

Internet of Things (IoT) and Smart Home Technology in Malaysia: Issues and Challenges for Research in Adoption IoT and Latest Technology for Home Building

Salmiah Aziz^{1,2,a)}, Siti Nuratirah Che Mohd Nasir^{1,2,b)}

¹Universiti Teknologi MARA, Kampus Sri Iskandar, Bandar Sri Iskandar, Perak, Malaysia.

²Universiti Malaysia Kelantan Kampus Bachok, Bachok, Kelantan, Malaysia.

Corresponding author: ^{a)}myyaarc@gmail.com

^{b)}nuratirah.mn@umk.edu.my

Abstract. The capability of the Internet of Things (IoT) to electronically meter, path and monitor objects in the physical world has encouraged a flow of innovation and interest from many industries. It's probable to driving, chaotic changes across many sector offerings a myriad of potential services and applications. Smart home service, one of the symbolic developing technologies in the IoT era, has changed house equipment into being more intelligent, remote controllable, and interconnected. This paper is division of current the author's research on the adoption of IoT application for home building in Malaysia. The data and information presented in this paper were gathered from the reviews of the available relevant literature related to IoT and smart home in Malaysia. This paper addresses the major concern and challenges in IoT and smart home in Malaysia. Based on the analysis, it was found that three main challenges cited in the literature are perception of usefulness, confidentiality and privacy of consumer data, and absence of enterprise IoT applications in the country. As for Iot and smart home technology improvement in the near future, suggested tackling the current issues on home online education and working from home (WFH) especially because of the problematic pandemic Covid-19 worldwide.

INTRODUCTION

To date, the Internet develops one of the technologies that is promptly growing and shifting. It has become trending over the world. The Internet of Thing is a tool organized of devices, sensors, networks, cloud storage, and application. Each device able to connect with additional device over the Internet to share the information and consummate some purposes. IoT is identified as one of the new upcoming technologies and were acquisition responsiveness from many fields globally. Malaysia is one of the countries in the development phase to surge the growth of IoT, which is comparable to other countries with the evolving IoT applications growth. However, it was not easy to grow IoT devices due to some issues and challenges in implementing IoT devices [1]. Gartner projected that over 26 billion devices will be linked in the year 2020 while the Internet Society expected that the number will upsurge to 100 billion in year 2025. The development of Internet and innovative in ICT had led to the gradually norm of IoT in many areas and eased borderless link in many fields. Contextualised within the progress of Smart City, much has been stated on the challenges and impact of using of IoT for smart living [7]. Like all new developments, there is potential for both increased opportunities and risks for consumers. And of course these digital issues are not just limited to advanced economies. Although penetration levels differ, 2 billion of the 3.2 billion people online globally are in developing countries. Making sure the foundations of a connected system are designed to benefit citizens and consumers in all locations will be essential [13].

Malaysia is one of the few Southeast Asian countries that possess the infrastructure requisite for IoT adoption. The Malaysian government even released a strategic roadmap for the adoption of IoT nationally in 2015. And yet, there are quite a few stumbling blocks in the way for IoT to take-off in a big way in Malaysia. Figure 1 shows Malaysia's National IOT Strategic Roadmap [8]. The Malaysian smart home market is expected to exceed US\$ 235 Million by 2025. Smart homes are the residences that are equipped with information and computing technology devices that

anticipates and responds to the requirement of the owner in an effective and efficient manner. There is a growing demand in the Malaysia market for safe and secure living environment, especially concerning safety functionalities and discrete monitoring for elderly people. According to the worldmeters, in 2018, 77.3% of the Malaysian population lived in urban area. By 2030, roughly 83.4% of the population is expected to live in urban areas. This creates an enormous opportunity for the smart home market players [12]. Figure 2 shows Revenue of the smart home automation market in Malaysia from 2015 to 2021 (in million U.S. dollars) [4]. The statistic shows a revenue forecast for the smart home automation market in Malaysia from 2015 to 2021. The overall revenue of the smart home automation market in Malaysia is forecasted to reach 51.26 million U.S. dollars in 2020.

