Research Article

Challenges of IoT Based New Generation Smart-Government

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Abstract. A milestone of Information Technology in 21st century is Internet of Things (IoT). The most significant aspect of IoT is its application in smart cities. The IoT is considered as software foundation of modern smart cities and is making revolution in the development of smart-government. The IoT is the backbone of smart cities and smart cities are the backbone of a smart-government. There are two types of smart-governments: (1) New Generation Smart-Government, (2) Extended Smart-Government. We illustrate the differences between the new generation smart-government and the extended smart-government. In this paper, a framework of new generation smart-government is proposed with inner and outer layer process. This framework is designed to illustrate the players, process and the challenges of the smart-government. Are search survey is carried out to study the challenges of smart-government from the perspectives of India, USA and Kuwait. It is observed that the challenges differ from country to country. The survey reports bring out some interesting facts that mindscaping is the biggest challenge for Kuwait, investment is the biggest challenge for India and security & privacy is the biggest challenge for USA.

1. Introduction

Gartner Inc. states that the information technology is heading towards IoT and its market is heading towards smart cities and smart-government [11]. The IoT is considered as software foundation of smart cities. Cisco introduces another concept called "Internet of Everything" (IoE) [21]. IoE involves three types of communication protocols: (1) People-to-People (P2P), (2) People-to-Machine (P2M), and (3) Machine-to-Machine (M2M). Pundits argue that the concepts of IoT and IoE are fundamentally different. IoT involves only M2M communication protocol whereas IoE involves P2P, P2M and M2M protocols. IoT just connects objects, but IoE uses a network to correlate people, process, data and things to become "intelligent". In short, IoT is a subset of IoE [19]. CISCO predicts that the impact of IOE in the public sector alone will be $4.6 trillion [2].

Smart city has been viewed as a key strategy to promote smart traffic, smart utility service, public safety, green & hygienic environment, sophisticated life style. A smart city involves IoT based several utility networks such as electricity, water, drainage, sewage etc. As many fear, smart cities do not increase your budget in utility bills. On other hand, it reduces the cost of utility services. ACISCO report states "Allover the world, energy bills can be reduced by $13.1 billion per year" [21]. Another key aspect of smart city is public safety. A basic safety network of smart city is CCTV network systems. In San Antonio, streetlights are adjusted in stormy weather to improve visibility and reduce accidents. Chicago's smart city initiative has improved its public safety significantly [17].

Smart-Government is the next generation of e-Government [13, 29]. Even though the initiatives on smart-government is at the novice stage, several countries such as Dubai, Australia, Singapore and Moldova have shown significant progress in the implementation of smart-government and seen visible results and outcomes [8, 14]. A Smart-Government Project for Mongolia is funded by the World Bank. Most countries have realized that smart-government is no more luxury and is a necessity. Realizing the benefits, governments have started allocating budgets worth of billions into these projects. Developed and developing countries are moving from e-Government to smart government [8].

2. What is Smart-Government?

The concept of embedded system was born at the MIT Instrumentation Laboratory in 1961 by means of Apollo Guidance Computer. Kevin Ashton of MIT introduced the terminology IoT in 1999. Later CISCO extended IoT to IoE in 2012. The modern smart cities are built on IoT enabled networks. The historical aspects of smart-government are illustrated in Figure 1. The traditional e-government is the automation of existing administrative process and is meant for paper-free office, document maintenance, information retrieval, inter-departmental communication, and work-flow automation. On other hand, Government 2.0 (Gov2.0) is meant for open data (right for information), transparent, community-engaged, decentralized or federated, flat or matrixed structure, and collaborative [11, 13, 29]. In Gov 2.0 Summit 2009, Tim O'Reilly expressed Gov 2.0 as "Government as a Platform". According Barack Obama administration, Gov 2.0 is a software model of Lincoln "Government of the people, by the people, for the people" and is about "putting government in the hands of citizens".
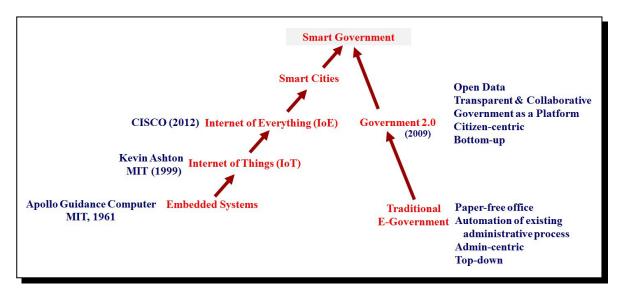
Figure 1. Smart-government

