leveraging CSIRO's Sensor Networks Lab capability, AEHRC approached the SSH platform to address some of these users' limitations to the smart home adoption. The novel approach of AEHRC's SSH platform is its capability to capture and derive information from simple sensor-networked homes specific to extracting their activities of functional independence for support rather than expecting from sensors worn or constant burden on the elderly user to interact with the technology. The SSH platform focuses on health promotion and features state of the art monitoring, and takes advantage of the growing internet access and increasing bandwidth.

While designing the innovative platform, AEHRC followed some key principals to ensure ease of uptake and maximise its value to our community:

- Non-intrusive monitoring
  - Respect the individuals home and privacy
    - Inconspicuous wireless monitors
    - No video or audio capture
  - No dependence on devices that must be worn by the individual
- Clinically relevant measures
  - Specific to the individual (not generic)
  - Activities of Daily Living used to determine an individuals ability to live alone
  - Mobility, meal preparation, sleep, social activity, hygiene.
  - Vital signs measured with TGA approved devices
  - The Clinical Web Portal provides a clinician with a detailed view of the participants measures over time
- Promote self management
  - An iPad app is used by the individual to view their ADL scores and vital signs over time
  - Blood pressure monitors, weight scales, etc. are all part of the home system allowing the individual to become involved in their own health measures and management
- Promote family and community support
  - Video conferencing in the iPad increases social interaction with friends and family
  - A secure family portal allows nominated friends and family to see the measures on a web page, designed to mirror the iPad for easy communication with the aged relative.
  - Alerts can be generated to notify family and friends of unusual readings or activities

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[4] Pol, M. C., Poerbodipoero, S., Robben, S., Daams, J., van Hartingsveldt, M., de Vos, R., et al. (2013). Sensor Monitoring to Measure and Support Daily Functioning for Independently Living Older People: A Systematic Review and Road Map for Further Development. Journal of the American Geriatrics Society, 61(12), 2219–2227. doi:10.1111/jgs.12563

[5] IBES. Smart technologies for older people: a systematic literature review of smart technologies that promote health and wellbeing of older people living at home

[6] Smart Tech for Elderly. http://www.smartwiredhouse.com.au/trade/news-article/304

[7] Varnfield M, **Karunanithi M**, Lee C-K, Arnold D, Ding H, Smith C, Walters D. Smartphone-based home care model improved utilisation of cardiac rehabilitation in post-myocardial infarction patients: Results from a randomized controlled trial. HEART 2014 100(22): 1770-9, doi: 10.1136/heartjnl-2014=305783

2.1 Features and Function of the Smarter Safer Homes Platform:

Wireless monitors are placed in a home to measure motion, room temperature, electrical device usage, door opening/closing, humidity, and sleep quality. Each of these devices interacts wirelessly with an internet hub that allows raw monitor information to be securely delivered to CSIRO's SSH servers.

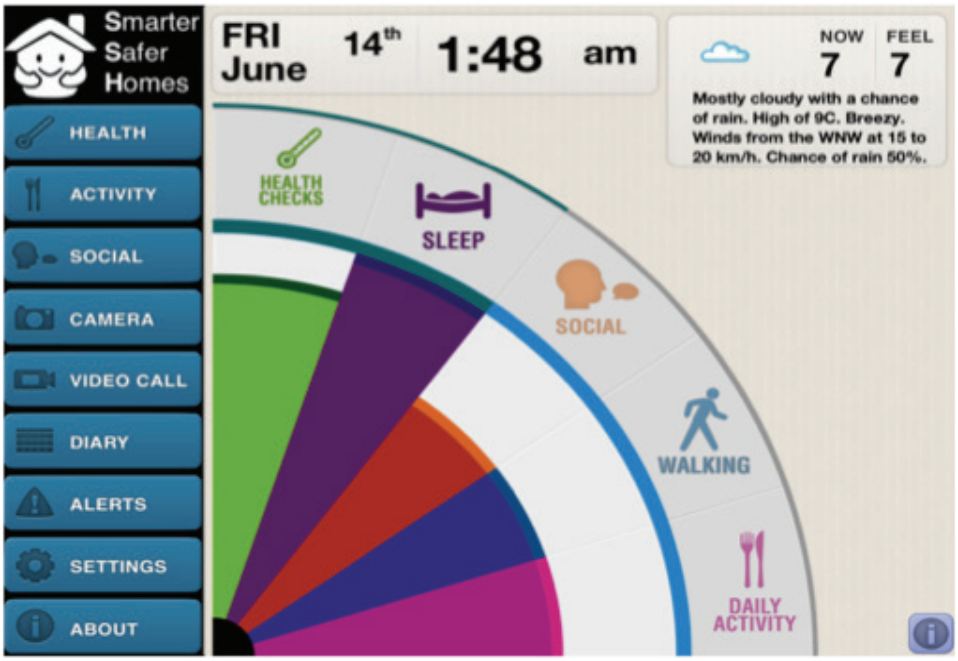
An iPad is used as the Bluetooth hub for the vital signs monitors (body temperature, weight, etc.). The iPad is also home to the SSH app.