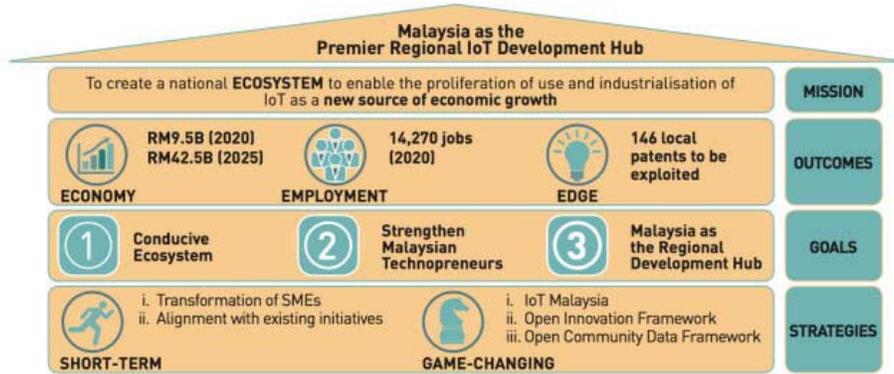


FIGURE 1. Smart Home Automation Market Revenue (2015-2021).

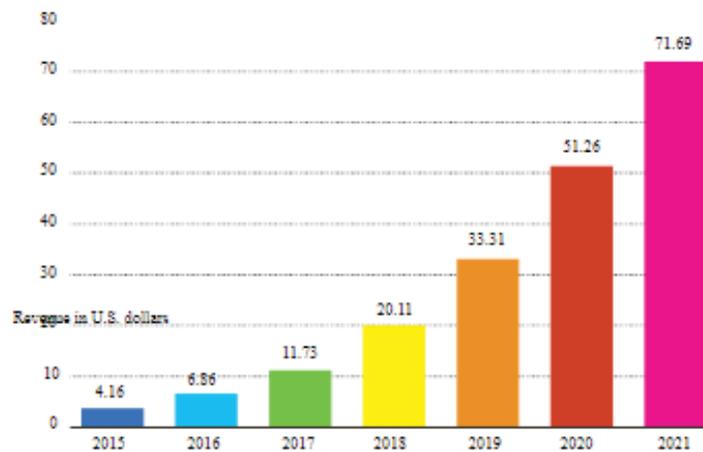


FIGURE 2. Smart Home Automation Market Revenue (2015-2021).

IOT AND SMART HOME TECHNOLOGY

If the Internet is about data created by people, the IoT is about data created by things [9]. The Internet of Things (IoT) is taking smart devices into the home – even before you move in. Modern homes furnished with smart meters, smart appliances, smart power shops and sensing devices modify the development of energy-aware smart homes (Fig. 3) [16]. Although the smart home has been a dream for both utilities and consumers for a long time, such applications are still very uncommon [17]. Figure 4 shows smart grid system architecture application for a home building.

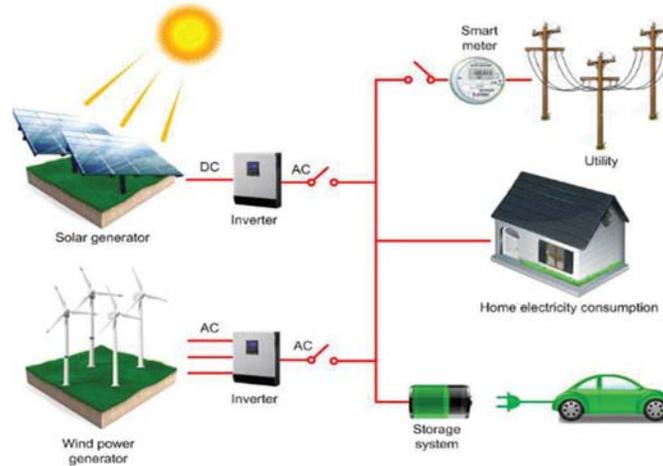


FIGURE 3. Smart Home.

