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A Conceptual Model of Internet of Things (IoT) for E-Participation

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Abstract. Participation is compulsory for every activity. It is always needed for encouraging people and related stakeholders for supporting the activity to achieve the goal(s). Nowadays, growth of technologies supports and make the citizen participation activities easier. There are more than 1.5 billion internet-enabled PCs and over 1 billion internet-enabled mobile phones will move towards an Internet of Things (IoT) as massive devices by 2020. IoT can be defined as the networked interconnection of everyday objects and often equipped with ubiquitous intelligence. IoT will improve the ubiquity of the Internet by integrating every object for interaction via embedded systems and leads to a highly distributed network of devices communicating with human beings as well as other devices. Therefore, IoT will be interesting research field in the future. Literature reviews show that there is still limited research on the use of IoT regarding to E-Participation. This paper aims to examine IoT for supporting citizen participation. Hopefully, this paper makes contribution by providing a new conceptual model regarding to utilization IoT for encouraging citizen participation. This research also has implications for theory and practices. For theory, the model can be added to the body of knowledge of IoT and E-Participation fields. It also complements and enhances the existing models of IoT and E-Participation. In addition, practitioners and related stakeholders can consider the elements of the new model for successful implementation.

Keywords: Internet of Things (IoT), E-Participation, a new conceptual model

1. INTRODUCTION

Participation is compulsory for every activity. It is needed to achieve the goal(s) set by the stakeholders. Nowadays, participation can be done through electronic technologies, such as email, Facebook, WhatsApp, Twitter, Mobile Phone and others. Different societies and countries have own technologies for supporting participation. The sort of technologies depends on the context, environment, stakeholders, activities and other complex factors. Furthermore, technology is always changing and IoT is one of the latest technology that has potential to support participation. IoT has been used in various fields, such as industry, environment, society [1]. In the society domain, IoT can be applied regarding to the development and inclusion of societies, cities, and people, such as e-participation, e-inclusion and others. There are lots of model regarding to IoT, e-participation and its applications. Details about this will be explained in the literature review below. The review shows that there is still limited research about a model related to use of the IoT in the E-Participation field. Therefore, this paper aims to examine and propose a new conceptual model of IoT for supporting citizen participation. Hopefully, this research makes contribution by providing a new conceptual model of IoT for encouraging citizen participation. This model can be added to the body of knowledge of IoT and E-Participation fields. This paper consists of Introduction, literature reviews about IoT and e-Participation, a new conceptual model of IoT for

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supporting e-Participation, analysis and discussions, then finally conclusion, contribution and further research.

2. LITERATURE REVIEW

2.1. Internet of Things (IoT)

The term of Internet of Things (IoT) was found first time by the founders of the original MIT Auto-ID Centre, Kevin Ashton in 1999 and David L. Brock in 2001 [1]. IoT can be explained as "*the networked interconnection of everyday objects, which are often equipped with ubiquitous intelligence"* [2]. IoT will increase the ubiquity of the Internet by integrating every object for interaction via embedded systems, which leads to a highly distributed network of devices communicating with human beings as well as other devices. In another references, [1] explained IoT as "*a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network".*

The phrase of IoT has vision about the future machines: the machines in the nineteenth century learned to do; in the twentieth century, they learned to think; in the twenty-first century, they are learning to perceive, sense and respond. Moreover, Future Internet has vision to merge computer networks, Internet of Media (IoM), Internet of Services (IoS), and IoT into a common global IT platform of seamless networks and networked "things". There are some domains for IoT applications, such as Industry, Environment and Society. In the Industry domain, IoT activities involve financial or commercial transactions between companies, organisations and other entities. For example, manufacturing, logistics, service sector, banking, financial governmental authorities and others. Furthermore, IoT also can be applied into Environment domain regarding to the protection, monitoring and development of all natural resources, such as agriculture and breeding, recycling, environmental management services, energy management and others. Additionally, IoT can be implemented in the Society for development and inclusion of societies, cities, and people. The examples of IoT in the Society are e-participation, e-inclusion (aging and disabled people), and others. Moreover, IoT can be implemented in the aerospace and aviation, automotive, intelligent buildings, telecommunications, medical technology, independent living, pharmaceutical, and others [1].

