



Smart Home Assisted Living for Elderly: The Needs for Regulations

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Abstract

Assistive technology devices for elderly in smart home aims at providing support and healthcare services in a domestic home to ensure their health condition, safety and security. However, neither definition nor specific legal and administrative policy is in place to govern its establishment. Hence, a comprehensive smart home assisted living legal framework for elderly is required and this paper is intended to discuss the needs for amendments of law in housing development. This paper is a legal doctrinal research whereby analysis is conducted based on the statutory provisions of Malaysia housing statutes, codes, and guideline. The finding shows that, the absence of smart home for elderly components and infrastructure in the Housing Sales and Purchase Agreement will deny residents' right from protection by the housing developer. Therefore, amendment and improvement in law and regulations to include terms of smart home for elderly is needed to ensure its development is in accordance to the law.

Keywords: Smart home assisted living; Elderly; Malaysian housing law.



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1. Introduction

Housing has always been important place to elderly after retirement, as an asset providing final security and a convenient settlements to 'age in place' as well. Malaysian Healthy Ageing Society provided that the percentage of Malaysians aged 60 and above has been steadily increasing over the years and is projected to continue its upward trend (PHB, 2018). As the growing number of elderly population within the range of 60 and above increased from 7.9 percent to 8.8 percent from the year of 2010 to 2014, the number is predicted to increase to 10.6 percent in 2020, 15.3 percent in 2030 and up to 19.8 percent in 2040 (Meikeng, 2017). This is due to the planning for longer life expectancy for men to increase from 72.5 years from 61.6 years and 77.4 years from 65.5 years for women.

The growing number of elder citizen demands extra care and treatment to be provided to them together with the needs to guarantee their welfare and good health living require housing development trend to accommodate and cope with that necessity (Brink, 1990). The government policy to increase people's life expectancy with assistance of technology (Malaysia National Transformation) has initiated the concept of smart assisted living for elderly or known as smart home. Although the definition of smart home covered wide aspect of technology functioned to provide automation for convenience of inhabitants (Robles *et al.*, 2010), managing energy consumption (Ding *et al.*, 2011) and maintaining security and safety of its residents (Chan *et al.*, 2008; Ding *et al.*, 2011; Robles *et al.*, 2010), it is also designed to monitor the health and assist in medication management for the elderly (Lee *et al.*, 2011). As intended to assist elderly, it implies the concept of making life easier and medication services and doctor's consultation be brought home. A remote health monitoring in smart home allows people to remain in their comfortable home environment but still have access to immediate treatment to facilitate their health condition (Dohr *et al.*, 2010).

Having realized the needs to provide assistant and help for elderly, advance technology healthcare is introduced in a domestic home to ensure their health condition, safety and security is observed. Several numbers concept of housing development in Malaysia have introduced homes for elderly such as the Green Leaf Retirement Resort Community in Sepang, Selangor, Ara Greens Residence located in Ara Damansara, Selangor, Green Acres in Ipoh, Perak, Eden-on-the-Park in Kuching, Sarawak and the new project in Johor Bahru known as Forest City (Rachel, 2017). This concept of house aimed to provide care along with activities to keep residents mentally and physically active and healthy as they live among the retirees community. Different concept of house offered different features such as appliances for health checking monitored from central medical hub for the readings of glucose levels,

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electrocardiogram (ECG), oximetry, diabetes and blood pressure. Apart from that, the house is also equipped with disabled-friendly and emergency-ready features intrinsically connected to the worldwide emergency medical assistance system to provide telemedicine in a home ([Health and WellnesAraGreen Residences](#)). Although this concept of home is designed to serve elderly, it is obvious that not all chronic diseases or medical conditions are suitable for home tele care, such as those that require the permanent presence of health-care personnel or life-critical monitoring equipment ([Botsis et al., 2008](#)).

