

The Benefits and Challenges of Implementing IoT in Smart Cities

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Abstract- The goal of the smart city is to make it easier for citizens to make decisions that are relevant to the city by providing them with the necessary information at the appropriate time and in the appropriate location. Communication between people and objects, as well as between objects themselves, is made possible by systems based on the Internet of Things, which lays the groundwork for the smartification of services. However, integrating the Internet of Things with the services provided by the city might be difficult in order to make the city smart. The goal of this article is to determine which difficulties are associated with putting IoT into practice in smart cities and rank them in order of importance. IoT gadgets are the precursors of the forthcoming era of decentralised computing and possess the capacity to connect with other computing devices over a network. Literature research and the opinions of industry experts were used to identify ten obstacles to the application of IoT in the process of making cities smart. In addition, the TOPSIS methodology is applied in order to assess the problems that have been found. According to the findings, the most significant obstacle is interoperability in the internet of things (IoT). This is because businesses are creating IoT solutions individually by using multiple platforms, which leads to poor integration in the devices and concerns with data security. The businesses are going to need to create a platform that is open-source so that they can promote an interoperable framework. The research will assist policy planners and practitioners in understanding the possible difficulties associated with putting IoT into practice, which will ultimately make citizens' lives easier.

Indexed Terms- Smart cities, IoT, Challenges, Big data

I. INTRODUCTION

Citizens have always been drawn to cities as an essential component of urban growth because cities provide more chances for work and business, superior amenities, and the availability of resources. [1] This is because cities give more options for employment and business. More and more individuals are choosing to make their homes in urban areas because of the allure that cities have for them. The demand for better organisation of urban resources, transit systems, service providers, and physical infrastructure rises in tandem with the rate at which cities are experiencing population growth. Therefore, in order to create a quality of life that is both sustainable and long-lasting for its residents, a city needs to grow more intelligent. Therefore, cities need to discover numerous strategies towards addressing fresh issues and risks in order to keep up with the present reality. Cities all across the world have taken the initiative to look forward for solutions that would enable diversified land uses, transportation links, and high-quality urban services that are associated with long-lasting economic growth.

Emerging as a response to the problems caused by fast uncontrolled urbanisation and an increase in population density in cities is the idea of a "smart city." This concept's primary objective is to give a solution to these problems. The integration of information and communications technology is critical to the process of urban smartening. The concept of a "smart city" is straightforward; nevertheless, there is no universally accepted definition of such a city due to the various interpretations of the word "smart" that exist throughout the world. The term "smart city" has been defined in a variety of ways throughout the published research; however, one of the most widely accepted

definitions comes from IBM, which describes a smart city as "the city that makes optimal use of all the interconnected information available today to better understand and control its operations and optimise the use of limited resources."

Smart cities are communities that are designed around the concept of using the Internet of Things (IoT) in conjunction with a number of different sensors to fulfil the requirements of its residents. IoT systems enhance people's quality of life by fostering the development of an autonomous environment through the use of devices that are able to compute, perceive, and communicate with one another. A future urban landscape that is fitted with IoT offers a shrewd answer to problems relating to transit, energy management, health, education, city services, surveillance, and concerns associated with technology. Smart solutions based on the Internet of Things will have an effect on the residents' quality of life. Implementation of IoT, with its capabilities including the capacity to link items and the ability to interact with humans in a ubiquitous and intelligent manner, is essential for realising the potential of smart cities. The development of services based on the Internet of Things is envisioned as a means to automate, regulate, and monitor the actions of humans in smart environments.[2,3] However, the fact that there are so many different areas in which IoT may be applied makes its deployment a difficult process. The process of implementing IoT is difficult and time-consuming, and it requires a significant amount of both planning and financial resources. Due to the fact that it is decentralised, the degree of unpredictability is increased, which in turn poses a problem regarding security. As a result, the current research created a framework for deploying IoT in smart city environments based on the prioritising of implementation difficulties using the TOPSIS methodology.

- Challenges for Implementation of IoT in Smart City

The deployment of IoT is contingent on a number of different important variables. It may be helpful for management to have an awareness of the obstacles of implementation while creating, directing, and regulating the services provided by smart cities. In order to deliver services of a higher quality,

