

Smart Urban Management and IoT; Paradigm of E-Governance and Technologies in Developing Communities

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Abstract—Technologies as one of the factors of smart urban governance have a critical role in the accomplishment and development of smart cities. IoT and ICTs as an evolving technology can assist governmental agencies in integrated urban management. Therefore, this study was designed to answer two research questions of what application does IoT and generally ICT have in smart urban governance? and what is their impact on citizens' participation? For comprehensive analysis of scientific documents and empirical evidence, two methods of review study and survey study on 400 residents of Isfahan city were used. The results of the review study show that online services, monitoring, data gathering, public e-participation, and cooperation enhancement are the five potential uses of IoT and ICTs in smart urban administration. While survey outputs depict that for efficient use of technology in management, the simultaneous development of technical and social infrastructure is essential. In conclusion, the promotion of the IoT, like other technologies in smart urban governance, needs the proper association with management, social, cultural, economic, and environmental systems. Hence, the present study provides recommendations to develop this alignment and to facilitate the use of IoT in urban governance.

Keywords: Smart urban governance, E-Governance, Internet of things, E-Participation, Information and communication technologies

I. INTRODUCTION

In the recent decade, the concept of smart cities has expanded widely in urban management and planning. Future cities are mechanized cities in which most of the urban activities will proceed through smart portals [1],[2]. Smart governance is an essential part of smart cities. In smart governance, officials must be accountable to the urban issues and address the various challenges to the people. Citizens must also participate smartly through ICTs in the urban development and decision-making process, solving urban problems and pursue their rights [3],[4]. Smart government is a platform for good urban management. All the services that are provided in a smart city should be administered to the people through the smart governance channel. This type of governance increases citizens' participation in various activities and reduces the costs of urban management and co-operations [5].

In the world of crises in the 21st century, especially at the time of writing the article, when the crisis of the coronavirus pandemic has overshadowed cities and human societies, the need for smart urban governance to achieve sustainability is

increasingly felt [6]. Electronic coordination between different organizations and components in a government enhances the quality of services and increases the possibility of achieving the management goals at different levels. The most important objectives of smart governance are; I- Development of communication networks using ICTs, II- Promote comprehensive and integrated information systems, III- Realization of e-government and acceleration of management affairs, IV- Automation of decision-making and development processes [7].

In realizing smart urban governance and as an element of smart cities, the Internet of Things (IoT) is a revolutionary technology that seeks to solve the socio-spatial problems that modern communities face. IoT can be used in numerous smart city applications, including (but not limited to) comprehensive community planning, city-wide service monitoring, expanding public transit while reducing traffic congestion, improving neighborhoods safety, and facilitating sustainable e-mobility. The Internet of Things has been increasingly evolving in various fields, culminating in the development of several platforms, standards, and protocols, etc. Different forms of IoT networks and technologies are implemented in today's smart cities, and they all run independently [8],[9].

As mentioned, the Internet of Things plays an important role in smart cities, and many studies have examined the applications of the IoT in smart cities. However, fewer studies have focused on the use of the IoT in smart urban governance, and the role of this technology in urban planning and development processes is still vague [10]. Therefore, the present study has been compiled to answer two basic questions; What is the role of the Internet of Things in smart governance? And what effect do the IoT and ICTs have on the quantity and quality of citizens' participation?

II. PROPOSED METHOD

In order to integrate theoretical documents and empirical evidence, two methods of review study and survey study have been used in this research.

A. Review Study

To answer the research questions, the method of systematic literature review was used for a detailed analysis of scientific studies. Systematic review is a structured form of literature review that focuses on one or more specific questions and attempts to provide answers using the analysis of all available valid resources. Systematic review is a

common and recent method of investigating the related literature, formulated by Cooper and Hedges (2009) in six stages; problem definition, literature search, data evaluation, data analysis, interpretation of results, and conclusion [11].

In the Introduction section, the problem was defined and the questions were explained. The materials of this study are relevant papers indexed in Scopus, Web of Science, PubMed, Routledge, and IEEE in the period of 2011-2021. Because the smart urban governance and the use of IoT in management sectors are more recent topics. The search string is as follows:

TITLE-ABS-KEY [(“IoT” OR “Internet of Things”) AND (“Smart governance” OR “Urban Governance” OR “Urban Management” OR “Citizen Participation” OR “E-Governance” OR “E-Participation”)]

An initial search in databases on January 20, 2021, returned 17 articles. This small number indicates the study gap in this field. Therefore, more general studies were included in the analysis from other sources, namely recommendations from academics and peer reviewers. Systematic literature procedures, such as the PRISMA method, allow the use of documents from sources other than database searching [12]. This increased the number of studies to 20 (which all of the studies are provided in the References section).

