

The Challenges and Contribution of Internet of Things (IoT) for Smart Living

N.H.arjumin, S.Sidek, M.A.Hassan, N.Kudus, S.Mohamed, M.A.N.Rajikon, M.Kamalrudin

ABSTRACT: *The evolution of Internet and advanced in ICT had led to the increasingly usage of Internet of Things (IoT) in various sectors and facilitated borderless connection in various fields. Contextualised within the development of Smart City, much have been reported on the challenges and contribution of using of IoT for smart living. This paper presents a review of the challenges and contribution of using IoT for smart living. Using a systematic method to analyse the literature, 31 articles have been selected for the review. It was found that the contributions of IoT surpass the challenges of using IoT. Two significant contributions have been identified, which are facilitating communication and improving safety as well as improving quality of life. Meanwhile, 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. This review provides an overview of the adoption of IoT for Smart Living, focusing on its challenges and contribution.*

KEYWORDS: *Internet of Things (IoT), smart living, challenges, contribution*

1. INTRODUCTION

The Internet of Things (IoT) is getting a lot of hype due to its promises for a smarter future where things and human are connected via wireless technology to communicate with each other [1].

Revised Manuscript Received on June 01, 2019.

M. A.Hassan, N.Kudus, S.Mohamed, M.A.N.Rajikon

Centre for Languages and Human Development, Universiti Teknikal Malaysia Melaka

N.H.Marjumin, S.Sidek, M. A.Hassan, Kamalrudin

Institute of Technology Management and Entrepreneurship, Universiti Teknikal Malaysia Melaka.

S.Sidek, M.A.Hassan, N.Kudus, S.Mohamed, M.A.N.Rajikon, M.Kamalrudin, Research Group IS3, C-Act, Universiti Teknikal Malaysia Melaka

It is also widely used to access multimedia content and services and other various tasks using social network applications, where statistically around two billion people using internet in their daily activities [2]. Together with its development and wide usage, IoT has led to borderless connection in various fields and brought the society to a new level of lifestyle and environment, which is known as “smart living”. The concept of the “smart living” originally came from the concept of Smart City. In this context, the IoT functions as strategic communication devices to enhance the competitive profile of a city [3]. Most of the literature categorized smart living as one of the dimensions in Smart City, smart economy, smart environment, smart people, and smart governance [4]. Smart living is everyday objects in our living environments segmented with digital technology [5] and it consists of three basic aspects, which are smart technology, smart materials and smart design that contribute towards the achievement of the user oriented goals with respect to safety and security, healthcare, accessible and comfort [6].

Relating IoT as the innovation of technology, the theory of diffusion of innovations suggests the acceptance of users towards a new technology greatly depends on how the technology is being introduced and the user’s perception towards its usefulness [7]. When users perceive the technologies as ease to use and give more contribution, they will easily accept these technologies in their daily life [8][9]. Other challenges related to IoT are privacy and security [8][10]. To ensure the acceptance of customers towards technology, the system-level confidentiality, and privacy’s guarantee are essential [11][12]. Although there are challenges in using IoT, it also brings contribution for users. Ref. [13] describes IoT technologies to support telemonitoring and assistance. Through the development of a smart assistive prototype called Ambient, IoT helps to observe, show and balance emotions or mental states, offers to raise the quality of life for people at home [14], task performance among abnormal people [15]. Within the context of Smart environment, IoT brings users to access their data from any devices connected to

network [16].Further, the implementation of IoT in Smart city optimizes the capabilities of city services[17][18].There is also an increase usage of IoT among elderly people where it fosters autonomy as well as increases safety in the home environment [19]. Many have claimed that the usage of IoT among society leads to new opportunities for the Information and Communication (ICT) sector and improves the functioning of the process undertaken in companies [2][4][11][12].

The discussions, thus far have shown that the usage of IoT has been widespread and directly related to the development of smart living. The purpose of this paper is to present a review of literature related to the implementation of IoT. It is related to the research and reviews conducted for the use of Internet and social media [20][21][22]. The conduct of the literature was guided by two research questions, which are (i) what are the challenges related to IoT and (ii) how does IoT contribute to development of smart living. The second research question is addressed by focusing on the contribution of IoT. This paper is organized into five sections. The introduction presents a brief discussion of the challenges and contribution of IoT, followed by the research methodology in the second section. The third section presents the result and discussion section. The paper ends with a conclusion section and future work related to the use of IoT for the development of smart living.