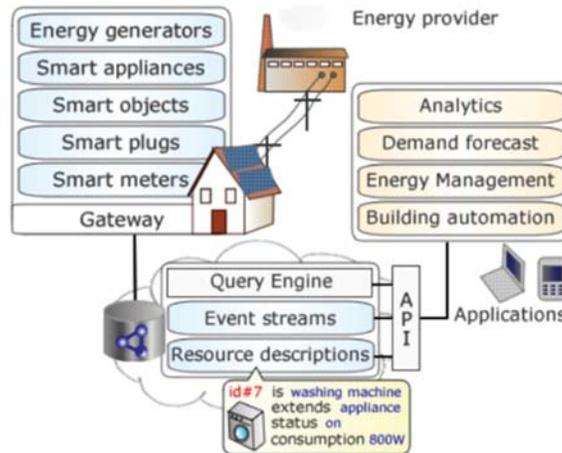


FIGURE 4. Architecture to provide data interoperability in the smart grid: data produced in households is semantically annotated and fed to the cloud. A query engine provides a uniform interface to data that can be exploited by applications.

While interior design and technology are theories that are not usually discussed, the onset of smart home gadgets is leading more designers to integrate a digital focus on the features of design. As the market for home interior speedily grows, the industry is also making greater investments to improve innovative products by implementing IoT, with terms like ‘ITerior’ and “IoT-terior’ into their layout. In fact, over 24 billion digital devices will be connected through IoT by 2020, referring to research from Gartner. And while the clue of linking household appliances like TVs, stoves, and refrigerators to the internet isn’t ground-breaking news, the possible of enhancing the home beautification industry with smart technology is driving IoT growth [14]. With a worldwide shift headed for technology in every aspect, the client was fascinated in considerate the willingness of consumers and other stakeholders, especially in B2B, to adopt IoT in the home with smart home proposing. YCP Solidiance was tasked to identify chances in sectors of residential and retail as well as certain consumer benefits and attitude towards IoT / Smart Home products and offering (YCO Solidiance). Smart homes technology has been presented as a key means by which households can optimize their use of energy-consuming appliances [15]. Malaysia Smart Home Market classified by application areas; Smart Appliances captured maximum share of the Malaysia smart home market, security is the second biggest application segment of the Malaysia smart home market, being followed by Home Entertainment, Energy Management application segment captured least share of the Smart Home market, The average revenue per Smart Home in the Comfort and Lighting segment presently amounts to US\$ 44 [12]. Control and Connectivity segment captured highest share of the Malaysia Smart Home active households in 2018, being followed by Home Entertainment and Comfort and Lighting segment, In Malaysia, the household penetration for Security applications is expected to hit around 7.2% by 2025, Energy

Management application captured least share of the Smart Home active households in 2018, This report titled Malaysia Smart Home Market, Number, Household Penetration & Key Company Analysis - Forecast to 2025 provides a comprehensive assessment of the fast-evolving, high-growth Malaysia Smart Home Industry (Wood, 2019). Other than that, application of smart home divide into six categories such as Control and Connectivity (Home Automation), Comfort and Lighting (Home Automation), Home Entertainment, Smart Appliances, Energy Management, Security Application [12].

Internet provider in Malaysia such as Telekom Malaysia (TM), biggest internet provider in Malaysia endorsed their service on smart home solutions consists of security and safety, user configurable, monitor and control from anywhere, affordability (flexible plan), easy to use, and open platform. Figure 5 shows smart home solutions and its services for home automation. Figure 6 shows smart home apps steps provided by TM [10].



FIGURE 5. Smart Home Solutions Provided by TM.