The chosen papers were thoroughly examined to extract the data required for the analyses presented in the following sentences. CMA 3.0 software was used for accurate analysis of the studies' text. CMA 3.0 is a professional application for meta-analyze and meta-regression. And it was used because it has more features for deeper scientific text analysis than Excel. To analyze the contents of the articles, a spreadsheet was designed with selected papers on the rows, and columns for collecting data on a wide range of items and issues. There were three phases of the analysis. To begin, the author read several papers and gathered the necessary details (Phase 1). Then the information collected was double-checked, and grouped into several themes based on commonalities, and information was coded (Phase 2). Finally, in the third phase, the coded data was reexamined and used for writing the article (Phase 3).

B. Survey Study

Survey methods were employed for making more reliable conclusions and to use empirical evidence in response to research questions. The case study in this survey is Isfahan city and people's electronic participation in its comprehensive master plan. Isfahan Master Plan is an urban plan with a participatory approach, parts of which were held online and through the portal of ICTs due to the widespread of coronavirus in 2020 [13].

For this purpose, a closed-ended online questionnaire consisting of 15 questions was designed related to the level of people's knowledge about the Internet of Things, their ability and willingness to use the Internet to participate in public affairs, as well as their electronic participation in Isfahan Master Plan more specifically.

The population studied in this survey are citizens of Isfahan. Cochran's formula was used to determine the sample population size [14]. Base on this formula and the fact that

Isfahan has over 1.96 million inhabitants, the sample size must be over 385 people to reach at least 95% reliability and generalizability in findings. Therefore a sample size of 400 citizens of Isfahan was studied.

After determining the size of the sample population, experimental samples (including 30 residents of the city) were randomly selected to assess the reliability and validity of the questionnaire. For this purpose, Cronbach's alpha test in IBM SPSS software was used [15]. Cronbach's alpha coefficient was 0.77 for the experimental sample and 0.84 for the total sample population. Therefore, the questionnaire used could be cited and accepted.

III. FINDINGS AND RESULTS

The Internet of Things as an evolving technology plays an effective role in the accomplishment of smart cities. The statement that the IoT is one of the key factors in smart cities is agreed upon by most of the experts in this field [16]. The two major roles of the Internet of Things in smart cities and smart governance are to provide services and to transfer data and information [17]. According to the scientific literature, there are five major applications for the IoT in smart urban management; Online services, Monitoring, Data gathering, Public e-participation, and Cooperation enhancement.

The extent of IoT applications is directly related to the knowledge of officials and citizens about it and the access to the required technology [7],[10],[18]. Therefore, before addressing IoT applications in urban governance, the level of citizens' knowledge of it and the public access to technology must be evaluated.

The results of the survey study shown that only 69 out of 400 people in the sample (17.2%) know the Internet of Things and its applications. Many citizens confused the IoT and the Web, which depict the lack of knowledge about IoT in the case study. The next finding is that only 3.7% of the sample have the experience of using IoT in their life and work. Regardless of smartphones, smart accessories like smart bands or watches are the most common technologies that were used, usually for exercises and daily activity among the sample. Many people stated that the reason for not using the IoT was lack of knowledge, high cost, and even uselessness. So, public culturalization and providing cost-efficient technologies are needed to use the IoT in a developing community like Isfahan.

Here, it should be noted that before starting to fill out the designed questionnaire, IoT and its applications were briefly explained to the participants.

A. Online Services

One of the main tasks of urban management agencies is to provide critical services to citizens. The continuity of these services in different situations, especially in the crises era, shows the efficiency of urban governance. Services can be provided in a traditional way (face-to-face) or online. Providing face-to-face services is usually time-consuming, costly, and requires multiple facilities. Besides, it is not possible to provide services face to face in all conditions (such as conditions resulting from the onset of coronavirus epidemy) [6],[19].

On the other side, using the internet in the provision of services, regardless of the cost of creating and developing basic infrastructure, reduces costs and speeds up bureaucratic processes. Also using cyber cloud space can reduce geographical constraints and lead to a fair distribution of services [20]. IoT and ICTs are the portals of online services and different settings can be provided through IoT and ICT networks. These technologies can turn available tools such as smartphones, smart TVs, computers, laptops, smart gadgets, etc. into a platform for requesting and receiving services. So, people can benefit from e-government and other urban settings anytime, anywhere [9]. Studies have listed several other benefits of using the IoT and ICTs in management. But using technology in public sectors may have some limitation and impacts.