2. RESEARCH METHODOLOGY

This review focuses on presenting the existing knowledge related to the use of IoT for Smart Living. IoT has been used in many areas that attempt to improve efficiency through its implementation. The review process involves two phases, which are:Phase 1, protocol for data selection and Phase 2, data analysis and reporting.

Phase 1: Protocol for data selection

Phase I of the review process focuses on the protocol for data selection. It started with identifying relevant studies using keywords. Using the keywords such as; “Internet of things”, “smart living”, “Smart city” and “usage of IoT”, we explored and selected the paper from sources such as journal, online books, conference, thesis and many others to identify the relevant literature. Initial searches for primary studies were undertaken using online database which are ScienceDirect, Google scholar, Emerald, PDF search engine, Scopus, EBSCOhost, and Springer Link. Checking references of each relevant articles was also one of the alternatives for the primary study.

All of the keywords were searched based on different combination. As stated, the sophisticated search strings can be constructed using Boolean AND’s, NOT’s and OR’s. As shown in Figure 1, the search process resulted in a total of 2,620 papers. Due to the extensive number of researches found, we refined our search based on the recent eight years publications, which is from 2009 to 2017. Then, we proceeded by scanning the abstract and introduction of the papers. The focus of the screening was on the phrase “IoT” and “smart living”, “contribution”and “challenges”

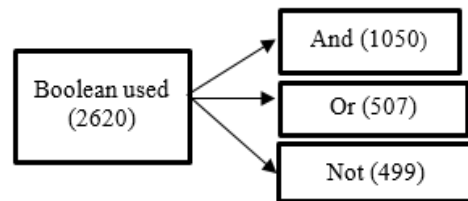


Figure 1: Boolean used

Papers that are not relevant to our study were ignored. The scanning of the abstract and introduction resulted in the acceptance of 75 relevant papers. To ensure the similarity and quality of the selected papers, the inclusion and exclusion criteria were adopted. The relevant papers were selected based on the criteria presented in Figure 2, which shows a total of 44 papers were excluded, while only 31 papers were included for the analysis. The papers included in this analysis cover both the contribution (26 papers) and challenges (5 papers) of implementing IoT, while the excluded papers include paper discussing the architectural aspect. These selected papers were further analyzed following the second phase of this review.

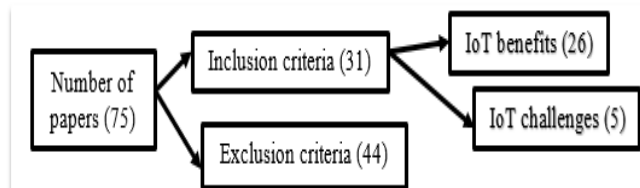


Figure 2: Inclusion and Exclusion criteria

Phase 2: Data Analysis and Reporting

The review presented in this paper was drawn on 31 papers based on the two levels of selection described above. These papers were analyzed based on the research objectives.

Specifically, it focuses on the contribution and challenges of IoT. The results of the analysis are presented below.

3. RESULTS& DISCUSSION

This section presents the findings of the literature review focusing on the challenges and contribution of implementing IoT. Table 1 presents an overview of the challenges and contribution of implementing IoT. Based on Table 1, it was found that only 5 studies discuss the challenges on IoT, while 26 studies discuss the contribution of IoT. There are also three studies that discuss both the contribution and challenges of IoT. Thus, it can be concluded that IoT has a promising future as there are more contribution being discussed in comparison to the challenges.

RQ1: What are the challenges related to IoT?

Table 1 summarises the challenges of IOT as cited in the existing studies. Three main challenges cited in the literature are perception of usefulness, confidentiality and privacy. As shown in Table 1, perception of usefulness was cited in one study, while issues of confidentiality and privacy were cited in two studies respectively. 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 [9].

Issues related to privacy and confidentiality are largely highlighted in the business context. The stakeholder are unlikely to adopt IoT solutions if there are no surety in terms of data confidentiality, authenticity and privacy [23]. 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 [23]. However, the current solutions for ensuring data privacy are not straightforwardly applied in IoT context due to the demand of monitoring the access to information in an on-line and manageable way [11]. Thus, in order to ensure confidentiality and privacy in knowledge management system, numerous access control techniques have been proposed, which includes Role-Based Access Control (RBAC) that greatly used as a successful alternative to conventional discretionary and mandatory access control. The above mentioned presents some of the issues related to the acceptance of IoT technology. Hence, it is critical to give

attention to customer’s good perception towards technology so that they will not hesitate to accept and use the technology in their daily routine.