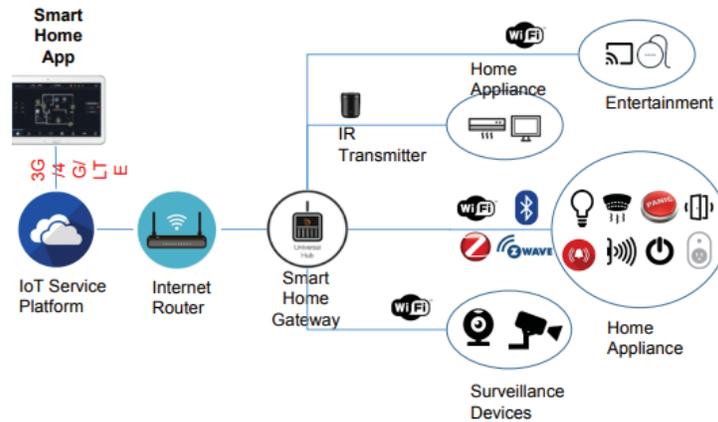


FIGURE 6. Smart Home Apps: How it works? By TM.

IOT Issues and Challenges for Smart Home Building

The Malaysia smart home market is driven by factors such as significantly growing IoT market, cost reduction measures enabled by home automation systems, manufacturers expanding their product portfolios, and increasing importance of home monitoring from remote locations. However, there were issues and challenge to adopt IoT for home building in Malaysia. Issues for IoT adoption for smart home have been discussed in the next points.

Issues in Security, Privacy and Protection of Consumer Data

The main challenges of IoT implementation are issues related to security and privacy. It was also found that there is a lack of information related to the ways to overcome the challenges, although the challenges were discussed in length [7]. Security and invade privacy are potential of smart home technology complications. Personal privacy is exposed by access through a smartphone or personal computer at home. Although it is reported that industry has established many security technologies and practices to keep individual privacy, it will unavoidably come down to lawmakers to decide whether security agencies are permitted to enter citizen's home. It is also expected that security services, will lead to the accumulation of a large number of sensitive personal data for day-to-day activities. Likewise, the hackers attack in the smart home may cause of a huge loss of security and safety of the homeowner. Among threats that may be caused by the hackers are data loss and data hacking, counterfeiting, denial of services, eavesdropping, buffer overloading, malicious amendments, password based attacks and etc. At present, the ability of smart home to foresee human behavior correctly is restricted. Precisely, a smart home whose technical mechanisms are functioning without flaw may still deliver an unreliable service, as the system is not intelligent enough to correctly understand or correctly anticipate the needs of its consumer. Although smart homes have many benefits that makes human's lives useful, these smart properties are costly which can be difficulty to the consumer demand. The cost of the smart home is high due to the technology that is comparatively new [11]. Furthermore, quoted the improvement of common standards and protocols, the data storage migration to the cloud and last but not least an armada of security issues comprising the opportunity of data breaches, backdoors into home systems and vehicles being hacked by hostile intruders, need to be dealt with [3].

The 'disclosure and consent' model which governs digital products could now cover into other products, as lines are blurred between digital and physical items. These usually uniform terms and conditions give consumers no flexibility for cooperation, and give providers full opportunity to command how products and services can be used. Consumers International has identified other areas where multiple connected devices and services could give cause for serious concern: the development of hybrid products; the erosion of ownership norms; remote contract enforcement; lack of transparency; complex liability; lock-in to products and systems; locked out of alternatives; and data, privacy and security. Stated that consumer protection as presently perceived and implemented will be sufficient to uphold consumer privileges in an environment where appliances and devices in our homes, our vehicles and about our persons, become smarter and more connected – to each other, to the Internet and to third parties. While data privacy and protection has attracted a lot of attention, wider issues about what it means to be a consumer of highly networked products and services also need urgent consideration. A momentous issue is the risk that intellectual property arguments and digital rights management will extend to products and services containing software, and risk superseding consumer protection law. Earlier Consumers International research found that there is potential for consumer law to address intellectual property abuses as they effect consumer use of technology. Any comprehensive enacting or redesign of consumer law should implement more flexible methodologies to protect the rights of their citizens. This report looks at: current and future applications of smart and Internet of Things technologies; the implications for consumers; and the extent to which consumer protection law is able to address and remedy potential problems [13]. Moreover, growing demand of smart home devices, security and privacy breach is also increasing. The issues concerning to privacy and security breach are restraining the growth of the smart home market [12].