Here, it should be noted that in some studies, internet-based services have been introduced as a factor of boosting segregation between citizens who have access to the internet and those who cannot afford technology [21]. This inequality can also happen among age groups; Between the youth generation who has the knowledge of using the internet and older people who are less familiar with the web-based functions [22]. Therefore, before the development of IoT in urban management, developing a correct understanding of the IoT and web-based services as well as empowering different social groups to use them is essential.

Survey study findings mainly support the results of scientific literature. Many people in the sample (81.7%) said they were aware of online services. However a smaller percentage (30.2%) had experience of using internet services (either via the IoT or other web-based portals), and most of them expressed their satisfaction with the speed and accessibility. Among those who were aware of internet services but did not use them, lack of acquaintance with how to request services, lack of sufficient trust and knowledge of working with the Internet, or lack of appropriate facilities was the most important reason for choosing traditional ways. A small number of these people also thought if they applied for services face to face, they would receive a better response.

Findings of the literature review and the questionnaire show that the use of the IoT and generally technology to provide services is an issue more than just implementing the required infrastructure. In addition to providing appropriate web-based services, local governments should urge citizens to use these services. This encouragement can occur in a variety of ways, such as advancing public awareness, improving citizens trust, offering special benefits, etc [8].

B. Monitoring

In good urban governance, it is important not only to provide services but also to maintain and monitor them. Studies show that maintaining services and facilities over time is more expensive than providing them. Therefore, the development of an Internet-based network such as the IoT is essential for monitoring services and infrastructures [23].

IoT monitoring is an IoT-based approach that allows management agencies to analyze dynamic systems and process billions of events and alerts. IoT monitoring also enables governance to bridge the gap between devices and services by collecting and analyzing diverse IoT data at web-scale across connected devices, citizens, and applications [24]. Also, IoT monitoring can be used in different scales to maintain natural and built environments. The Internet of Things helps to forecast and monitor crises and potential hazards such as forest fires, and epidemics outbreak. Besides, it can evaluate the resistance of dams and infrastructures to earthquakes, floods, etc [25].

Empirical evidence shows that for better IoT monitoring, the private sector and the public sector should use the IoT concurrently. Achieving this goal depends on the type of interaction between the private sector and the public sector in different governments. In other words, the private sector in smart cities can identify the needs of the target community to provide better services and develop businesses in collaboration with urban governance and legal use of web-based monitoring data [26].

To analyze findings from the survey in this field, the sample population clustered into 3 groups; Unemployed, Private sector employees, and Public sector employees.

Among private sector employees, 29 out of 62 people state that they use the internet to provide and monitor their services. Only one person has the experience of using IoT in his business.

Among public sector employees, 28 out of 36 people have experience of using the internet to provide and monitor services, most of whom are employees of banks and municipalities. Here only 7 people conveyed that they use Internet of Things.

It can be a result that the lack of smart internet usage still exists in both private and public sectors. In order to realizing e-governance and smart city in the case study, it is necessary to develop and integrate web and IoT in the management structures.

C. Data Gathering

Data collection¹ is one of the most costly and complex processes in urban management. Collecting data such as climate information, the volume of traffic on a particular street, census data of citizens and buildings, etc. annually costs a lot of time and money from the agencies of urban and national governance. Therefore, local governments use the Web and the IoT to gather information from people, different environments, and urban systems [8].

1- It should be mentioned that IoT monitoring is a more specific form of IoT data gathering and in some cases, they have a similar definition. But since in many studies, monitoring and data collection are introduced as two separate applications and have different principles, in the present study, they have been proposed as two separate uses of the IoT in management, too.

Using sensors to control the states of physical objects is known as IoT data collection. The IoT allows devices and technologies to track and measure data at any time. The information is transmitted, preserved, and retrievable. IoT data gathering enables comprehensive management of different urban systems and assists planners and managers in integrated decision-making [27].

The Internet of Things also plays an important role in managing and processing big data for smart urban governance. As organizations require data for analysis, IoT serves as a main source of that information, and this is where the role of IoT in gathering and managing big data comes into play. Big data analytics is gaining traction as a means of processing IoT-generated data from "connected devices", leading to better decision-making [28].