Item/ author	Benefits							Challenges		
	Quality of life	Safety & communication	Real-time information efficiency	Improve healthcare	awareness & monitoring	smart city & transport	Perception on usefulness	confidentiality	privacy	
[3]									/	
[6]	/									
[7]		/								
[9]	/						/			
[10]		/	/	/						
[13]		/								
[14]	/									
[15]		/								
[16]		/			/	/				
[17]			/	/						
[19]		/			/					
[23]	/							/		
[24]	/	/								
[25]	/		/	/						
[26]		/								
[27]	/									
[28]					/	/				
[29]										
[30]						/			/	
[31]								/		
Total	7	8	3	3	2	1	2	1	2	

Table 1: Contributions and Challenges of IoT

RQ2: How does IoT contribute to development of smart living?

The second research question is addressed by focusing and the contribution of IoT. It is expected that the contribution of IoT is strongly related to its contribution to Smart Living. As shown in Table 1 seven contribution of IoT have been identified. Based on the analysis of the 31 papers, it can be concluded that IoT the two main contribution of IoT are safety and communication (8 papers) and enhancing the quality of life (7 papers). Meanwhile, the other contribution were cited in fewer papers. They are i) accessing to real-time information (3 papers), ii)improving services efficiency (3 papers), iii) improving healthcare (2 papers), and iv) development of smart city and smart transport (2 papers). Benefit related to increasing awareness and monitoring was cited by one paper only.

Safety and communication is considered as the main contribution of IoT in developing Smart Living. Communication enables achievement of a common goal [5][16]. The dramatically changing of demographic in the industrialized countries, it helps people with special needs to maintain and foster their autonomy, thus increasing

safety in living[13][15]. The ability of IoT to enhance people-to-people communication improve their quality of life, energy saving and security [19] [23]. However, in order to ensure the safety and wellbeing in one's home, with the help of smart items, the home has to become intelligent first [15]. Smart home is a residence equipped with technology that enhances safety of patients at home and monitor their health conditions [7]. In terms of smart city, the safety aspect can be optimized by fully utilization of information such as the speed of the buses, road and lights conditions. This information will be communicated to other buses in order to optimize their cruising [10]. All the seven studies show that IoT contribute to the quality of life in Smart Living. It is claimed that the concept of smart living involves the quality of live, which involves a number of terms such as healthy environments[24][25]. IoT has the ability to provide may lead to a good environment by surrounding patients where they know what they should do instead of always being controlled by users [14][23][26]. However, in order for IoT to allow people to better perform their daily living activities and enjoying entertainment and leisure activities, users must first understand their needs and develop a key technology to support such needs [14]. The promotion and combination of smart houses with other smarter elements of cities could affect a significant enhancement of the quality of life and a stronger city sustainability [27][28].

From the organizational perspectives, IoT brings new businesses; smart city as well as smart transport are developed. IoT supports the process of automation in relation to smart organization [29]. IoT technologies offer the development of new business opportunities by enhancing the cross-cutting applications and services based on the use of a common underlying ICT platform [11]. With respect to Smart tourism destinations tourism destination utilizes the resource management towards maximizing consumer's satisfaction while demonstrating sustainability over an extended timeframe [25]. Thus, the development of Smart Tourism destinations also encourage the formation of smart city [25]. Moreover, environmental control system help to enhance people's health status [19]; thus boosting their immunity to prevent diseases. The system provides a good sleeping environment with a soft illumination of light and comfortable air flow of space [26][29]. There were three studies discussed that IoT provides easy access to the real time information and increase the efficiency in Smart Living environment. A report by economist entitled "It's a smart world", IoT services promotes borderless access to value-added services and greater efficiency, such as real time information on public transport network[10] [25]. Next, the invention of TV camera that monitor children when most of working parents have little

capabilities to monitor their children [9][16]. However, IoT technology could be particularly evolves tension in child-parent relationship [9]. For instance, in a research by ref. [30] regarding monitoring in diabetic children by their parents, shows that particular tensions arose in later adolescence where they want some space to take control while parents remain enthusiastic about their welfare and they seek to maintain access to data[30][31].