According to a recent Acquity Group study, "Consumer embracing of network-connected technology is on the rise, with 69 percent of consumers planning to buy an in-home device in the next five years. By the end of next year, a total of about 13 percent of consumers will own an in-home IoT device such as a thermostat or in-home security camera. Presently, only about 4 percent of those surveyed own such a device." [9]. But that's just the start. Wearables are growing enormously. Juniper Research predicts "retail revenue from smart wearable devices, including smart watches and glasses, will reach \$19 billion by 2018 compared with \$1.4 billion this year." From Fitbit to BodyGuardian to the Ralph Lauren biometric T-shirt, technology is becoming less of an appendage and more a part of us physically. And, of course, the soon-to-be-available Apple Watch is expected to give this trend a

nice push [9]. Even babies are getting connected through Mimo, a baby monitor that's actually a onesie with sensors. Monitoring respiration, temperature, and sleep status, it sends a stream of data to parents' phones. Then there are also important research and IoT products in the works to help end the tragedies of children's deaths in hot cars [9]. Studies show also IoT has become widespread and it opens the opportunity for cyber-attack and fraud. The extreme quantity of data that will flow between the connected vehicles, connected home and insurance company is unprotected to interception. The new IoT products are also likely to lead to new application and claim frauds. Insurers will need to invest more for data security and fraud protection [19].

Demand and Growth of IoT Market Among Malaysian (Smart Homes Allows Individuals to Create a Flexible Work-Life Balance That's Useful for All Ages)

With today's eventful generation, the request for smart homes permits individuals to make a flexible work-life balance that's useful for all ages. For example, the major home furniture and appliance giant, IKEA, newly launched a trendy smart lighting system that links to tablets and mobile devices. Meanwhile, HiCan established a smart mattress that pools the elements of entertainment, health management, and connectivity. When wearable tech and cooking appliances are shared, the ability to turn off the stove on your way to work can mend the levels of safety for families [14]. Behind the trendy products in home décor, there are services that connect household appliances into an entire home control system. This service tolerates users to decorate their homes while creating a new IoT environment. In fact, IoT-equipped homes are able to control heat via smartphone or virtual assistant, switch on/off lights with Wi-Fi, and start the pressure cooker from your smartphone. As last year's major trend in IoT was about security and energy efficiency, 2019 seems to be focusing on the "how" of making your home relaxing through smart decoration. Thus, we can only expect to see how home construction and makeover will be based on IoT functions in the near future [14].

Lack of IoT Awareness among Malaysian

According to IoT Malaysia Evangelist and CEO of REDtone IoT, Dr. Mazlan Abbas, one of the major challenges before Malaysia today is deficiency of IoT awareness. Dr. Abbas tells, "*People might have heard about IoT but mainly in the consumer space – wearables and smart homes applications. But since the cost is still expensive, not many are willing to use them except for the few, i.e., the early adopters.*" Now, we all know that wearables and smart home appliances become outdated just as quickly as they become trendy or fashionable. "*Personally, I have invested in many such devices just for the sake of becoming one the early adopters even though I know that after a year, it will be an 'old' gadget. But then again, there are not many people like me,*" quips Dr. Abbas [8].

Absence of Enterprise IoT Applications in The Country

Another challenge is the absence of enterprise IoT applications in the country. "*These devices are not as trendy and fashionable like their consumer counterparts. Sensors that are being used in enterprises will last longer – maybe 3-5 years or even more. They are more robust and sometimes well-hidden somewhere. Thus, there is no need for some fancy design to house the sensors. However, these sensors can be more expensive, and when we talk about hundreds or thousands of sensors, the cost of deployment can become very prohibitive,*" stated by Dr. Abbas [8].