There are several references about model or framework regarding to IoT, such as [3] capture the integrated morphology of IoT. The model consists of Application interface, service management, device management, security, platform abstraction and devices. Each layer has several components, such as Service management has two components: composed services runtime and service monitor; [4] examine security concerns of IoT, such as user identification, temper resistant, Secure software execution, secure content, secure network, secure data communications, identity management and secure storage; [5] proposed cooperative IoT model. The model consists of Persons, Source node, Sink Node, Wireless Node, Gateway, Future Internet and The Rural Healthcare Centre (RHC) Doctor; [6] emphasize the architecture of unit IoT. The architecture has two types: a man-like nervous (MLN) with a centralized data centre. It has three main parts: brain (management and centralized data centre: M&DC), spinal cord (distributed control nodes), and a network of nerves (IoT network and sensors). Another type is a modified MLN model. Its distributed data centre not only in the M&DC but also in some distributed cord nodes; [7] examine that the IoT system is generally divided into three layers: the perception layer, the network layer, and the service layer (or application layer). Each layer has many elements, such as Perception layer consist of optical fibre, card reader, camera, transducer, smart sensor and other facilities; [8] capture the IoT schematic showing the end users and application areas based on data. The application domains in this model are chosen based on the scale of the impact of the data generated. The users span from individual to national level organization addressing wide range issues; [9] proposed model about IoT infrastructure from some domains, such as Sensing paradigm, Addressing schemes, Connectivity model and Quality of Service (QoS).

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2.2. E-Participation

E-Participation basically consist of two elements: electronic technology and participation. There are three definitions of e-participation as following: [10] explain *"The "e (lectronic)" in eParticipation has a clear association with earlier "e" disciplines (eBusiness, eGovernment) and refers to the use of new information and communication technologies (particularly the Internet), with the implication that the technology has the ability to change or transform citizen involvement in deliberation or decision-making processes;* [11] defined e-participation as: *"Fostering civic engagement and open, participatory governance through Information and Communications Technologies (ICTs). Growing evidence points to the rapid expansion of e-Participation as a tool for engagement and strengthened collaboration between governments and citizens. Its objective is to improve access to information and public services as well as to promote participation in policy-making, both for the empowerment of individual citizens and the benefit of society as a whole";* [12] also defined e-participation as *"the various dynamic activities of interaction, communication, participation and management through several electronic technologies, implemented by numerous stakeholders, such as internal, external, dominant and less dominant stakeholders, which are supported by support systems, influencing and influenced by many complex factors, changes, laws and policies as well as financial capital".*

Furthermore, there are previous works that capture E-Participation frameworks which will be explained as following: [13] proposed three levels of participation for characterizing e-democracy initiatives and examine high-level stages involved in policy making from agenda setting, analysis, policy creation, and implementation through to monitoring; [14] proposed a framework includes layers, such as the democratic processes, participation areas, participatory techniques, categories of tools and any ICT technologies involved; [10] developed a model consists of elements as following: e-Participation actors, activities, effects, evaluation, contextual factors and the research approach involved; [15] also developed a domain model of e-participation consists of three main domains: the stakeholder, participation process and ICT Tool; [16] proposed a framework of ICT exploitation for E-Participation initiatives consist of three-steps procedure for an E-Participation initiative implementation presented; [17] examined a framework consists of 7 phases: Policy and capacity building, planning and goal settings, programs and contents development, process and tools, promotion, participation, post-implementation analysis; [18] developed a hands-on guideline consist of six-step iterative that will help to develop and implement E-Participation initiatives successfully; [19] proposed a reference framework for E-Participation Projects that captures the holistic engineering approach to provide the requirements of various E-Participation development projects from different organisations. It also supports communications between project actors with different levels of technical and political backgrounds from different perspectives; [20] used Actor-Network Theory (ANT) Approach to develop Malaysia E-Participation Framework; [21] proposed a Metamodel for the e-participation framework; [22] also developed a model of e-participation within school; [12] proposed a generic model of e-participation using ANT perspective based on the UK and Indonesia case studies.