However, providing a smart home assisted living for elderly (SHALE) invites several argument as regard to the protection of the interests of the elderly to enjoy a safe and secured private home. Safety of housing in terms of infrastructure and physical design is essential especially involving systems to be enjoyed by vulnerable people. Systems should be robust and reliable as the person with disabilities will rely on the installed devices which will become internalized within their self-concept ([Dewsbury and Edge, 2001](#)). In addition, as these concept of homes targeted to provide a medication management for elderly, a higher duty of care is placed on the housing developers and service providers to avoid any injury or harm to smart home residents. Therefore, rules and guidelines provided for building smart home assisted living for elderly must be observed and adhered. As this concept of home is still new in Malaysia, it raises the question of: 1) whether SHALE is in accordance with housing planning standard provided by local authority and 2) whether the existing Malaysian housing laws have adequately provide protection to the smart home buyer.

2. Methodology

This paper adopts doctrinal legal research whereby analysis is conducted through investigation of rules and principles of particular legal issues; in this context is referring to the legal status of developing smart home assisted living for elderly according to Malaysian law. Legal research analysis conducted is expecting to suggest probable conclusion for improvement of law.

3. Definition of Smart Home Assisted Living for Elderly

Smart home assisted living for elderly (SHALE) is a domiciliary service supported by technological solutions such as advance sensor technology, wearable medical devices ([Demiris and Hensel, 2008](#)) and wireless communications that provide healthcare and wellness management tools in a home. It is to enable independent living and improvement of quality of life for elderly, to reduce the workload of caregivers and assist daily living activity in home environment as well as to monitor elderly under medication ([Cavallo et al., 2015; Zhang et al., 2008](#)).

Practically, the concept of SHALE embedded with several technology features purposely oriented as 'assistive technology' [Hellman \(2014\)](#). The home is designed to be elderly-friendly, accessible and require special fittings in terms of lighting and furnishing of environments, sensors and network systems to monitor health, trigger response services, to perform domestic tasks and various methods of social communication ([Dohr et al., 2010](#)). Apart from that, it is also equipped with devices that provide compensatory services for cognitive, sensory, and physical disabilities ([Kerssens et al., 2015](#)).

Although there is no standard definition of what is smart home assisted living for elderly and what are the technology devices that should be available in a home, section 2 of the Private Aged Healthcare Facilities and Services Bill 2017 (the Bill) defined the word 'healthcare services' (First Schedule of the Bill) to include:

1. *Services of healthcare professionals and healthcare para-professionals*
2. *Service for the screening, diagnosis, or treatment of persons suffering from, or believed to be suffering from, any disease, injury or disability of mind or body*
3. *Service for curing or alleviating any abnormal condition of the human body by the application of any apparatus, equipment, instrument or device, or any other medical technology*
4. *Service for preventive or promotive health purposes*
5. *Protection, supervision and rehabilitation services*
6. *Accommodation for the purposes of any healthcare services*

These type of services that is provided in premises such as a residential facility, a day care facility, any premises as the Minister may prescribe or any premises incorporating the specifications of residential or a day care facility will be subject to the Bill ([Malaysia, 2017](#)).

In this aspect, although the Bill is intended to regulate the establishing of private centre care for elderly, the Bill has sufficiently put emphasis on the needs of the healthcare service provider and housing developer to observe the facilities offered is in accordance to the law and regulations.

The word 'accommodation' (First Schedule of the Bill) is uncertain whether it will include a home embedded with healthcare technology. However, through the definition of 'housing accommodation' as defined in Section 2 of the Housing Development (Control and Licensing) Act 1966 (HDA 1966), housing accommodation includes any building, tenement or messuage which is wholly or principally constructed, adapted or intended for human habitation or partly for human habitation and partly for business premises and such other type of accommodation as may be prescribed by the Minister ([Malaysia, 1966](#)). Presumably the word accommodation forming part of definition of housing accommodation will be explicitly indicating the applicability of the Bill to regulate matters related to smart home assisted living for elderly.