Resistance from Within the Company (Transparency Is the Key to Productivity)

The industry necessities to come up with a win-win business model for both the IoT vendor and the user to solve this dilemma. But, before that, businesses need to tackle the resistance from within the company also. "*Transparency is the key to IoT implementation because it will translate to productivity,*" quoted by Dr. Abbas. "*It's easy to see how too much transparency can send jitters to some group of people or how pushing productivity eliminates jobs, that in turn may cause social issues.*" To put it simply, most people just don't know where to start their IoT journey. And we all know, the passage of a thousand miles originates with one step [8].

Users Perceptions on Iot As Part of Their Daily Life (Factors of Accepting the Technology Are Ease of Use and Usefulness)

Persuasive technologies, such as feedback systems providing real-time energy monitoring and recommendations, have been shown to raise the awareness of users about their energy consumption and inducing a long-term change in their behavior and lifestyle [18]. Studies related to IoT challenges stated that human aspect should be considered since IoT technology involves human as the main platform for interaction and the main challenge in the adoption of new technology such as IoT is the acceptance of the users. As suggested by Technology Acceptance Modelling (TAM), the predictive factors of accepting the technology are ease of use and usefulness [2]. Issues related to privacy and confidentiality are largely emphasized in the business perspective. The stakeholders are unlikely to adopt IoT solutions if there are no surety in terms of data confidentiality, authenticity and privacy [6]. Data confidentiality indicating the confirmation that only particular entities have the right to gain and manipulate data, whereby data may represent an asset to be protected to secure the competitiveness [6].

However, the recent solutions for ensuring data privacy are not straightforwardly applied in IoT framework due to the demand of observing the access to information in an on-line and controllable way [5]. Thus, in order to confirm confidentiality and privacy in knowledge management system, numerous access control techniques have been suggested, which comprises Role-Based Access Control (RBAC) that seriously used as a successful alternative to conventional discretionary and obligatory access control. The above revealed presents some of the issues related to the acceptance of IoT technology. Hence, it is critical to give attention to customer's good insight towards technology so that they will not hesitate to accept and use the technology in their daily routine [7].

RESEARCH METHODOLOGY

A collection of data analysed in this paper is gained through literature review from other authors in the aspect of IoT and smart home technology in Malaysia. Secondary data, such as books, articles, journals, newspapers, web page, reports, thesis, and conference proceeding were also the sources of information of this paper. The review process involves of data selection, data analysis and reporting. Review process focuses on the data selection. The analysis attempts to review on presenting the existing knowledge related to the use of IoT for smart home in Malaysia context, current issues, problems faced amongst Malaysians on smart home technology.

RESULTS AND DISCUSSIONS

To simplify the findings as below the points of issues and challenges of IoT and latest technology adoption for home building:

- Major issues were on security, privacy and protection of consumer data
- Demand and growth of IoT market among Malaysian (Smart homes allows individuals to create a flexible work-life balance that's useful for all ages)
- Lack of IoT awareness among Malaysian
- Absence of enterprise IoT applications in the country
- Resistance from within the company (Transparency is the key to productivity)
- Users perceptions on IoT as part of their daily life (Factors of accepting the technology are ease of use and usefulness)

Hence, three main challenges cited in the literature are perception of usefulness, confidentiality and privacy of consumer data, and absence of enterprise IoT applications in the country. Perception of usefulness was cited in six studies, while issues of confidentiality and privacy were cited in seven studies respectively. There was one cited by study of issue of absence of IoT enterprise in the country.

CONCLUSIONS

The focus of this review is to investigate the existing literature related to the challenges of issues and challenges of IoT and latest technology adoption for home building. For this purpose, many articles have been selected and analyzed. Based on the analysis, it was found that IoT implementation major issue significantly in terms of security, privacy and protection of consumer data. As currently many demands and growth of IoT in Malaysia because of its

usefulness and the market among Malaysian to create a flexible work-life balance through smart home living. However, there was a lack of IoT awareness among Malaysian. Absent of enterprise IoT applications in Malaysia needs to look for as the government currently supported the agenda of IoT, big data and artificial intelligence. Moreover company transparency needed for resistance in the business IoT application system towards the users. In this world of rapid growing of technology, IoT gives perceptions on how people can assimilate technology in their lives. As IoT is valuable information that could be used in numerous ways, it's internationally used, as well as Malaysia. Although it's beneficial, it also has flaws and obstacles in implementing it in the industries. There is lots of room for improvement, for an example the online education sector for home used on how IoT could fit in and be implemented in the Malaysian education system and working from home (WFH) as we reaching year 2021 with trend of new Norma because of pandemic Coronavirus.