3. RESEARCH METHODS

This paper was conducted based on desk research. This type of research was chosen as it still limited IoT implementation in Indonesia. Therefore, we have limited resources for empirical research. Firstly, we developed research design consist of set up the aim of this research, literature reviews, analysis, develop a new model, discussion and conclusions. Secondly, the actual research as shown in the table 1 below is started by set up the aim of this research, collection of the previous model or framework of IoT and e-participation, development of a new conceptual model of IoT for supporting citizen participation, discussion of the model, advantages, limitations and other important points related to the new model.

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Table 1. Step by step research method

Step	Activity	Output
1	Set Up Aim of the research	Aim of the research
2	Collect the previous frameworks of IoT and e-participation	List of the existing IoT and e-participation frameworks
3	Develop a new model of IoT for supporting e-participation	A New model of IoT for e-Participation
4	Discuss about the advantages and limitations of the model	Explanation about the advantages and limitations of the model
5	Emphasize the conclusion, conclusion and identify the further research regarding to IoT and e-Participation	Conclusion, contribution and further research

The previous frameworks of IoT and e-Participation was collected from various references, such as conference proceedings, journals, books and PhD dissertation. We searched the references from the Google Scholar engine by typing the keywords Internet of Things (IoT) or/and e-Participation, framework, model. Furthermore, the relevant references were accessed and analysed. Lastly, we emphasized the conclusion, contribution and identify further research opportunities related to IoT and e-Participation.

4. ANALYSIS AND DISCUSSION OF THE NEW MODEL

Based on the literature reviews above, a new conceptual model of IoT for supporting e-Participation has been developed as shown in the figure 1 below. The model below consist of some elements, such as stakeholders, existing electronic technologies, IoT, object/planning actions, support systems, complex factors, changes, financial capital, laws and policies. The element of stakeholders could be citizens, government institutions, researchers and scholars, politicians, voluntary organizations as identified by [23] as well as non-government organization (NGO), industries and others. The stakeholders, such as citizen, government, NGO and others could have two ways participation, interaction, communication and management of the object/plannig actions through the existing electronic technologies and IoT. The two ways participation, interaction, communication and management are supported by some support systems that are influencing and influenced by various compex factors, changes, financial capital, laws and policies. The financial capital is also emphasized by [24] related to infrastructure funding and ICT investment. The support systems are trainings, organization structure, procedures and others. The object/planning actions could be government or non-government activities, such as politics, education, planning, business and others. The complex factors consist of common and specific factors. The common factors are social, politics, economics, and culture. The specific factors are something that influence the participation process depends on the context, such as weather in specific area, psychology of specific people, communities, natios, laws of specific country and others. Changes are something that influence the participation after the change happened. For example, the change of regulation influence the way of participation for the government activities. This new model enhances the generic model of e-participation by [12] by adding IoT component. The previous generic model is based on ANT perspective, Indonesia and UK case studies as well as only use electronic technologies without IoT. The existing electronic technologies are website, mobile, social media, radio, and others. In the future, citizen should consider and can use IoT for supporting their participation in the government or non-government activities. This new model also complements the existing model or framework of e-participation and IoT developed by other researchers as explained in the literature review above.