policymakers have the ability to prepare for the introduction of internet of things technologies. Following an examination of the previous relevant literature, a set of challenges was chosen for this study. The Internet of Things (IoT) and the applications it has found in smart cities have brought about a revolution in the 21st century. According to Gartner Inc., the Internet of objects industry of today is focused on smart cities and governments, and it is anticipated that there will be 3.3 billion linked smart objects in 2018. Establishing environmentally responsible technical procedures for city management, including utility control, power, housing, and transportation, is an essential component of smart cities. The end objective is to deliver a safer and higher quality of life for people while also lowering overall expenditures. According to a survey by Gartner, the amount of money spent on Internet of Things technology in smart cities is predicted to increase to 9.7 billion by the year 2020 from its billion investment in 2015. It is believed that the next generation of electronic governments will be smart governments. In spite of the fact that it is still in its infancy, smart governance has already been implemented with promising outcomes in Dubai, Australia, Singapore, and Moldova. To ensure long-term viability and better meet the requirements of their constituents, these governments implement cutting-edge strategies in all aspects of their business, including operations, communications, and technology infrastructure. As a result of the various advantages, governments all over the globe have begun devoting resources worth billions of dollars towards transitioning from electronic administration to smart government. In this article, we argue that smart governments are not a direct extension of e-governments by proposing a state-of-the-art framework for smart governments that illustrates the many stakeholders, interactions, procedures employed, and obstacles. In addition, we provide evidence to support our position. In conclusion, we present a study of a survey that focuses on the difficulties associated with implementations in the United States of America, Kuwait, and India.

• Overview of Smart-Governments:

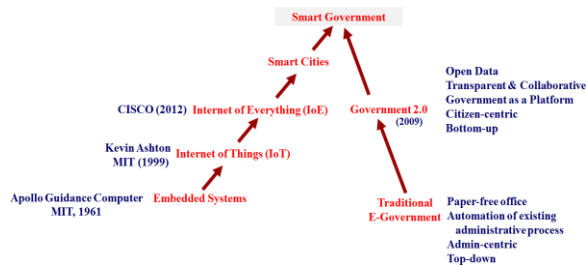


Figure 1: The progression of technology towards intelligent administration is referred to as "smart government." [4]-

Figure 1 presents a representation of the government. Since the development of the first embedded system at MIT, the progression of technology has led to the creation of smart cities, which are all constructed using IoT-enabled networks. The automation of administrative procedures in traditional e-governments is thought of as a step towards paperless offices, data upkeep, information retrieval, interdepartmental communication, and work-flow automation. In most cases, access is restricted, there is no transparency, and the focus is on the administration. On the other side, Government 2.0 is commended for being community-engaged, decentralised or federated, and citizen-centric. It offers the public access to data that is both open and transparent, fulfilling their "right to information." [50]

• Smart-government vs. e-government

E-government and smart city technology have come together to form the concept of smart government. As can be seen in Figure 2, we distinguish between two distinct forms of smart governance. The first category is referred to as a "extension – smart government," and it is essentially an expansion of conventional forms of electronic governance. This is the technical marriage of traditional e-government and smart cities, relying on the primary benefits of both, but it is not transparent and is still administration-focused. [5,6] The second category is known as "next generation – smart government," and it is essentially a hybrid of "Government 2.0" and "smart cities." This kind of governance is the

model that many different nations strive to model themselves after. It is open and transparent in all of its dealings with the public and engages the public in all of its activities.

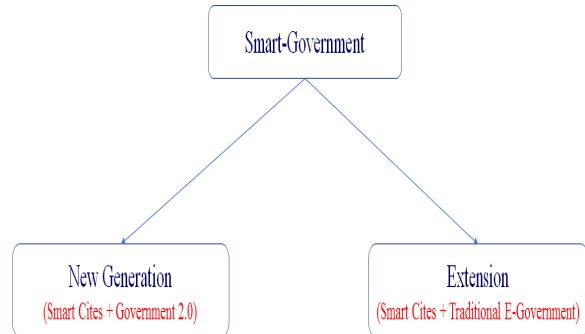


Figure 2: Two types of smart-government [7]

• Smart-Government case study

Figure 2 depicts two distinct models of "smart" governments; one of these models, India, is an excellent example that demonstrates the distinction between both models. Between the years 2004 and 2014, the Congress Party, which was led by Dr. Manmohan Singh, served as India's ruling party. Mr. Narendra Modi of the BJP Party has served as India's Prime Minister since 2014. During the initial phase of Dr. Singh's administration, the conventional use of the internet for official purposes was encouraged. In order to carry out the conventional aspects of electronic governance, the administration led by Dr. Singh initiated the Aadhar Project, which distributed vitally important individual identification cards to all 1.2 billion Indian people. Before this, attempts to provide each person with an official form of identification had not been successful. [8,9] During the process of implementation, the administration of Dr. Singh encountered extraordinary hostility from the public for a period of time, including from the parties in opposition. As soon as the current president, Mr. Modi, assumed office, his administration made it a priority to advance the concept of a smart government. He coined the phrases "small-governance and smart-governance" to describe it. In June of 2015, his government initiated an initiative to create smart cities as an initial step. [10,11] The attempts of electronic government taken by the administration of Dr. Singh were met with opposition, while the initiatives of smart

