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Perceptions on smart home concept among the millennials in Johor

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Abstract. The concept of smart home is a rising trend within the housing industry in Malaysia. With the advance of technology, homeowners are able to control and monitor their home through the smartphone or other networked device. However, it was discovered that Malaysians are highly reluctant in adopting smart home concept and similar Internet of Things (IoT). Within the smart home market, there were cases where potential home buyer may be unaware of the technology, thus hinder its adoption and further development. This research aims to investigate the awareness of potential home buyers specifically among the young millennials on smart home concept; perception on the factors influencing them to buy and key features that they will consider in buying a smart home. Questionnaire survey has been conducted and descriptive analysis has been used to analyse the data. Findings showed that the knowledge on smart home concept is still low among the target population. Respondents with the intention to buy smart home has chosen 'saving energy, time and money' as the main factor influencing while 'wireless lighting system' as the key features that taken into consideration. These findings may encourage the adoption of the smart home concept among the Millennia Generation in Malaysia and therefore intensify its development in the future.

1. Introduction

In recent years, the concept of smart home has been developed tremendously to facilitate self-care home. A smart home is an ordinary home that equipped with pre-programmed and installed home appliances, thus help the house to operate by itself. Smart home system can be personalized according to the user's daily routine which helps to make sure that the house is giving suitable order at any time regardless of whether there is anyone or no one in the house. When everything is integrated into one system, the house will always be in the good condition whereby there will be no messy switches or stand-alone controls.

Initially, the advents of internet and government policy initiatives that promote energy efficiency to mitigate climate change have begun to attract home buyer's attention in smart home concept technology, especially in developed countries [1]. A series of gadgets, domestic appliances, linking sensors and other devices, which automated controlled, assessed or monitored remotely by the users of smart home technology eventually make its way to the local and global market to meet the needs of its user [2, 3]. Smart home technology has the potential of conveying benefits to modern households and its habitants [4]. The concept of smart home is an assuring and efficient way of maintaining good health, providing comfort and safety thus helps to improve the quality of life through its intelligent technology [5, 6, 7].

Despite of positive benefits of smart home and its emerging market opportunities particularly in developing countries such as Malaysia, Singapore, China, South Korea, Thailand and Indonesia, it was discovered that the rate of smart home concept adoption among individual users is generally low [8, 9]. Precisely, according to [1], the rate of smart home adoption among individual users in Malaysia is lower than other countries of Asia as Malaysians are discovered to be highly reluctant in adopting smart home technology and similar internet of things (IoT) [1].

Basically, people are not fully aware of smart home functions, potential risks and benefits are due to its new emerging technologies. The lack of knowledge, trust and experience to embrace the benefits of the new technology may lead to the low rate of the perceived usefulness of smart homes and the benefits it could create [10-12]. The feedback of technologies adopters, which may not always be positive, is heavily affected from the perception of emergent technologies [13]. In consequence, negative role in smart home technology acceptance by the potential users can be cause by the lack of user awareness together with negative defamation [14, 15]. Therefore, this study aims to investigate the awareness and perception of potential home buyers on the smart home.

2. Smart home benefits, challenges and features

The word *smart* has recently become a collective term for an innovative technology that possesses some degree of artificial intelligence. The ability to acquire information from the surrounding environment and react accordingly to it, is the key attributes of a smart technology [2, 3]. To improve the wellbeing of people, an innovative concept such as the smart home is the long-term objective of smart technology [16-19]. The benefits or risks of the smart home will influence the users whether to accept or reject its application.

The adoption of smart home can affect the life of home buyers financial and non-financially. There are various of previous studies have highlighted the benefits of smart home concept. According to Wilson *et al.*, the main perceived advantages of smart home are saving energy, money and time [20]. The concept of automation which enable the home owner to control almost everything from the gadget has led to the energy efficient and help to save loads of money over time. As the home is equipped with the automation system which integrated to the smartphone, the concept is basically will enhance the communication among the household [10], assist the home living to improve health and quality of life [24, 27], as well as simplify the daily activities [10, 21]. The benefits of smart home can be enjoyed by the large community as a whole, where the concept may provide comfortable living space [2], improving security and safety [24], and manageable waste and resource consumption [23]. The following Table 1 summarize the benefits of smart home highlighted in previous studies.