In general, data collected by the IoT consists of two categories based on the data source; Data gathered from people, and Data gathered from the environment. According to privacy protocols, individuals must be informed and aware of critical information that IoT or other platforms collect from them and their private environment [29]. Survey outputs depict that less than a percent of the sample, willing to let sensors collect data from them and their living environment. Most citizens stated that they prefer to provide required information by themselves.

Information collected from individuals through the IoT or through their own statements is known as one-way participation. While the IoT and internet platforms have the ability to allow data to be exchanged bilaterally between individuals and governments which can lead to public e-participation.

D. Public E-Participation

One of the most important elements of smart governance is citizen participation, which according to the literature has many capacities and opportunities. Citizens may have practical and beneficial recommendations to help government authorities make effective policy choices [20].

The studies show that technology-assisted government programs have considerable results in terms of public participation. The majority of the literature focused on non-participatory and non-deliberative practices such as finding political patronage, consulting, or providing one-way information [7]. While some studies depict that IoT and ICTs have a great potential in developing two-way interaction between organizations and users (here refer to citizens). Discussion forums, electronic town hall meetings, and wikis are examples of technological applications that can be used in two-way networking systems where people can productively communicate with each other and with different agencies. The expanded use of IoT and ICT tools support citizen-created content, which promotes diversity of opinions, socio-political dialogue, and freedom of speech while also fostering crowd-sourcing initiatives and innovations [30].

Reports indicate that the use of technology in the participation also increases the presence of different age

groups, especially youths, in decision-making processes. But the fact is that although ICTs are well developed in decision-making processes, the use of IoT in participatory approaches is still in question. However, it is expected that there will be the same pattern for the development of both in urban participatory management and planning [26],[31].

The survey study of this research, which was partly done on the comprehensive master plan of Isfahan and citizen participation in it, shows different results from the conclusion of theoretical studies. Only 5 out of 400 (1.2%) have participated in the Isfahan Master Plan online, all of them have academic education and most of them are in the age of 25-40. This low participation may have occurred for the following reasons:

- Isfahan's New Master Plan (2020) is the first comprehensive urban plan with a participatory approach in the field of urban planning in Iran. Lack of experience in holding such programs can be the most important factor in low citizen participation
- The meetings of this plan were initially held face to face. But due to the Coronavirus outbreak, it suddenly changed to online mode. This unexpected change of status and the lack of proper technical and cultural infrastructures prevented the program from engaging a wide spectrum of citizens.

It also can be resulted that using IoT and ICTs in management programs needs a good public knowledge of the internet as well as obvious principles and agendas. A greater form of participation using technologies is cooperation enhancement which aligns collective efforts for the development.

E. Cooperation Enhancement

The use of the IoT and ICTs in smart urban governance can go beyond the bilateral participation of citizens in government and lead to a constructive interaction between people, government institutions, businesses, and various urban systems. Achieving this goal optimizes participation and cooperation in a community and besides preventing the waste of time and resources, can cause a collective effort towards sustainable development [32].

The IoT, as an interconnected network of sensors, devices, and cloud spaces, enables enhanced cooperation between different people, instruments, and institutions. Proper development of IoT and other communication technologies in management can increase public awareness and empower local communities. It also promotes businesses, facilitate environmental protection and improve integrated urban administration [25].

The mentioned benefits are mostly in theoretical documents but in practice, there is no such an utopia. Reports show that even in developed communities, the application of technology in management is not as effective as it should be and the reasons for this can be found in the administration principles and socio-economic status [7]. However, it can be hoped that the increasing experience of communities in the use of these technologies, along with

clear agenda for their use in urban management, will be able to fill the gap created between theoretical benefits and practice.

IV. CONCLUSION AND RECOMMENDATION

In order to answer two research questions, this study tried to identify the role of the IoT and generally technology in smart urban governance and citizen participation by investigating the scientific literature and empirical evidence. As a response to the first question, the uses of IoT and ICTs in urban governance were extracted from scientific studies and categorized in five applications mentioned in the previous section.

The role of technology in providing services and citizen participation is approximately obvious and accepted. Also, using the IoT and ICTs in urban systems may have other benefits and wide-range applications. But the results of the present study show that realizing smart governance in traditional management structures is a goal beyond adopting new technologies.

The experience of using technology in governance of a developing community like Isfahan has this point for urban planners and managers that using newer technologies like IoT in the service provision and attracting citizens participation needs sufficient technical and social infrastructures, simultaneously.