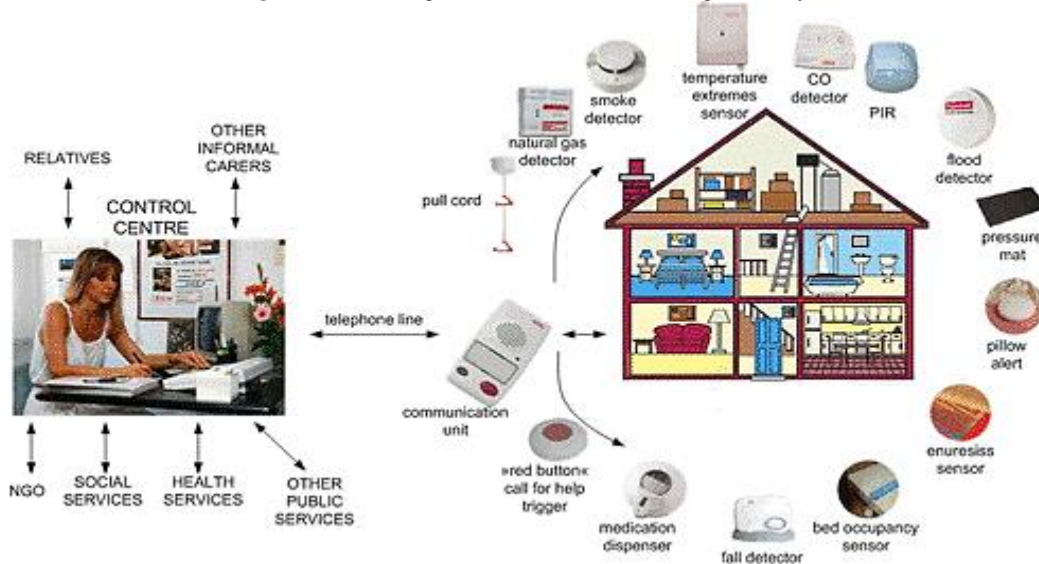
Although the Bill has comprehensively covered the related healthcare services, yet a clear term of a smart home assisted living for elderly that prescribe features and characteristics is not addressed in Malaysian housing law that make its implementation is arguable and possibly detriment the house purchasers. Therefore, the adoption of devices

and technology as well as the system operation in smart home assisted living will be analysed to incorporate the terms in Malaysian Housing law and housing sale and purchase agreements.

4. Technology at a Home

Aging factor has resulted natural symptom that weaken elderly sensory acuity such as touching, tasting, smelling, sight, hearing and body response to temperature. It may also cause decrease movement, stamina, and muscle strength, altered stability as well as altered mental clarity that lead to dementia and Alzheimer. Older adult is also vulnerable to sickness and disease whereby they will be suffering of osteoporosis, arthritis, heart disease, hypertension, and diabetes (Cocco, 2011). Thus, elderly-friendly technology devices in a home play bigger role in accommodating the residents.

Figure-3.1. Technologies in smart home assisted living for elderly



Smart home technology system is based on two approaches known as *distributed direct sensing* (DDS) and *infrastructure-mediated sensing* (IMS) (Chung *et al.*, 2016). DDS is an installed physical sensing network in smart home infrastructure to sense motion, presence, or other behavioural indicators. For example, systems that comprised of new set of sensors will transfer data collected to a centralized monitoring system where sensor fusion and activity inference take place. In contrast, IMS indicates existing sensor-based residences through electrical or air conditioning systems with the aim of monitoring activities of the individual. There are various types of smart home applications such as activity monitoring system employing wireless motion sensors, refrigerator door sensor, toilet flush sensor, water consumption sensor, bed sensor, or pressure mats, video monitoring system and home-based sensors for enhancing safety such as smoke detector, temperature sensor, door security system, and so forth (Bruce, 2011; Kang *et al.*, 2010).

The major difference between systems designed for individuals is the software programming of the devices refers to functionality of the installed system. Two home network systems could be physically identical, contain the same components, but function very differently and operate in many different ways (Dewsbury and Edge, 2001). Therefore, for this purpose, a robust regulatory housing framework, particularly on regulating the standards of SHALE is needed to ensure that a reputable home assisted living is developed in Malaysia.

4.1. Long Term Care for Elderly

Injury in a house is common among the elderly caused by failing memory that make them to forget task in a home such as turning off the stove, water pipe, air-conditioner and other appliances which if not being careful will lead to home fires or increase of energy consumption. Smart home for elderly is mostly equipped with sensors and automation-based devices without depend on human control. These technologies can be leveraged to ensure a living environment that accommodates the mental and physical decline which is most likely occur among the aged (Cocco, 2011).