As a summary, it can be concluded that various contributions of IoT that brings towards development of Smart Living [32]. The most cited contributon of IoT is communication and safety of users. This is based on the growth of the industrialized countries which experience an increase in the life expectancy [33] and a decline in the birth rate. Living in this condition, there is a need for a system that can guarantee their safety at home. In general, it can be concluded that IoT has a significant contribution to the development of Smart Living [34].

4. CONCLUSION

The focus of this review is to investigate the existing literature related to the challenges of IoT and its contribution to development of Smart Living. For this purpose, 31 articles have been selected and analyzed. Based on the analysis, it was found that IoT contributes significantly in terms of improving the quality of life, safety and communication. However, in order to implement the IoT, several challenges need to be considered, which are related to the privacy and security and users acceptance related to the perception of easiness when using IoT. Based on the analysis, it was found that less emphasis was given on the ways to resolve the challenges. Although an extensive research was found in this field of study, studies that focus on smart living in Malaysia are very limited.

ACKNOWLEDGEMENT

We acknowledge the financial support from the Ministry of Education, Malaysia and the Universiti Teknikal Malaysia, Melaka for their assistance in this research. PJP (PJP/2015/PBPI(4D)/S01457).

REFERENCES

- [1] Caragliu, A., Bo, C.D., and Nijkamp, P. Smart cities in Europe. 3rd Central European Conference in Regional Science-CERS. pp.45-59, 2009.
- [2] Alarcón, F., Perez, D., and Boza, A. Using the Internet of Things in a Production Planning Context, Brazilian Journal of Operations & Production Management, 13 (1), pp.72, 2016.
- [3] Atzori, L., Iera, A., and Morabito, G. The Internet of Things: A survey. Computer