Table 1. The benefits of smart home

Benefits	**Sources**
Saving Energy, Time and Money	[20]-[24]
Attractive and understandable	[25]
Easy access	[10], [24]
Enhance Communication	[10], [26]
Enhance Health	[24], [27], [28]
Enhance Quality of Life	[10], [20]-[24], [27], [29]
Manageable for waste and resources consumption	[23], [30]
Provide comfortable living space	[2], [20]-[22], [24], [26], [29], [30]
Simplify the residents daily activities	[10], [21], [25], [27]
Improving security and safety	[24]

Dealing with technology, there are a few challenges have been discovered in adopting smart home. For instance, less knowledge on the system and technology is one of the factors that hindered the

adoption of the smart home concept [31, 32]. As user's knowledge is a fundamental requirement for a successful adoption of smart home concept, this issue has led to another challenge such as difficult to manage as well as getting used with the system due to its complexity [21]. The element of cost is another challenge to adopt smart home as the concept involves higher initial expenditure which usually covers the cost of system components, supplies and labour. Concerns were raised over the cost of various aspect of smart home technology such as cost of installation, smart repairs and maintenance [10]. Besides the advantages offered, the smart home is also coming with its own set of risk, security and safety concerns especially on the privacy and data security aspect. These issues have formed a perception that the smart home can be unreliable and does not fit the lifestyle of the individuals [35-37]. The following Table 2 summarize the challenges of smart home that have been discussed in previous studies.

Table 2. The challenges to adopt smart home

Factors	**Sources**
Less knowledge	[31], [32]
High expenditure	[33] [10], [21], [24], [31], [34]
Unavailability in the market	[31], [35]-[37]
Security and safety issues	[21], [24], [25], [33], [38]
Unreliable	[35]-[37]]
Difficult to handle or understand	[21], [31]
More complexity	[21], [33], [34], [37]
Does not fit lifestyle	[10], [21], [24], [31], [35]-[37]

Smart home solution is developed mainly to provide users with support in controlling the home appliance system such as light and ambient temperature, and managing devices such as refrigerators, driers or washing machines. It was discovered from the literature that smart homes features can be categorised into five categories as illustrated in Table 3.

Table 3. Smart home features

Features	Sources
Home appliances	[21], [24], [39]-[43]
Intelligent curtain	[21], [39]-[41]
Intelligent plug and lighting	[24], [40], [42], [44]
Temperature monitoring system	[24], [39], [41], [42], [44], [45]
Security system	[24], [39], [41], [46]
Integrated system	[39], [41]

3. Methodology

This research is quantitative research by design. A total of 348 respondents has been involved in the data collection by using random sampling technique. The population sample for this study is based on the age group as the study is focusing on the Millennials or 'Digital Natives' group which are generally born after 1980s and grew up using technology. This generation have a strong interest in new technologies and the first generation to be raised with the access to the Internet of Things (IoT) [47]. They are often considered as more comfortable with and more knowledgeable in innovation rather than the previous generations. Questionnaire survey has been conducted and the data were analysed by using descriptive analysis. This study is conducted within the state of Johor, where the economy of this state is at an advanced level as compared to other states in Malaysia (except for Kuala Lumpur). According to Malaysian Investment Development Authority (MIDA), Johor state remains as an attractive place for

economic activities despite of uncertainties condition of global economic. Besides, Johor is one of the states that currently has a few of smart home development projects.

4. Findings

4.1 Respondents Profile

From the frequency analysis of the respondents, the percentage of female respondents is 59% (204 respondents), while male respondent only 41% (144 respondents). The percentage of respondent's age is dominant by category 21 to 25 years old which is 62% (216 respondents) from the total response. This category basically is more responsive to new technology emerged in their surroundings. Then, the second contribution is from range 15 to 20 years old with 22% (77 respondents) and followed by age range between 26 to 30 years old with 12% (43 respondents). For the races, 81% (285 respondents) are Malay, 14% (47 respondents) and 5% (16 respondents) are Chinese and Indian respectively.

4.2 Awareness of Potential Home Buyers on Smart Home Concept

The respondents have been asked on their home ownership, intention to buy a house and their consideration in buying a smart home. Based on the survey carried out, majority of the respondents does not own a house (94%) and have the intention to buy a house (93%). This finding is in line with the age group considered for this study as most of the respondents are at the early age of 20s. Although the purchasing power of these group is still low, most of the respondents showed that they have the intention to buy and own a house. On the consideration in buying a smart home, 61% of respondents have considered to buy this concept while 39% are not. These results are reported in table 4 below.

Table 4. Respondents' awareness on smart home concept

Questions	Percentage
Do you own a house?	
Yes	6%
No	94%
Do you have intention to buy a house?	
Yes	93%
No	7%
Have you considered to buy a smart home?	
Yes	61%
No	39%

Respondents that have not considered to buy the smart home have been asked further on the factors that influencing them. The results showed that the main factors that hindered the potential home buyers on buying smart home is due to knowledge, cost and complexity. The overall results are presented in the following Table 5.