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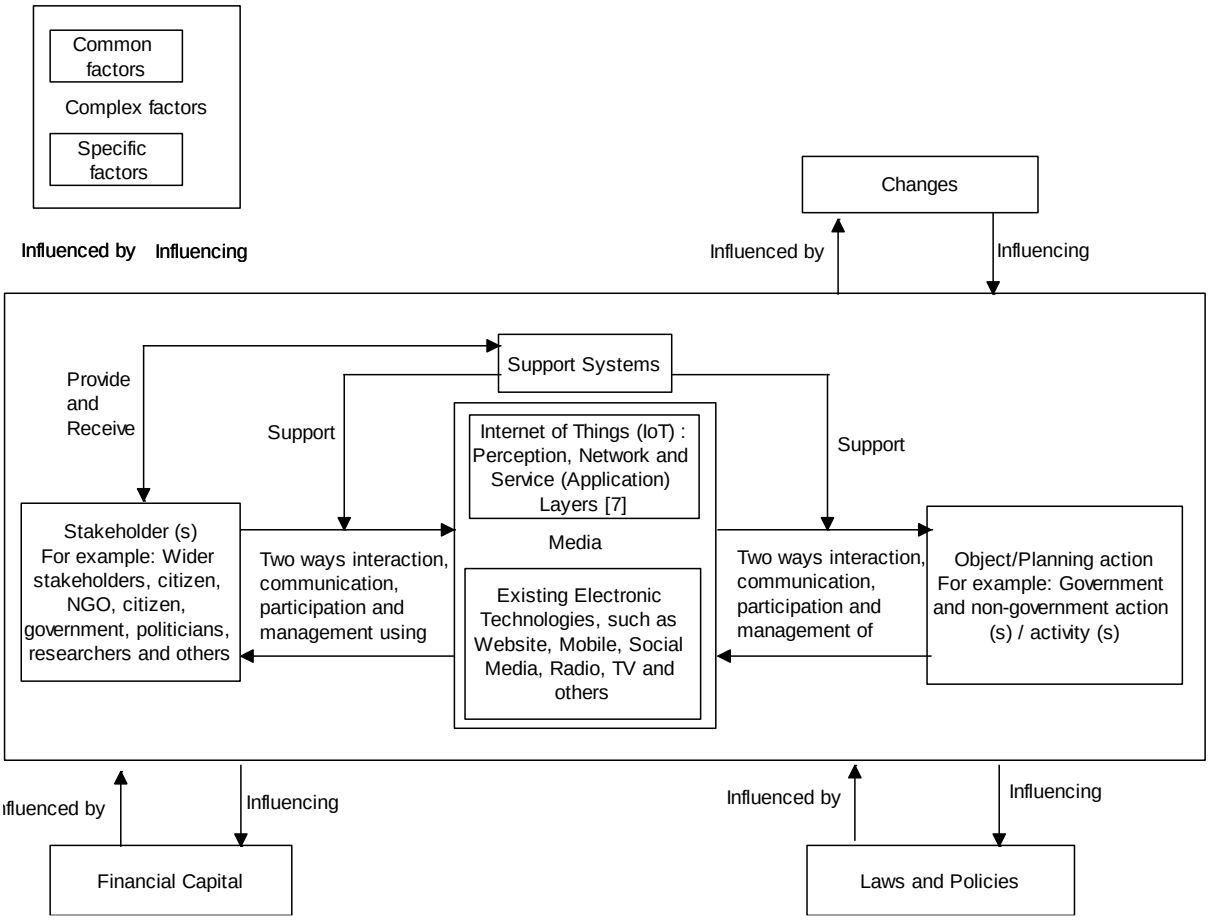

Figure 1. Model IoT for supporting e-Participation

The novel model above captures the object and the process from macro perspective and interdisciplinary approach, such as computing, finance, public administration, politics, culture. This interdisciplinary model complements the major findings by [25] Also, the model considers non-technological factors as well as described in the figure above, such as financial capital, laws and policies, complex factors and changes. The importance of non-technological factors is also identified by [26]. The architecture of IoT could be refer to the work of [7] which consist of three layers: perception, network and service (or application) layers. However, this model also has limitations, such as it has not been applied in the empirical research and details of the IoT can be referred to the has been captured in this paper. The IoT as part of participation media hopefully improve data transparency, open participation, open collaboration and ubiquitous engagement as stated by [27].

5. CONCLUSIONS, CONTRIBUTONS AND FURTHER RESEARCH

IoT can be implemented in various areas, such as industries, environment and society. It is still limited research capturing the use of IoT for encouraging citizen participation. Additionally, IoT application for supporting citizen participation need to consider not only technological factors, but also non-technological factors. Different context may have different sort of IoT application as well as the specific/contextual factors as part of complex factors. IoT in this new model is the additional technologies besides the existing electronic technologies, such as website, mobile, social media, radio and others.

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The main contribution of this research is a new conceptual model of IoT for supporting e-Participation. This research also has implications for theory and practice. For theory, the model can be added to the body of knowledge of IoT and e-Participation fields. For practice, the policy makers or practitioners should consider the elements in the model, such as stakeholders, the existing electronic technologies, IoT, object/planning actions, financial capital, complex factors, changes, laws and policies for the IoT implementation project in order to support citizen participation.

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