Monitor information received in CSIRO SSH Servers is used to calculate the ADLs. Motion sensors can track a person's movement through the home, we can compare this to the individuals typical movements, and calculate a mobility score. Similarly the combination of motion in the kitchen, along with kettle/microwave/fridge usage, can calculate an ADL for meal preparation.

These values are calculated at the end of a day as a score for this individual's typical behaviour.

The iPad app is the focal point for information, social interactivity, and vital sign measurement for the individual.

The front page of the app gives an overview of the wellbeing of the individual at a glance:



The rays show measures for the major categories of the persons well being with a short ray signifying a low ADL score (0-40%), a medium ray for a typical ADL score (40-60%), and a long ray as a high ADL score (60-100%). Alerts are also flagged on this page to let the individual know if there was a high blood pressure reading for example that their carers have been notified of.

Clicking on each ray will reveal the detail of the score, and will allow historical measurements and scores to be viewed.

The buttons on the left also allow access to video calling, keeping a diary of health, and some participants wanted the security of a front door camera accessible from the iPad too.

This data is available in the same format through the Family Portal on the internet. The individual may control the level of detail available to each family member from full to limited to none.

The Clinical Portal allows clinicians to browse over more clinically relevant data for multiple patients at a time. The clinician can set the alert conditions for each patient individually.

3 Collaboration and Cooperation to demonstrate SSH Platform

The identification of the design requirements and care/support needs for the development of the SSH platform has not gone without the cooperation with the relevant community organisations and sectors relevant for the delivery of aged cares and innovation. Furthermore, its application to support service can only be tested with collaboration with organisations that have the expertise in aged care, in particular to enhance the support and care delivery through innovative methods.

At the initial stage of the development, AEHRC collaborated with Autumn Lodge aged care and the University of New England, at Armidale, New South Wales in 2012. The design and development involved a workshop with older residents from independent living homes of Autumn Lodge, to gather their needs of technology, information and simple, easy interface that they were most comfortable with. We used a professional GUI designing company to engage in the workshop to provide the guides and specifications for the user interface development of the tablet PC (iPAD) app (as described in Section 2.1 above).

Following the development of the SSH platform, which featured an iPad app and a corresponding family web portal, a technology pilot evaluation over 12-months was conducted between September 2013 and September 2014 among 8 residents (>70years) in independent living homes connected to NBN, owned by Autumn Lodge, Armidale... Each home was fitted with approximately around 20 passive, battery driven sensors and 3 or 4 medical devices as required. Each participant was given an iPad with the SSH app pre-installed to promote self-management of their own medical and activity records.

The trial results demonstrated that SSH platform not only demonstrated accurate recognition of daily activity patterns and changes/trends of the residents through in-home passive sensors[8], but was able monitor their health status through an objective and personalized Activity of Daily Living scale. Hence, the outcome of these results would assist in the timely interventions from family, carers and/or health professionals[9].

Although the technology evaluation of SSH platform demonstrates functionality and features for potential mechanism for aged care support, there is still a requirement for its evaluation and/or validation in real aged care service related setting. Such evaluation would permit the identification of enhanced services and care support for the aged care staff but importantly it needs to create the business service models that would provide value for the residents and their family.

To do this, AEHRC has collaborated with Global Community Resourcing, Brisbane (expertise in community care innovation), through whom a 12-month pilot trial is currently being conducted with Bromilow Home Care Support Pty. Ltd.in Sunshine Coast, Queensland. The purpose is to identify the key elements and functionalities of the SSH platform to enable home care services and furthermore, to develop the levels of service delivery models for customer offering. The pilot trial has recruited five homes serviced by Bromilow Home Care Support, which have fitted with environmental sensors and health devices similar to that deployed in Armidale.

[8] Activity of Daily Living Assessment through Wireless Sensor Data, Q. Zhang, M. Karunanithi, D. Bradford, Y. Kasteren, EMBC 2014
[9] Objective assessment and scoring of Activities of Daily Living, M. Karunanithi, Q. Zhang, Pending patents

4 Further Research and Development

Since the SSH platform functionality is specifically developed towards independent living, there is still scenarios where partner or family are still within a home setting. Hence, the SSH platform needs further enhancing to separate and support elderly people living in a multi-residential environment. Hence, the pilot at Bromilow and University of Sunshine Coast, we are also exploring two homes which have dual-occupancy to differentiate person in need of care.

Due to the flexibility in the functional design of the SSH platform, it has been also identified as showing potential for application in supporting people with disability. This is also being explored with Bromilow, as their services also include the provision of care support for people with disability in the community.

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