In answer to the second research question, it should be said that almost all researchers agree that technology has the potential to promote public participation. While the survey outputs depict that this influence on citizens' participation is directly affected by socio-economic and managerial factors. The level of public knowledge about technology and overall access to required instruments among different strata are the most important socio-economic factors. Besides, public trust in institutions and the motivation of local authorities to utilize technology in urban management can be the most important management factors.

To conclude, the development of the IoT, like other technologies in smart urban governance, needs the proper association of management, social, cultural, economic, and environmental systems. Therefore, there are some recommendations in order to promote this alignment and facilitate the use of IoT in the governmental processes;

- The development of IoT in smart urban governance must be in stages that start from environmental systems then enter the socio-economic structures of communities. This procedural development enables planners to identify deficiencies and problems and increases the capacity to align technology with the context.
- In using the IoT to monitor and control socio-economic factors, different capacities should be used for public awareness improvement and culturalization. Because the more people embrace these technologies in their lives, the easier it will be to promote them.
- In providing services through technology, urban governments must ensure that a wide spectrum of citizens have access to the required facilities and equipment. Considering alternatives for people who don't have sufficient knowledge or financial capability of using

technology, can prevent institutional injustice and social segregation [33].

In the end, the findings and recommendations of the present study can be a reliable scientific basis for future research. Now, researchers aware of the role of the IoT and ICTs in smart urban management should examine how these technologies can be developed and enhanced in the governance structures.

REFERENCES

- [1] H. Smith, "Smart cities and internet of things", *Journal of Information Technology Case and Application Research*, Vol 21, NO. 1, pp: 3-12 2019.
- [2] J.B. Pick, "Smart cities in the United States and worldwide: A rich arena for MIS studies", *Journal of Information Technology Case and Application Research*. Vol 19, NO. 3, pp: 133-144, 2017.
- [3] R.W.S. Ruhlandt, "The governance of smart cities: A systematic literature review", *Cities*, Vol 81, NO.1, pp: 1-23. 2018
- [4] H. Jiang, "Smart urban governance in the 'smart' era: Why is it urgently needed?", *Journal of Cities*, 2020 (in press).
- [5] P. Dey, and S. Roy, "Governance in smart city: an approach based on social network", in *Smart Cities: A Data Analytics Perspective*, M. Ayoub Khan, F. Algarni, and M. Tabrez Quasim, pp: 63-87, 2020.
- [6] D. Das, and J. Zhang, "Pandemic in a smart city: Singapore's COVID-19 management through technology and society", *Journal of Urban Geography*, 2020.
- [7] Z. Tomor, A. Meijer, A. Michels, and S. Geertman. "Smart governance for sustainable cities: findings from a systematic literature review", *Journal of Urban Technology*, Vol 26, NO.4, pp: 3-27. 2019.
- [8] J.R. Gil-Garcia, T. Pardo, and M. Gasco-Hernandez, "Beyond smart and connected governments; sensors and the internet of things in the - public sector", *Springer: Public Administration and Information Technology*, Vol 30, 2020
- [9] A. Kazemi, M. Serrano, and A. Lenis. "Smart governance of heterogeneous internet of things for smart cities", *IEEE Publication: 12th International Conference on Sensing Technology (ICST)*. 2018.
- [10] E. Park, A.P. del Pobal, and S.J. Kwon. "The role of internet of things (IoT) in smart cities: technology roadmap-oriented approaches. *Journal of Sustainability*, 2018
- [11] H. Cooper, and V. Hedges, "Research synthesis as a scientific process," in H. Cooper, L. V. Hedges, and J. C. Valentine, eds, *Research Synthesis as A Scientific Process. The Handbook of Research Synthesis and Meta-Analysis*, New York: Russell Sage Foundation, pp: 3-18, 2009
- [12] A. Liberati, D.G. Altman, J. Tetzlaff, C. Mulrow, P.C. Gøtzsche, J.P. Ioannidis, and D. Moher, "The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration," *Annals of Internal Medicine*, Vol 151, NO.4. 2009
- [13] K. Ghasemi, M. Behzadfar, and M. Hamzenejad. "Evaluation of conformity of Isfahan urban development plans with the comprehensive model of human islamic needs" *International Journal of Architecture, Engineering and Urban Planning*, Vol 30, NO. 1, pp: 76-86, 2020.
- [14] D.M. Johnson, and C.W. Shoulders, "Beyond magic words and symbols: rethinking common practices in quantitative research", *Journal of Agricultural Education*, Vol 60, NO. 3, pp: 291-303, 2019.
- [15] K.S. Taber, "The use of Cronbach's alpha when developing and reporting research instruments in science education", *Research in Science Education*, Vol 48, NO. 1, pp: 1273-1296, 2018.
- [16] Y. Mehmood, F. Ahmad, I. Yaqoob, A. Adnane, M. Imran, and S. Guizani, "Internet-of-things based smart cities: recent advances and challenges", *IEEE Communications Magazine*, 2017.
- [17] A. Zanella, N. Bui, A. Castellani, L. Vangelista, and M. Zorzi, "Internet of things for smart cities". *Internet of Things Journal*, IEEE, 2012.