Technology in a home exist in a form passive and active-intervention devices to monitor the condition and safety of the elderly person without intervening their daily care (Cocco, 2011). Devices in a home is based on sensor detection and motion detection that gather rich of information to develop activity patterns. Daily health condition of the elderly can be monitored for example through devices slip under mattress pads to detect heart rate, respiration and restlessness. Besides, motion detector in a home will be able to detect numbers of bathroom visits and in the situation whereby no detection in a home or falls, it can notify the caregiver to take early to treat the person.

Besides, pressure sensor which is known as Gait monitors is able to measure plantar pressure that is used to detect changes in a person's ability to walk as well as to detect falls (Cocco, 2011). Gait will be able to detect movement pattern of the limbs of humans during locomotion (Lin *et al.*, 2016). Aging factor, injuries, and pathological disease, may change a person's walking style into different one (Derawi, 2010). Apart from ability on

detecting motion in a home, gait monitor data is significant to enable considerable of application in healthcare, rehabilitation and physical therapy (Li *et al.*, 2009).

Unlike passive-intervention devices, active-intervention devices technologies includesensors equipped with alerts, reminder systems, and devices that assist with medication administration. Active-intervention sensors will monitor residents and may interfere on the resident' behalf if necessary. For example, if sensor detects any sign of extraordinary movements or person has fallen, closed-circuit television (CCTV) will immediately capture the event and system then alerts the nearest medical center and family members so that the person does not have to activate the system to alert for help (Cocco, 2011).

Other types of devices function as reminder. Such devices be built with automotive enunciators that alert the residents to perform certain task at certain date and time for instance to remind the upcoming appointment with the physicians or time to consume medicine. Reminder system in the house in some situation will take further necessary action in the situation if the reminder is unattended atinterval (Cocco, 2011). Some example of the tasks performed by the system alert are locking the door and window when residents are away, turning off electrical stuffs such as cooking stove and stopping the running of bath water. For medication assistance, some devices will assist in medication administration such as automated pill dispensers and sensor pads located underneath medication bottles to detect when and if medications are taken. Some smart home technologies remind occupants to take medicine as well as scan the prescription bottle to make sure that it is the correct one. The technology also keeps an inventory of pills and can call a pharmacy to order prescriptions when running low (Cocco, 2011). Therefore, technology in the house must be introduced to ensure safety for the aged, enhance their quality of life, as well as to reduce healthcare costs through injury and disease prevention and early intervention.

4.2. People with Dementia, Other Forms of Cognitive Impairment

Medication assistance in a smart home that is commonly needed by elderly is not challenging thanproviding devices and appliances for dementia and Alzheimer. Managing the care of persons with dementia(PWD) while enhancing their quality of life is challenging, especially for family caregivers. PWD is struggling with neuropsychological symptoms such as apathy, anxiety, and agitation that are common across the dementia spectrum and stressful to handle. Assistive technologies could support the needs to promote independence, positive mood and behaviours, and quality of life without adding to caregiver burden (Hellman, 2014).

Apart from the common assistive technology devices in a home, a psychosocial treatments for PWD, therefore, needs sensory interventions such as music, social contact such as real or simulated presence using photos and videos, and orientation to place and time using cues and reminders. Past memories can reduce boredom, stimulate conversation, and preserve personal identity by remembering past events and experiences with the aid of objects such as personal photos or objects.

Psychosocial interventionsin a form of interacting activities,cognitive and emotional are able to improve neuropsychiatric symptoms and quality of life of PWD but traditionally depend on human interaction. With the assistance of technology in a home to provide virtual 'companion' in the living environment using audio visual programs that combine images, music, and messages from trusted individuals that are relevant and pleasing to the patients will engages them meaningfully and positively. A simulatedpresence of loved ones will be provided through photos, videos and voices to assist PWD with important activities and routines as time reminder (e.g., "time to eat") will be followed with the visual showing the action of people eating. Reminder tools are also set through voice, alarm, clock, date that will be displayed on the home screen (Kerssens *et al.*, 2015).

5. Housing Legal Framework for Smart Home Assisted Living for Elderly

The major problem with smart home assisted living for elderly is concerning its conformity to the housing planning requirements and the integration and interaction among heterogeneous systems developed by different manufacturers will probably face difficulties to interact with each other (Basarudin *et al.*, 2017). The Design-for-All concept considers for standard users is lacking in precision and standardization increaseheterogeneity in subsystem development, both in terms of applications and services (Halim *et al.*, 2015).