government taken by the government of Mr. Modi were accepted and welcomed enthusiastically by the people of India. We will begin by outlining the goals of both forms of government, e-government and smart-government, in order to gain an understanding of why people's perspectives shifted in such a short amount of time. The primary purpose of conventional forms of electronic governance is to computerise and streamline pre-existing bureaucratic procedures. It is a process that works from the top down and is a closed, opaque system that is more beneficial to the administrators than it is to the average citizen.[49] On the overall, this resulted in discomfort for the typical person while providing little actual benefits to that individual. However, the goal of smart governance is to offer individuals and their governments with a lifestyle that is respectful of one another, open to communication, and intelligent. As a result of the process being people-driven and being driven from the bottom up, it offers more benefits to the public than it does to the administrators of the government. Therefore, in India, the general populace took a greater interest in its implementation than did the government officials.

IoT-based Smart-Governments and frame work
 According to the findings of this study, "new-generation smart-government" describes smart-government systems. The problems that must be overcome in order to build smart governments that incorporate Government 2.0 and IoT-based smart cities will be the primary emphasis of this session. In doing so, we provide a framework for smart governments that demonstrates the many phases of the process as well as the obstacles that are involved.[12]

- Innovative infrastructure for Internet of Things-based smart governments
- In light of the abundance of research that has been conducted on smart cities, it is becoming increasingly clear that adequate frameworks for smart governments are required. On the basis of past research, we propose an original architecture for an Internet of Things-based smart government, as depicted in Figure 3. Using a two-layer model, the framework outlines the many players and

activities that contribute to the implementation process.

- Inner-layer phases of smart-government:
 The initial step in getting ready to implement smart government is landscaping, which typically accounts for one-third of the entire project and is the first stage in the preparation process. The concept of "smart landscaping" refers to the process of constructing whole new underlying utility networks, such as those for power and water, which also incorporate IoT technology. The implementation of smart networks necessitates an upgrade to 5G networks as well as the construction of a four-layer lattice consisting of sensors, networks, platforms, and application layers. This essential component of smart governance is the cornerstone of the internet of things (IoT) and is especially vulnerable to security breaches. The administrative function of the government that is constructed on top of smart networks is called a smart process. [13]

Before the system and process are implemented, one of the crucial decisions that must be taken is whether the target smart government will be an extension of the current e-government or whether it will settle with becoming a new generation of e-government.

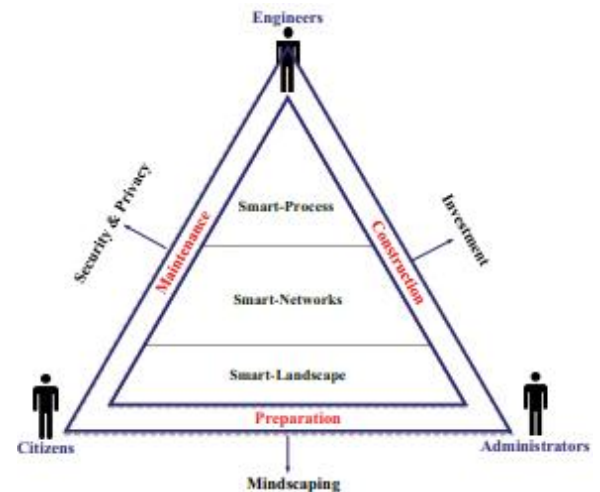


Figure3:A Framework of smart-government [18]

- Outer-layer phases of smart-government:
 The initial phase of the outermost layer is called preparation, and it consists of a number of

subphases: initiation, mentality, analysis, idea, priorities, planning, budgeting, and design. To begin, it is necessary to determine if the intelligent government that is being put into place will be hierarchical or flat, open or closed, centralised or decentralised. The next stage is to get both public and government officials to accept the concept of smart governance by altering their mentality. Seminars, workshops, brainstorming sessions, and training sessions are some examples of the types of preparation that fall under this category. Administrators have a responsibility to persuade residents to embrace the future changes, while citizens have a responsibility to put pressure on administrators to make the necessary adjustments. The building phase starts with the development of a smart landscape, then moves on to the creation of smart networks, and finally moves on to the creation of smart processes.[15,16,17] The current stage of smart governance is referred to as the implementation phase. During the time designated for maintenance, the infrastructure is subjected to on-going management and monitoring.