One may lead to a conclusion that smart-government is an extension of e-government. This is not true. It is wrong interpretation that smart-government is a technological union of e-government and smart cities. There are two types of smart-government (see Figure 2). One is called"extended smart-government" which is an extension of traditional e-government. It is a technological union of traditional e-government and smart cities. The second type is "next generation smart-government" which is the combination of Gov 2.0 and smart cities [4, 13, 29]. The extended smart-government may be closed,non-transparent, and admin-centric. On other hand, new-generation smart-government is open, transparent, and citizen-centric [11, 13, 29].
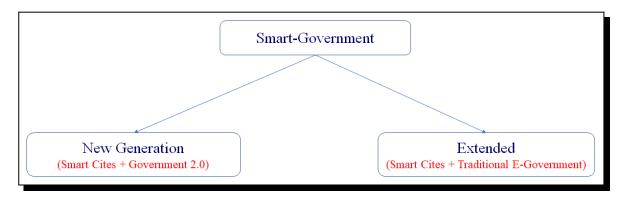

Figure 2. Two types of smart-government

Since the extended smart-government is non-transparent and a closed system in addition to convenient work-flow automation, it is more preferred by administrators than citizens. In the implementation of extended smart-government, administrators are more interested than citizens. Thus, the extended smart-government initiatives are driven by top administrators and it is top-down process. Since the new generation smart-government is open and transparent, it is more preferred by citizens than administrators. When the administrative system is open and transparent, the weakness of administration (if any) will be exposed to the citizens.

Thus, the new generation smart-government initiatives are driven by citizens and it is bottom-up process [11, 13, 29].

In this paper, we discuss only new-generation smart-government. Here onwards, smart-government means only new-generation smart-government.

3. Overview

This research focuses on the challenges in the implementation of smart-government which is the integration of Gov 2.0 and smart cities. In this paper, we analyze major challenges in the development and the implementation of smart-government. We provide a framework for smart-government that illustrates the phases and challenges of smart-government. We focus on three challenges that are considered to be the most significant: Mindscaping, Investment and Security & Privacy. We have conducted a research survey in Kuwait, India and USA and studied how the challenges of smart-government are different from one country to another. The outcome of the survey is interesting. The primary challenge in USA is Security & Privacy and the primary challenge in India is Investment. On other hand, the primary challenge in Kuwait is Mindscaping.

In the following section, we explain the framework of smart-government which we have designed to illustrate the development phases and their challenges. In the subsequent section, we describe the research survey process, the methodology of data collection and the data analysis. In the end, we summarize the most important results and present recommendations for further study.

4. A Framework of Smart-Government

There are several models and frameworks for IoT [14], IoE [21], smart cities [1, 5] and smart-government [5]. Fernandez-Anez [5] provides a framework for smart-government with 5 phases: Concept & Design, Financing, Implementation, Management and Transferability. Strohbach *et al.* [28] designs an analytical framework for Internet of Things and Smart City stressing on integrated big data. Jin *et al.* [12] have presented an information framework of IoT based smart city encompassing the complete urban information system. Perera *et al.* [26] have proposed a service model of IoT. Schaffers *et al.* [27] have developed cooperation frameworks of smart cities for Open Innovation. Ning *et al.* [24] have built Future Internet of Things Architecture employing Mankind Neural System or Social Organization Framework model. Gubbi *et al.* [7] have defined the architectural elements of cloud centric IoT. Anthopoulos [1] provides an elaborate literature survey on different models and frameworks for ICT based smart cities. Anthopoulos says "Researchers, practitioners, businessmen, and policy makers consider smartcity from different perspectives and most of them agree on a model that measures urban economy, mobility, environment, living, people, and governance" [1].

Now, we design a framework of smart-government emphasizing the challenges in the implementation of smart-government (see Figure 4). The framework describes the actors and activities of smart-government projects. The actors are administrators, citizens, and smart-workers. The phases consist of two layers: outer-layer phases and inner-layer phases. The inner-

layer phases are: Smart-landscape, Smart-networks and Smart-process. The outer-layer phases are: Preparation, Construction and Maintenance.

4.1 Inner-layer Phases of Smart-government

The inner-layer phases of a smart-government includes smart-landscape, smart-networks, and smart-process (see Figure 4). Smart-landscaping is the IoT based foundation of smart-cities [14]. During the smart-landscaping, IoT networks are embedded with the utility networks such as electricity, water, drainage and sewage networks etc. In addition to civil landscaping, smart-landscaping includes alignment of IoT sensors and actuators with the utility networks. Sabah Al-Salem University is a new upcoming smart-university in Kuwait. The landscaping cost of Sabah Al-Salam University is one-third of its whole project cost (see Figure 3).

Figure 3. Sabah Al-Salem University City, Kuwait

Smart-networks consist of IoT layers which integrate all basic utility networks in conjunction with IoT protocols. There are 4 IoT layers: Sensor layer, Network layer, Platform layer and Application layer [14]. It also uses 5G networking system for communication. Smart-Process is the government administrative process based on Gov 2.0.