Therefore, to develop a crucial housing system for vulnerable people, housing developer and service provider must comply with all legal requirements and related laws concerning housing development stages (Yeon *et al.*, 2017). The whole process depends on the type of development constructed by the developer whereby if any development which is carried out for the purpose of human habitation, it requires approval and permission from the Local Planning Authorities.

Housing development in Malaysia falls under the purview of the Ministry of Housing and Local Government which is governed by the Housing Development (Control and Licensing) Act 1966 Act 118(HDA 1966) to warrant any housing development undertaken to be carried out by the licensed developer. Section 5(1) of HDA 1966 provides that:

"No housing development shall be engaged in, carried on, undertaken or caused to be undertaken except by a housing developer in possession of a license issued under this Act;"

It brings the meaning of any development carried out without valid licence is considered an offence as mentioned in the case of *Kheng Soon Finance Bhd. v MK Retnam Holdings Sdn. Bhd. & Anor.*[1989] 1 MLJ 457;

The court refused an application by the chargee for an order for sale, stating that there is a duty on the part of the chargee to enquire if the housing developer (charger) has a valid housing developer's license. In the instant case, the chargor was not in possession of a valid developer's licence. The being so, the court held that the charge was void ab initio.

And it was further stressed that “.....to carry on a business of housing development without a license is a serious offence”.

It highlights that, any development which is carried out for the purpose of habitation will be strictly observed by the authority body to ensure the safety and protection is granted to the house buyer.

The imposition of the HDA 1966 will be for the purpose of promoting serious commitment and obligation on the licensed developer to deliver a quality houses to the purchasers, pursuant to the enforcement of 6B and 11 of the HDA 1966 (Sufianand and Rozanah, 2008). The imposition of Section 6B of the HDA 1966 which reads that;

“If any licensed holding developer—

(a) is carrying on his business, in the opinion of the Controller, in a manner detrimental to the interest of the purchasers or to any member of the public;

(b) has insufficient assets to cover his liabilities;

(c) is contravening any of the provisions of this Act; or

(d) has ceased to carry on housing development in Peninsular Malaysia,

the Controller may, after having given the licensed developer an opportunity to submit reasons within a specified time on why the deposit under paragraph 6(1)(a) or (b) should not be forfeited, forfeit the whole or a part of the deposit.”

The said provisions are considered as one of methods to ensure developer observes the terms and conditions to conduct a development in a manner not to detriment the interest of the purchasers. Although the law provides such protection to the house buyer, yet in the context of SHALE, prevention from any injury is utmost as it involve vulnerable people living in a home rather than later action to prove the interest of the purchaser has been detrimental due to defects either on the workmanship for substructure works (Sufianand and Rozanah, 2008).

Meanwhile, section 11(1) of the HDA 1966 which provides protection to the purchaser states:

“Minister may without prejudice to the generality of the powers of the Minister to give directions under section 12 for the purpose of safeguarding the interests of the purchasers of the licensed housing developer based on several listed causes”.

Although the provisions potentially provide protection in the situation whereby purchaser encounter problem of poor workmanship and materials, however in succeeding in claiming against the developer, purchaser should present cogent evidence that the protection in the aspect of housing infrastructure, properties and facilities are guaranteed to the purchaser based on the agreement between housing developer and purchaser. Certainly, the right of the home buyer derived from the contractual relationship with the developer upon agreements entered between them in dealing with house purchasing. Sales and purchase agreement (SPA) bind both parties with the contractual rights and duties that have to be obeyed.

The significant protection that has been addressed by the law is mentioned in regulation 11(1) and (1A) of the Housing Development (Control and Licensing) Regulations 1989 which has made it mandatory to include Schedule G, H, I, and J¹ to be incorporated in all the standard sale and purchase agreements (SPA) for newly built-houses (Malaysia, 1989). The said schedule has directed the developer to ensure the parcel together with all the common property and facilities be built in a good and workmanlike manner in accordance with the description set out in the Fourth Schedule. The definition of ‘workmanlike manner’ is referring to the conformity of workmanship which must be carried out with proper skills and care (Ramsay et al., 2001), while in terms of materials used, the Uniform Building By-Laws 1984 has stated requirement for certain building material must conform with the approval Standard Specification imposed by the laws or Code of Practice prescribing the quality of material or standards of workmanship such mentioned in by-law 53 (Malaysia, 1984).