- Challenges of implementing IoT-based smart governments:

The capacity of the Internet of Things (IoT) to turn e-governments into smart governments, as well as to aid in making governments more open and responsive to the requirements of the people, is one of its many appealing features. This undertaking comes with a number of obstacles, all of which serve to slow down the implementation of smart governance. A list of 27 issues spanning several dimensions that are important to the implementation of smart cities was provided by Fernandez-Anez et al. Some of these challenges include mindscaping, construction, and maintenance. In this part, we will explore three difficulties associated with IoT-based smart governments that are of key significance owing to their impact to the overall success or failure of implementation: mindscaping, investment, and security and privacy. Because of these obstacles, the outer-layer phase of the smart-government system presented in Figure 3 receives more emphasis.[19]

- Mindscaping

It is not a simple task to request that a government embrace a new infrastructure. To begin the process of transitioning from an electronic government to a smart government, it is necessary to get the support of both the government and the people.[20,21] The process of persuading an entity to agree to a change is what we mean when we refer to Mindscaping. Convincing people to support smart governments is not a major worry because of the openness, transparency, collaboration, community engagement, and citizen-centric aspect of these types of governments. The most significant challenge, on the other hand, is attempting to alter the mentality of the administration. Many different governments continue to operate in a hierarchical and centralised fashion.[22,23] In the Middle East, for instance, the deployment of a smart government would be greatly sought by the people for a sophisticated way of life, but in order to do this, tightly controlled and inflexible administrative structures would need to be opened up. The most significant difficulty comes from the Mindscaping process that is engaged in this situation.[24]

- Investment

Despite the uncertainty of the global economy, an increasing number of nations' governments have begun transitioning towards e-governance in recent years.[33,34] It is necessary to modernise the currently available technical resources in order to make room for more advanced Internet of Things (IoT) technologies in order to make the transition from electronic government to smart government. The infrastructure necessary for the operation of telecommunication networks is an essential component of every government. Among these are the upgrading of all already operational networks to 5G networks, the most up-to-date sensors, ample storage space for managing large amounts of data, power supply, and a great lot more.[35]

- Security and Privacy

Security and privacy concerns are among the most difficult obstacles to overcome while implementing smart governance.[39,40] The large-scale internet of things networks used in smart

governments are extremely vulnerable to security breaches. In October of 2016, Internet of Things (IoT) devices like as digital cameras and DVR players were the cause of huge, malicious distributed denial of service (DDoS) assaults launched against Oracle Dyn services. These attacks were managed by various Mirai botnets. This was the most severe attack of its type, necessitating the expenditure of several hours in damage control measures before the strikes ceased.[25,26,27,28] If it were successfully carried out, an assault of this size might render a government inactive in a matter of minutes, which would be to the detriment of the country as a whole.[29,30] In order to develop smart governments without compromising citizens' privacy, it is vital to find solutions to the problems already provided by the internet of things (IoT). customers of Internet of Things devices, whether they are corporations or individual customers, should have a general understanding of technology and should often test their equipment for vulnerabilities. It is also essential that Internet Service Providers establish policies pertaining to the Internet of Things (IoT).[31,32]

- Smart-government survey and discussion:

We prepared a poll to highlight the current status of the issues that are posed by the deployment of smart government, and we disseminated it to an audience that was active in IoT research, government, and technology in three countries: the United States of America, India, and Kuwait.[36,37,38]

- The survey and procedure:

The study contained a description of the three outer layer phases of smart governments, which were preparation, building, and maintenance. [46,47] Additionally, the survey included in-depth explanations of the three problems associated with the implementation of smart governments, which were minds aping, investment, and security and privacy. The following request is being made: "Please indicate the impact of the challenges that the United States of America, India, and Kuwait face in the implementation of smart-governments." A rating of low, medium, or high is provided for each of the tasks in the table that has been

provided. The participants in the survey were given a verbal explanation from the administrator of the survey on the goal and substance of the survey.[48]

CONCLUSION

Smart urbanisation necessitates the provision of efficient services in order to raise the bar for service quality. In order to do this, a platform that rethinks the conventional urban process parameters is required. However, in order to carry out this activity successfully, a substantial amount of data must first be gathered. Utilising the benefits offered by IoT devices can help improve planning and development. This study addresses the difficulties encountered during the development of IoT systems, which were then ranked using the TOPSIS methodology according to their respective weights. [41,42] This work provides a new path and actuates the need to do empirical research in order to quantify the difficulties. The highlighted difficulties may then be analysed further using different MCDM approaches such as AHP, ANP, ISM, and DEMATEL while operating in a fuzzy environment, and the results can be compared. The findings may be improved even more with a case-based validation. The deployment of some features, such as data security, AI-fueled autonomy, and mesh connectivity, might be a nightmare for smart cities that use the internet of things. The implementation of the Internet of Things calls for an in-depth understanding of its planning and development as well as careful consideration of the C points.[43,44,45]

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