4.2 Outer-layer Phases of Smart-government

The outer-layer phases of smart-government include Preparation Phase, Construction Phase and Maintenance Phase (see Figure 4).

Preparation phase includes initiation, analysis, concept, priorities, planning, budgeting and design [5, 22, 32]. Zubizarreta *et al*. [5, 32] states that the concept includes the idea whether the smart-government is flat or hierarchical, open or closed data, centralized or decentralized etc. It involves in changing them in d set of citizens and administrators to accept the philosophy of smart-government. The preparation is carried out by seminars, brain-storm meetings, workshops, training etc. It also involves in making the citizens and administrators commit in the migration from e-Government to smart-government. The action is mutual. Administrators push the citizens to accept the changes and citizens push the administrators to implement the changes. Only when both the citizens and the administrators are determined to migrate to smart-government, the implementation of smart-government will be smooth andsuccessful.
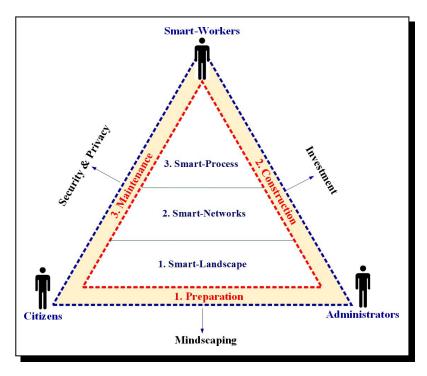
Figure 4. A Framework of smart-government

The construction phase begins with smart-landscape and then the implementation of smart-networks and the development of smart-process. This is also called the implementation phase of smart-government. During the maintenance phase, the infrastructure of smart-government is maintained and managed. Digital Disruption [11] in the maintenance phase is considered as a major concern in the IoT based smart-governments.

In the next section, we will discuss the major challenges in the development of smart-government.

5. Challenges of Smart-Government

As far as challenges are concerned, IoT based smart-government is in the same boat with any other new innovations and technologies. The challenges of Gov 2.0 are well-studied [5, 20, 30]. The challenges of Gov 2.0 are inherently inside smart-government and are studied for Romanian government [25] and Swedish government [15]. Howard [10] provides a high-level view of the challenges facing governments as they seek to sustain and improve services in an era of economic uncertainty and profound social change. The three major challenges are: Mindscaping, Construction and Maintenance.

5.1 Mindscaping

Mindscaping is a process of convincing someone to accept a change. Here it is a process of changing the mindset of the citizens and administrators to commit themselves in the migration from traditional e-Government to smart-government. Smart-Government is open, transparent, collaborative and citizen-centric. Open government and open data are among key initiatives of smart-government [8]. One of the key aspects of open government is transparency and Right

to Information (RTI) Act that mandates timely response to citizen requests for government information. The public becomes better informed about whether the government is performing and conforming to highest ethical standards. Harshetal [8] states "Open data are instrumental in the transformation from e-government to smart government. The closed culture within government, which is caused by a general fear of the disclosure of government failures and any resultant democratic impact, is the biggest challenge for transforming into an open government". The best description of them indscaping process is due to Meijeretal [20]. They describe three challenges (1) Transformational Leadership, (2) Getting Citizens Interested, and (3) Developing Mutual Trust which algorithmically characterize the mindscaping process. Gohar Feroz Khan [9] correlates mindscaping with information socialization (stage 1), mass collaboration (stage 2), and social transaction (stage 3).

Most governments in Asia and Africa are hierarchical and centralized. While smart-government provides sophisticated life style, it changes closed administrative system into open administrative system. The transition phase of moving from closed rigid administrative system into open transparent administrative system is considered as one of the top-most challenges.

5.2 Investment

The existing network requires all the government departments to be upgraded to 5G networks which is basis for smart-government development. In addition, the Information Systems require all servers and network accessories to support their sensors and other IoT systems. The reality is that the existing resources cannot be used in the IoT infrastructure. Thus, it leads to huge wastage of scraping the existing resources. Smart-government requires modern infrastructure which leads to huge financial commitments. Finance is a major challenge. The investment challenge is "How to generate revenue? How to self-sustain? How to involve private sectors in the investment? How to upgrade the infrastructure which normally gets outdated every year or two?" [11].