For example, in *KC Chan Brothers Development SdnBhd v. Tan Kon Seng & Ors [2001] 4 CLJ 659; [2001] 6 MLJ 636* (High Court of Malaya at Temerloh), house-buyers of low cost units complained that specifications of the building as shown on the approved plan and attached as part of the agreement has not been complied with. The vendor developer defendant failed to build the houses in accordance with the approved building plans and forming part of the sale and purchase agreements. It was decided by the Magistrate in favour of the purchaser plaintiffs and granted their prayers for damages with costs and interests.

In other words, all provisions in the sale and purchase agreement are actually statutory requirements which must strictly be complied with cl. 23, particularly is meant to be as an additional protection for house buyers, without effecting or limiting their rights under the common law.

Another method of ensuring housing safety protection for the purchaser is through the requirement to obtain Certificate of Completion and Compliance (CCC) by making sure all the essential services, including access roads, landscape, car parks, drains, sanitary, water and electricity installations, fire hydrants, sewerage and refuse disposal requirements and fire lifts, have been provided, supervised and completed in full compliance with the provisions of

¹**Schedule G:** This schedule is introduced by reg 11(1) of the Regulations 1989 (PU(A) 58/1989). Schedule G is for sale and purchase of landed house (land and building) by way of 'full sell then build' concept.

Schedule H: This schedule is introduced by reg 11(1) of the Regulations 1989 (PU(A) 58/1989). Schedule H is for the sale and purchase of flat houses (building and land intended for subdivision into parcels) by way of 'full sell then build' concept.

Schedule I: This schedule is introduced by sub-reg 11(1A) of the Regulations 1989, inserted by regs 15 and 8(b) of the Housing Development (Control and Licensing) (Amendment) Regulations 2007 (PU(A) 395/2007). Schedule I is for sale and purchase of landed house (land and building) by way of 'build then sell' concept.

Schedule J: This schedule is introduced by sub-reg 11(1A) of the Regulations 1989, inserted by regs 15 and 8(b) of the Housing Development (Control and Licensing) (Amendment) Regulations 2007 (PU(A) 395/2007). Schedule J is for sale and purchase of flat house (building and land intended for subdivision into parcels) by way of 'build then sell' concept.

the law and technical conditions as imposed by the Local Authority in approving the Planning Permission and Building Plan (By-law 25A of Uniform Building By-Law 1948).

However, due to the absence terms of smart home assisted living for elderly in Housing Sales and Purchase Agreement, it will exempt the developer's duty and protection that should be granted to the purchaser consequently lead to detrimental cause to the residents (Md Dahlan *et al.*, 2017).

However, as SHALE provides healthcare services, the proposed Bill which highlights on the safety care for elderly must be observed by housing developers and technology service providers for the reason in the situation whereby SHALE devices and components are deliberately excluded under SPA, while precisely described under different legislations such as inPrivate Aged Healthcare Facilities and Services Bill 2017, it implies duty on developers to be aware of current housing requirements.

Section 4 of the Bill requires for person that provide a private aged healthcare facilities and services to get approval and license together with the duty of licensee in section 20 to ensure such services is conducted, assessed and managed by healthcare professionals and the caregivers must be trained and competent. This significant provisions under the Bill signifies the requirement for a healthcare service provider to make sure the services is guaranteed, qualified and safe for the elderly. However, in the context of SHALE, the physical services which are transformed into technology devices substituting the role of caregivers in a home definitely requires observation and higher duty of care on the part of housing developer to ensure the devices are approved, assessed, managed and maintained by qualified and skilled person in charge. After all, developers and service providers' role in providing SHALE must be accordance to the real objective of the Bill to guarantee safety and security of devices for the elderly.

Therefore, as discussed, the inclusion of SHALE development and provisions amendment in the housing legislation is necessary to rationalize the existing Act as well as to serve as a deterrent to developers who might deliberately disobey the law by taking advantage of unsuspecting house buyers (Yeon *et al.*, 2018). The inclusion of SHALE terms in housing regulations will highlight the significant of providing a quality and safety house to the old person with and without cognitive impairment to ensure the continuous protection and to make their life happier.