Table 5. Factors That hindered the potential home buyers in a smart home

Factors	**Percentage**
Less knowledge	27%
High expenditure	18%
More complexity	16%
Difficult to handle	12%
Unavailability on the market	9%
Less security	8%
Unreliable	6%
Does not fit in concept	4%

4.3 Factors Influencing Potential Home Buyers to Buy Smart Home

Out of the 348 respondents, 61% of the respondents who have considered to buy a smart home is due to the factor that smart home can save energy, time and money. These factors have the highest percentage (15%). The second factor is improved the security and safety system of the house with 11%. The third factor is the concept can help to improve the quality of life (10%), followed by provide residents with a comfortable living space (8%). The fifth factors that considered by the potential buyers is easy access to the system (7%). While the other factors such as its ability to remotely control home appliances, more attractive and understandable, help to simplify the residents' daily routine activities, assist home living to improve health, communication as well as manage waste or resources consumption for a large community player have the range between 6 to 7%. Table 6 below simplified the finding of this analysis.

Table 6. Factors influencing potential home buyers in buying a smart home

5 main factors that influence potential buyers to buy Smart Home Concept	1. Save energy, time and money (15%);
	2. Improved the security and safety system of the house (11%);
	3. Improve the quality of life (10%);
	4. Provide residents with a comfortable living space (8%); and
	5. Easy access to the system (7%).

4.4 Key Features of Smart Home

Based on the survey conducted, it is found that the respondent has general preference in selecting the features embedded to the smart home concept. Among the 18 features as presented in Table 7 below, the most important features considered by the respondents are the wireless lighting system (10%) that interrelated with the factor that the smart home concept will help to save energy, time and money. Second is door and window sensor (9%) which may make the life of the home buyers more convenient. Third, respondents have considered cooking appliances (8%) as one of the important features as it helps to make the work in the kitchen much easier and simple, followed by smart outdoor security camera (7%). Finally, the respondents consider smart air conditioner as the fifth key features as it allows the users to monitor home temperature intelligently for comfort management.

Table 7. Preference of potential home buyers on smart home features

Features of the Smart Home Concept	Frequency	Percentage	Ranking
Home appliance control			
i. Cooking appliances	75	8%	3
ii. Fridge and Freezer	47	4%	
iii. Home laundry appliances	52	5%	
iv. Dishwasher and disposal system	55	5%	
Intelligent curtain			
i. Smart curtain	44	4%	
ii. Door and window sensor	89	9%	2
Intelligent plug and lighting			
i. Wireless lighting system	93	10%	1
ii. Wi-Fi smart socket	68	6%	
Temperature Monitoring System			
i. Smart Thermostat	23	2%	
ii. Smart air conditioner	69	6%	5
iii. Smart smoke sensor	50	5%	
Security system			
i. Panic alarm button	41	4%	

ii. Smart door lock	67	6%	
iii. Security kit	44	5%	
iv. Smart outdoor security camera	71	**7%**	4
Integrated system			
i. Google home	41	4%	
ii. Voice command smart system	43	5%	
iii. Smart things hub	40	4%	

5. Discussions

From the finding, 61% of the young Millennia population in Johor has the awareness of the smart home concept and they are considering buying smart home concept in the future. They believe that the concept can save energy, time and money. Besides, the concept also helps them to improve home security and safety of the residents thus, improve the quality of life. Apart from that, the smart home concept can provide residents with a comfortable living space, easy access to the system with high security system. Indeed, these five factors are essential to the potential buyers in buying the concept. These findings are in line with study conducted in [49] found that the attractiveness of smart home services was positively related to the users' intention to use the services. The study also revealed that there was a negative association between the perceived cost and usage intention. In term of features, the smart home concept should be embedded with wireless lighting system (Intelligent Plug and Lighting), Door and Window sensor (Intelligent Curtain), Cooking Appliances (Home Appliances Control), Smart Outdoor Security Camera (Security System) and Smart Air Conditioner (Temperature Monitoring System).

6. Conclusion

This research provides the perceptions of future home buyers specifically among the young millennials to support the development of the smart home market in Malaysia. From the finding, it is found that more information of smart home concept is needed to promote and expand such development in Malaysia. Therefore, a study on the effectiveness of the concepts should be conducted to reveal the actual usefulness and impact of the smart home features on the home buyers financially and non-financially. It is hoped that the research information from this article will serve as a guideline particularly to the property developers, smart home suppliers and local authority to improve the features of smart home concept in tandem with the changing needs of the potential buyer in the future.

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