5.3 Security & Privacy

Business Insider states "We asked executives about the Internet of things and their answers reveal that security remains a huge concern" [31]. Once the construction is completed, the resources of smart-government are maintained by people representatives and smart-engineers. Even though Digital Disruption is a major concern, the biggest challenge during the maintenance phase is Security & Privacy [11]. Insmart-government, the IoT connects everything from security CCTV cameras to home products such as vehicles and electronic appliances. As devices get connected more & more and data is collected more & more, privacy and security concerns will increase too. In an article in Forbes, it is stated that Internet-connected appliances including televisions, kitchen appliances, cameras, and thermostats can already "spy on people in their own homes" [18]. Networked video games, Smart TV's, Facebook Live, Laptop Skype cameras, Home security cameras, Baby monitors, thermostats and Internet connected appliances are used to spy the users [18]. Security researchers demonstrated that it would be possible to remotely control automobiles [6] and certain medical instruments such

pacemakers, insulin pumps and implantable cardio verterdefibrillators [16]. The US National Intelligence Council in an unclassified report maintains that it is possible to spy and monitor the activities of other countries through IoT devises [23].

The challenge is "how do we ensure that these IoT devices are adequately secured?" The large IoT network in smart-government open savenues for potentially huge attacks on critical services. The lack of security in the IoT will make it attractive for attackers to target.

6. Research Survey

Online and direct research surveys were conducted to study the challenges of smart-government from the perspectives of India, USA and Kuwait. The survey report has brought out some interesting facts that mindscaping is the biggest challenge for Kuwait, investment is the biggest challenge for India and security & privacy is the biggest challenge for USA (see Figure 5).
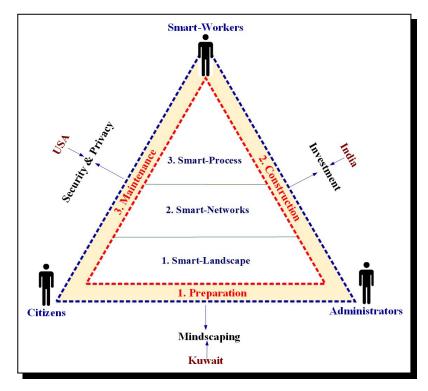

Figure 5. The challenges of smart-government

The **survey template** is given below:

Table 1. Survey Template

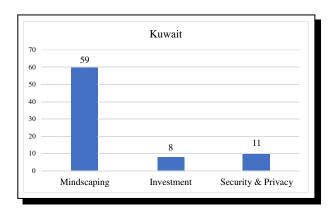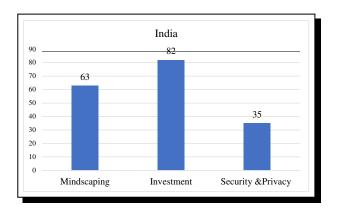| The challenge in the implementation of smart-government	The impact of this challenge in Kuwait is		
	Low (30%)	Medium (60%)	High (90%)
Mindscaping			
Investment			
Security & Privacy			

Figure 6. Mindscaping is the biggest challenge in Kuwait

In Kuwait, Mindscaping is the biggest challenge. The second challenge is Security & Privacy. The challenge with the least impact is Investment (see Figure 6).

Figure 7. Investment is the biggest challenge in India

In India, Investment is the biggest challenge. The second biggest challenge is Mindscaping. The challenge with the least impact is Security & Privacy (see Figure 7).
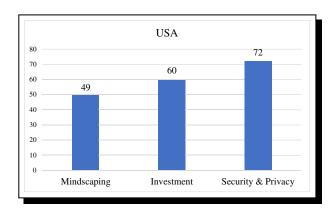

Figure 8. Mindscaping is the biggest challenge in Kuwait

In USA, Security & Privacy is the biggest challenge. The second challenge is Investment. The challenge with the least impact is Mindscaping (see Figure 8).

7. Conclusion

As smart cities enable increased intelligence of security, transport, and utility services, smart governments can leverage IoT to offer a single layer communication channel that result in an open, sharable and transparent citizen-oriented entity.

In this paper, we have argued that the smart-government is not an extension of e-government and smart-government is a new generation of e-government. A framework of smart-government has been proposed with inner and outer layer process. This frame work has been designed to emphasize the challenges of smart-government. A research survey has been carried out to study the challenges of smart-government from the perspectives of India, USA and Kuwait. The survey report has brought out some interesting facts that mindscaping is the biggest challenge for Kuwait, investment is the biggest challenge for India and security & privacy is the biggest challenge for USA.

With advances in smart technologies growing so rapidly, there has already been research that has conceived the term "Intelligent Governance" [3], a successor to smart-government. In the past, it was e-government and now it is smart-government. In the future, it is predicted that it will be intelligent governance. It is interesting to study a framework of intelligent governance that will help to study the structures,components and challenges of intelligent governance. Future work includes investigating the challenges further from the government, private sector and citizen perspectives.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All the authors contributed significantly in writing this article. The authors read and approved the final manuscript.

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