6. Conclusion

A settlement for elderly should offer peace, safety, security and tranquillity which entails the duty of housing developer to observe the safety requirement of home. Building a smart home for elderly requires involvement of not only a licensed but skilled and professional developers for the reason of the system of the house itself which demands a systematic management and its complexity healthcare system and devices that should be maintained and managed by expert.

Amendment to include specifications and descriptions of SHALE components and devices should be particularized and detailed out in Malaysian housing law especially in the in the following statutes i.e. the Housing Development (Control and Licensing) Act 1966, Sales and Purchase Agreement under Housing Development (Control and Licensing) Regulations 1989, Uniform Building By-Laws 1984 and the Street, Drainage and Building Act 1974 (Act 133) to provide adequate information and fair to the home users and expected to ensure home projects to be elderly-friendly, safe, guaranteed, accessible and to ensure its proper maintenance.

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References

- Basarudin, N. A., Yeon, A. L., Mohamed Yusoff, Z., Md Dahlan, N. H. and Mahdzir, N. (2017). Smart Home Users' Information in Cloud System: A Comparison Between Malaysian Personal Data Protection Act 2010 and EU General Data Protection Regulation. *Malaysian Construction Research Journal*, 2(2): 209-22.
- Botsis, T., Demiris, G., Pedersen, S. and Hartvigsen, G. (2008). Home telecare technologies for the elderly. *Journal of Telemedicine and Telecare*, 14(7): 333-37.
- Brink, S. (1990). International policy trends in housing the elderly in developed countries. *Ageing International*, 17(2): 13-20.
- Bruce, C. R. (2011). Informed decision making for in-home use of motion sensor-based monitoring technologies. *The Gerontologist*, 52(3): 317-24.
- Cavallo, F., Aquilanoand, M. and Arvati, M. (2015). An ambient assisted living approach in designing domiciliary services combined with innovative technologies for patients with alzheimer's disease, A case study. *American Journal of Alzheimer's Disease & Other Dementias*, 30(1): 69-77.
- Chan, M., Estève, D., C., E. and Campo (2008). A Review of Smart Homes—Present State and Future Challenges. *Computer Methods and Programs in Biomedicine*, 91(1): 55-81.
- Chung, J., Demiris, G. and Thompson, J. H. (2016). Ethical Considerations Regarding the Use of Smart Home Technologies for Older Adults", *Annual Review of Nursing Research*, vol. 34, 2016: Nursing Ethics: Vulnerable Populations and Changing Systems of Care. 155.
- Cocco, J. (2011). Smart home technology for the elderly and the need for regulation. *Pittsburgh Journal of Environmental and Public Health Law*, 6(85).