- [18] P. Brous, M. Janssen, P. Herder, "The dual effects of the Internet of Things (IoT): A systematic review of the benefits and risks of IoT adoption by organizations", *International Journal of Information Management*, Vol 51, 2020.
- [19] P. Lee, L. Leung, V. Lo, C. Xiong, and T. Wu, "Internet communication versus face-to-face interaction in quality of life", *Social Indicators Research*. Vol 100, NO. 3, pp: 375-389, 2011.
- [20] M.P. Rodríguez Bolívar, "Smart cities: Big cities, complex governance?", *Transforming city governments for successful smart cities*, pp: 1-7, 2015
- [21] P. Neirotti, A. De Marco, A. C. Cagliano, G. Mangano, and F. Scorrano, "Current trends in smart city initiatives: some stylised facts", *Cities*, Vol 38, pp: 25-36, 2014.
- [22] A. Yetano, and S. Royo, "Keeping Citizens Engaged A Comparison Between Online and Offline Participants", *Administration & Society*, Vol 49, NO. 3, 2015.
- [23] C.S. Ryu, and C.W. Hur, "A monitoring system for integrated management of iot-based home network." *International Journal of Electrical and Computer Engineering (IJECE)*. Vol 6, NO. 1, pp: 375-380, 2016.
- [24] D. Raposo, A. Rodrigues, S. Sinche, J. Sá Silva, and F. Boavida, "Industrial iot monitoring: technologies and architecture proposal." *Sensors*, Vol 18, NO. 1, 2018.
- [25] A. Sinha, P. Kumar, N.P. Rana, R. Islam, and Y.K. Dwivedi. "Impact of internet of things (IoT) in disaster management: a task-technology fit perspective", *Applications of OR in Disaster Relief Operations*, Vol 283, pp: 759-794, 2019.
- [26] A. AlEnezi, Z. AlMeraj, and P. Manuel, "Challenges of iot based smart-government development", *IEEE Green Technologies Conference*, 2018.
- [27] A. Khan, N.Z. Jhanjhi, M. Humayun, and M. Ahmad, "The role of IoT in digital governance", In V. Ponnusamy , K. Rafique , and N. Zaman, *Employing Recent Technologies for Improved Digital Governance*. Hershey, PA: IGI Global, pp: 128-150, 2020.
- [28] S. Barns, E. Cosgrave, M. Acuto, and D. Mcneill, "Digital infrastructures and urban governance" *Urban Policy and Research*, Vol 35, NO. 1, pp: 20-31, 2017.
- [29] S. Al-Sarawi, M. Anbar, K. Alieyan, and M. Alzubaidi, "Internet of Things (IoT) communication protocols: Review", *8th International Conference on Information Technology (ICIT)*, Amman, Jordan, pp: 685-690, 2017.
- [30] S. Royo, and A. Yetano, "Crowdsourcing as a tool for e-participation: two experiences regarding co2 emissions at municipal level," *Electronic Commerce Research*, Vol 15, NO. 3, pp: 323-348, 2015.
- [31] A.H. Sakil, "ICT, youth and urban governance in developing countries: Bangladesh perspective", *International Journal of Adolescence and Youth*, Vol 23, NO. 2, pp: 219-234, 2018.
- [32] Y. Kotb, I.A. Ridhawi, M. Aloqaily, T. Baker, Y. Jararweh, and H. Tawfik, "Cloud-based multi-agent cooperation for iot devices using workflow-nets", *Journal of Grid Computing*, Vol 17, pp: 625-650, 2019.
- [33] H. Jiang, S. Geertman, and P. White, "Smart urban governance: an alternative to technocratic smartness", *GeoJournal*, 2020.