- Networks, 54 (15), pp.2787–2805, 2010.
- [4] Lombardi, P. and Giordano, S. An Analytic Network Model for Smart Cities., pp.1–6, 2011.
- [5] Hsieh, J.L.C.A Wireless BCI-Controlled Integration System in Smart Living Space for Patients, pp.395–412, 2016.
- [6] Chen, S.Y. and Chang, S.F. A Review Of Smart Living Space Development In A Cloud Computing Network Environment.Computer-Aided Design and Applications, 6 (4), pp.513–527, 2009.
- [7] Demiris, G., Rantz, M.J., Aud, M.A., Marek, K.D., Tyrer, H.W., Skubic, M., and Hussam, A.A.Older adults'attitudes towards and perceptions of 'smart home'technologies: a pilot study.Medical informatics and the Internet in medicine, 29 (2), pp.87–94, 2004.
- [8] Sun, H. and Zhang, P. The Role Of Moderating Factors In User Technology Acceptance.International Journal of Human Computer Studies, 64 (2), pp.53–78, 2006.
- [9] Coughlan, T., Brown, M., Mortier, R., Houghton, R.J., Goulden, M., and Lawson, G. Exploring acceptance and consequences of the Internet of Things in the home. Proceedings - 2012 IEEE Int. Conf. on Green Computing and Communications, GreenCom, Conf. on Internet of Things, iThings and Conf. on Cyber, Physical and Social Computing, CPSCom 2012, pp.148–155, 2012.
- [10] Haoyu, L., Jianxing, L., Arunkumar, N., Hussein, A. F., &Jaber, M. M. (2019). An IoMT cloud-based real time sleep apnea detection scheme by using the SpO2 estimation supported by heart rate variability. Future Generation Computer Systems, 98, 69-77.
- [11] Miorandi, D., Sicari, S., De Pellegrini, F., and Chlamtac, I. Internet Of Things: Vision, Applications and Research Challenges. Ad Hoc Networks, 10 (7), pp.1497–1516, 2012.
- [12] Ziegeldorf, J.H., Morchon, O.G., and Wehrle, K. Privacy in the internet of things: Threats and challenges. Security and Communication Networks, 7(12), pp.2728–2742, 2014.
- [13] Dohr, A., Drobits, M., Hayn, D., and Schreier, G. The Internet of Things for Ambient Assisted Living, n.d.
- [14] Chen, L., Nugent, C., Mulvenna, M., Finlay, D., and Hong, X. Semantic Smart Homes:Towards Knowledge Rich Assisted Living Environments.Studies in Computational Intelligence,189, pp.279–296, 2009.
- [15] Villarroel, M.J. and Villarroel, C.H. Wireless smart environment in Ambient Assisted Living for people that suffer from cognitive disabilities, 22, pp.158–168, 2014.
- [16] Yusufov, M. and Kornilov, I. Roles of Smart TV in IoT-environments : a Survey. Proceeding of the 13th Conference of Fruct Association, pp.163–168, 2013.
- [17] Vicini, S. and Sanna, A. How to Co-Create Internet of Things-enabled Services for Smarter Cities.The First International Conference on Smart Systems, Devices and Technologies, (c), pp.55–61, 2012.
- [18] Shakeel, P.M., Tolba, A., Al-Makhadmeh, Zafer Al-Makhadmeh, Mustafa Musa Jaber, "Automatic detection of lung cancer from biomedical data set using discrete AdaBoost optimized ensemble learning generalized neural networks", Neural Computing and Applications,2019,pp1-14.<https://doi.org/10.1007/s00521-018-03972-2>
- [19] Boers, N.M., Chodos, D., Huang, J., Gburzyrski, P., Nikolaidis, I., and Stroulia, E. The Smart Condo: Visualizing Independent Living Environments in a Virtual World , n.d.
- [20] Sidek, S., Kudus, N., Izharudin, S.Z., Kamalrudin, M., Hassan, M.A. and Mohamed, S. Factors influencing internet addiction among university students: A review, Sci. Int. 28, pp.1343-1346, 2016.
- [21] Dora, M.T., Sidek, S., Hassan, M.A., Mohamed, S., Kudus, N., Mustaffa, F., and Mokhtar, M.Y.O. Internet addiciton among urban youths in Melaka, Asian Journal of Information Technology, 16(1), pp.14-18, 2017.
- [22] Mohamed, S., Sidek, S. Izharuddin, Z., Kudus, N. and Hassan, M.A. Social media impact on employee productivity at the workplace: A review, Asian Journal of Information Technology, 16(1), pp. 32-37, 17.
- [23] Miraoui, M., El-etriby, S., Abid, A.Z., and Tadj, C. Agent-Based Context-Aware Architecture For A Smart Living Room, 10 (5), pp.39–54, 2016.
- [24] Bodhuin, T., Canfora, G., Preziosi, R., and Tortorella, M.. Hiding Complexity And Heterogeneity Of The Physical World In Smart LivingEnvironments, pp.1921–1927, 2006.
- [25] Buhalis, D. and Amaranggana, A. Smart Tourism Destinations, n.d.
- [26] Lin, C., Lin, B., Lin, F., and Chang, C. Brain Computer Interface-Based Smart Living Environmental Auto-Adjustment Control System in UPnP Home Networking, 8 (2), pp.363–370, 2014.
- [27] Panwala, Fenil C., R. Kumar, and P. Mohamed Shakeel. "An analysis of bacteria separation and filtration from blood sample using passive methods." Measurement (2019).<https://doi.org/10.1016/j.measurement.2019.02.037>
- [28] Werthner, H., Alzua-Sorzabal, A., Cantoni, L., Dickinger, A., Gretzel, U., Jannach, D., Neidhardt, J., Pröll, B., Ricci, F., Scaglione, M., Stangl, B., Stock, O., and Zanker, M., 2015. Future research issues in IT and tourism: A manifesto as a result of the JITT workshop, Vienna. Information Technology and Tourism, 15 (1), pp.1–15, 2014.
- [29] Investigation, O. Association Between Sleep and Blood Pressure in Midlife. Jama Internal Medicine, 169 (11), pp.1055–1061, 2009.
- [30] Furman, W. Age and Sex Differences in Perceptions of Networks of Personal Relationships Child Development, pp.103–115, 1992.
- [31] Toscos, T.R., Connelly, K., Rogers, Y., Toscos, T., and Connelly, K. Best Intentions: Health Monitoring Technology Best Intentions: Health Monitoring Technology and Children, 2012.
- [32] Kyriazis, D., Varvarigou, T., White, D., Rossi, A., and Cooper, J. Sustainable smart city IoT applications: Heat and electricity management & Eco-Conscious Cruise Control For Public Transportation. IEEE 14th International Symposium on a World of Wireless, Mobile and Multimedia Networks, WoWMoM, 2013.
- [33] Ghaffarianhoseini, A., Dalilah, N., Berardi, U., and Ghaffarianhoseini, A. The essence of future smart houses : From embedding ICT to adapting to sustainability principles, 2013.
- [34] Baggio, R., Sigala, M., Inversini, A., Pesonen, J., and Eds. Information and Communication Technologies in Tourism 2014. eProceedings of the ENTER 2014 PhD Workshop, pp.1–146, 2013.