- Demiris, G. and Hensel, B. K. (2008). Technologies for an Aging Society, A Systematic Review of “Smart Home” Applications”, *Yearbook of Medical Informatics*. 3: 33-40.
- Derawi, M. O., 2010. "Accelerometer-based gait analysis, a survey”, *norwegian information security conference*, pp. 1-12.
- Dewsbury, G. and Edge, M. (2001). Designing the home to meet the needs of tomorrow. *Open House International*, 26(2): 33-42.
- Ding, D., Cooper, R. A., F., P. P. and Fici-Pasquina (2011). Sensor technology for smart homes”, *Maturitas*. 69(2): 131-36.
- Dohr, A., Modre-Opsrian, R., Drobits, M., Hayn, D. and Schreier, G. (2010). The Internet of Things for Ambient Assisted Living”, in *Information Technology: New Generations (ITNG)*, 2010 Seventh International Conference. 804-09.
- Halim, A. H. A., Goon, F., Hamzah, J. and S., W. Y. (2015). Connected Healthcare Inclusive and Continuous Precision Healthcare Services”, *MIMOS Corporate Market Strategy*, myForesight. Available: <http://www.myforesight.my/2015/08/03/myforesight-12/>
- Health and WellnesAraGreen Residences: Available: <http://www.aragreens.com/health-wellness.html>
- Hellman, R., 2014. "Assistive technologies for coping at home and increased quality of life for persons with dementia”, *inechallenges e-2014*, 2014 conference." pp. 1-7.
- Kang, H. G., Mahoney, D. F., Hoenig, H., Hirth, V. A., Bonato, P. and Hajjar, I. (2010). Center for integration of medicine and innovative technology working group on advanced approaches to physiologic monitoring for the aged, “in situ monitoring of health in older adults: Technologies and issues. *Journal of the American Geriatrics Society*, 58(8): 1579-86.
- Kerssens, C., Kumar, R., Adams, A. E., Knott, C. C., Matalenas, L., Sanford, J. A. and Rogers, W. A. (2015). Personalized technology to support older adults with and without cognitive impairment living at home. *American Journal of Alzheimer's Disease & Other Dementias*, 30(1): 85-97.
- Lee, C., Orszulak, J., Myrick, R., Coughlin, J. F., de Weck, O. L. and Asai, D., 2011. "Integration of medication monitoring and communication technologies in designing a usability-enhanced home solution for older adults”, in 2011 international conference." pp. 390-95.
- Li, Q., Stankovic, J. A., Hanson, M. A., Barth, A. T., Lach, J. and Zhou, G. (2009). Accurate, Fast Fall Detection Using Gyroscopes and Accelerometer-Derived Posture Information”, in *Wearable and Implantable Body Sensor Networks*, 2009 Sixth International Workshop, IEEE. 138-43.
- Lin, F., Wang, A., Zhuang, Y., Tomita, M. R. and Xu, W. (2016). Smart insole, a wearable sensor device for unobtrusive gait monitoring in daily life. *IEEE Transactions on Industrial Informatics*, 12(6): 2281-91.
- Malaysia (1966). Housing Development (Control and Licensing) Act.
- Malaysia (1984). Uniform Building By-Laws.
- Malaysia (1989). Housing Development (Control and Licensing) Regulations.
- Malaysia (2017). Private Aged Healthcare Facilities and Services Bill.
- Malaysia National Transformation: Available: <https://mytn50.com/>
- Md Dahlan, N. H., Yeon, A. L., Mohamed Yusoff, Z., Mahdzir, N. and Basarudin, N. A., 2017. "Smart Home' in The Statutory Formatted Housing Sales Agreements in Malaysia”, in *The European Proceedings of Social & Behavioural Sciences: 9th UUM International Legal Conference 2017*, Kedah, Malaysia."
- Meikeng, Y. (2017). Growing Demand for Retirement Villages. Available: <https://www.thestar.com.my/news/nation/2017/07/09/growing-demand-for-retirement-villages-the-demand-for-retirement-villages-in-malaysia-can-only-go-up/>
- PHB, U. a. M. C. t. L. M. s. F. L. S. L. (2018). Available: <https://www.nst.com.my/business/2018/03/344007/phb-uem-and-msc-consortium-launch-malysias-first-luxury-senior-living>
- Rachel, C. (2017). Where will you reside when you're old. Available: <http://essentialeconomics.com/wp-content/uploads/2017/02/The-Edge-Poperty.com-Article.pdf>
- Ramsay, V., Uff, J., Williamson, A., Furst, S. and Ramsey, V. (2001). *Keating on building contracts*. Sweet & Maxwell: London.
- Robles, R. J., Kim, T. H., Cook, D. and Das, S. (2010). A review on security in smart home development. *International Journal of Advanced Science and Technology*, 15.
- Sufianand, A. and Rozanah, A. R. (2008). Quality housing, regulatory and administrative framework in Malaysia. *International Journal of Economics and Management*, 2(1): 141-56.
- Yeon, A. L., Mahdzir, N., Mohamed Yusoff, Z., Md Dahlanand, N. H. and Basarudin, N. A. (2017). A Comprehensive Smart Home Legal Framework in Malaysia, A Necessity in The European Proceedings of Social & Behavioural Sciences: 9th UUM International Legal Conference 2017. Kedah, Malaysia.
- Yeon, A. L., Basarudin, N. A., Mohamed, Y., Z., Md Dahlan, N. H. and Mahdzir, N. (2018). Designing a legal framework of green environment in smart home project. *International Journal of Supply Chain Management*, 7(4): 460-70.
- Zhang, D., Hariz, M. and Mokhtari, M., 2008. "Assisting elders with mild dementia staying at home” in pervasive computing and communications, 2008." In *Sixth Annual IEEE International Conference*. pp. 692-97.