ACKNOWLEDGMENTS

The authors acknowledge Manuel Schmidt (expert in IoT, Bosch, Germany) for recommended the author to focus the topic of paper related to IoT and smart technology as it is needed for the future generation as it's on the rise because of Coronavirus. Special thanks to those who contributed to this project directly or indirectly.

REFERENCES

1. U. W. Badarudin, W. I. Din, Y. A. Prasetyo, Z. Musa, and S. Kasim, *International Journal on Advanced Science Engineering and Information Technology* 8, 2641-2647 (2018).
2. T. Coughlan, M. Brown, R. Mortier, R. J. Houghton, M. Goulden and G. Lawson, "Exploring Acceptance and Consequences of the Internet of Things in the Home" (IEEE International Conference on Green Computing and Communications, 2012), pp. 148-155.
3. Information on <https://www.malaysia-insights.com/malaysia-leverages-on-internet-of-things/>
4. Information on <https://www.mcmc.gov.my/skmmgovmy/files/20/203a1c3e-3284-4186-ba8f-8cb3df165efd/files/assets/basic-html/page-39.html#>
5. D. Miorandi, S. Sicari, F. De Pellegrini and I. Chlamtac, *Ad Hoc Networks* 10, 1497-1516 (2012).
6. M. Miraoui, S. El-etriby, A. Z. Abid and C. Tadj, *International Journal of Smart Home* 10, 39-54 (2016).
7. N.H.Arjumin, S.Sidek, M.A.Hassan, N.Kudus, S.Mohamed, M.A.N. Rajikon, et al. *International Journal of Recent Technology and Engineering (IJRTE)*, 8 (2019).
8. Information on <https://www.geospatialworld.net/blogs/iot-malaysia-adoption-challenges/>
9. Information on <https://www.autodesk.com/redshift/what-is-the-internet-of-things-design/>
10. Information on <https://www.tmone.com.my/assets/pdf/smart-industry-showcase/>
11. E. Wahab, 2. Shamsuddin, N. Abdullah and 4. S. Yi, "A Study on The Smart Home Adoption In Malaysia: A Foresight Perspective" (Proceedings of 112th The IRES International Conference, 2018) pp. 1-5.
12. Information on <https://www.businesswire.com/news/home/20191211005823/en/Malaysia-Smart-Home-Market-Report-2019-2025-Number>.
13. Information on <https://www.consumersinternational.org/media/1292/connection-and-protection-the-internet-of-things-and-challenges-for-consumer-protection.pdf>
14. Information on <https://nicolaswindpassinger.com/smart-homes-when-interior-design-meets-the-internet-of-things>
15. M. G. Salimona, A. H. Gorondutse and H. H. Abdullah, *IOSR Journal of Business and Management* 20, 60-69 (2018).
16. A. Totonchi, "Internet of Things for Smart Home: State-of-the-Art Literature Review" (International Islamic University Malaysia, 2018).
17. A. Monacchi, D. Egarter and W. Elmenreich, "Integrating Households into the Smart Grid" (IEEE Workshop on Modeling and Simulation of Cyber-Physical Energy System, 2013).
18. S. Darby, "The effectiveness of feedback on energy consumption: a review for DEFRA of the literature on metering, billing and direct displays" (University of Oxford, Environmental Change Institute, 2006).
19. D. Sivakumar, M. F. B. Jusman and A. N. B. M. Mastan "A case study review: Future of Internet of Things (IoT) in Malaysia" (In ASCENT International Conference Proceedings–Information Systems and Engineering, 2017) 23-24.