ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 4, Issue 3, March 2017

Role of Information Communication Technology (ICT) in the Development of Smart City.

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Abstract - **By 2030, the world's population is projected to be 8.5 billion and increase to 9.7 billion by 2050 and 11.2 billion by 2100. Half of humanity today lives in cities. Many cities are experiencing exponential growth as people move from rural areas in search of better jobs and education. Consequently, cities' services and infrastructures are being stretched to their limits in terms of scalability, environment, and security as they adapt to support this population growth. Visionaries and planners are thus seeking a sustainable, post-carbon economy to improve energy efficiency and minimize carbon-emission levels. Along with cities' growth, innovative solutions are crucial for improving productivity (increasing operational efficiencies) and reducing.**

I. INTRODUCTION

A smart city is an ultra-modern urban area that addresses the needs of businesses, institutions, and especially citizens. Here we should differentiate between a smart city and smart urbanism. The objective of these concepts is the same—the life of citizens. The architects of ancient cities did not take into consideration long-term scalability—housing accessibility, sustainable development, transport systems, and growth—and there is no scalable resource management that may be applied from one decade to another. Unfortunately, smart urbanism is not well represented in smart cities' development. Smart urbanism must also be considered as an aspect of a smart city, including information-communication technologies. In recent years, a significant increase in global energy consumption and the number of connected devices and other objects has led government and industrial institutions to deploy the smart city concept. Cities' demographic, economic, social, and environmental conditions are the major reasons for the dramatic increase in pollution, congestion, noise, crime, terrorist attacks, energy production, traffic accidents, and climate change. Cities today are the major contributors to the climate problem. They cover less than 2% of the Earth's surface yet consume 78% of the world's energy, producing more than 60% of all CO_2 emissions.

II. OBJECTIVES:

Innovative solutions are imperative to address cities' social, economic, and environmental effects. Those solutions involve three key objectives:

Optimized management of energy resources.This objective could be realized through the Internet of Energy (IoE), or smart grid technology. The IoEa, connects energy grids to the Internet, dispatching units of energy as needed, representing a set of distributed renewable electricity generators linked and managed through the Internet. The IoE enables accurate, realtime monitoring and optimization of power flows;

Decentralized energy production.The IoE concept allows consumers to be energy producers themselves, using renewable energy sources and combined heat and power units; decentralization enables smarter demand-response management of consumers' energy use.

Integrated business models and economic models. These models describe how organizations should deliver and reap benefits from their services (such as transport, energy consumption, and charging tolls); such models must be designed to support city development.

Safety and security. This includes surveillance cameras, enhanced emergency-response services, and automated messages for alerting citizens; realtime information about a city should be available

Environment and transportation. This entails controlled pollution levels, smart street lights, congestion rules, and new public-transport solutions to reduce car use; Home energy management. Options include timely energy billing, optimal energy management, saving, perhaps, 30%–40% on electricity bills; the European Commission estimates approximately 72% of European electricity consumers will have smart meters by 2020;

Educational facilities. More investment is needed to improve educational opportunities for all, lifelong learning, education through remote learning, and smart devices in classrooms;

Tourism. Preserving a city's natural resources promotes the growth of tourism; additionally, smart devices offer direct and localized access to information; Citizens' health. Using new technologies could improve people's health; citizens need full access to high-quality, affordable healthcare, and wireless body-area network technology—including sensors attached to the body or clothes and implanted under the skin—can acquire health information (such as heartbeat, blood sugar, and blood pressure) and transmit it in real time or offline through a smartphone to remote servers accessible by healthcare professionals for monitoring or treatment.

III. IMPLEMENTATION AND DEPLOYMENT

Designing and deploying smart cities needs experts from multiple fields, including economics, sociology, engineering, ICT, and policy and regulation. Various frameworks describing the architecture of smart cities have been proposed by both industry and academic sources. One of the most widely adapted and adopted models is the reference model proposed by the U.S. National Institute of Standards and Technology. Smart cities are complex systems, often called "systems of systems," including people, infrastructure, and process components. Most smart cities models consist of six components: government, economy, mobility, environment, living, and people. The European Parliament Policy Department said in 2014 that 34% of smart cities in Europe have only one such component.

Multiple approaches and methods have been proposed to evaluate smart cities from multiple perspectives, including an urban Internet of Things (IoT) system for smart cities, sustainability, global city performance, future urban environments, urban competitiveness, and resilience. But several fundamental architectural components must be in place to make a city smart.

3.1 Essential components.The basic underpinnings of a smart city include five components:

Fig 1: Smart City: Internet of Things

Broadband infrastructure.This infrastructure is pivotal, offering connectivity to citizens, institutions, and organizations. However, today's Internet lacks the robustness needed to support smart cities' services and data volume. It includes both wired and wireless networks. Wireless broadband is important for smart cities, especially with the explosive growth of mobile applications and popularity and the connectivity of smart devices;

E-services. The concept of "electronic services" involves using ICT in the provision of services, including sales, customer service, and delivery. The Internet is today the most important way to provide them (such as for tourism, city environment, energy, transport, security, education, and health). A European Union research initiative (called the innovation framework H2020) focuses on developing such e-services; and

Open government data. Open government data (OGD) means data can be used freely, reused, and redistributed by anyone. A multinational initiative to promote worldwide adoption of OGD was launched in 2012 with input from the Microsoft Open Data initiative, Organization for Economic Cooperation and Development, and U.S. Open Data Initiative.

Sustainable infrastructures. The International Electrotechnical Commission (IEC) says cities aiming to develop into smart cities should start with three pillars of sustainability: economic, social, and environmental. One of the first steps in addressing sustainability is to increase

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 4, Issue 3, March 2017

resource efficiency in all domains (such as energy, transport, and ICT). An efficient and sustainable ICT infrastructure is essential for managing urban systems development. Adepetu et al.1 explained how an ICT model works and can be used in sustainable city planning. For a sustainable ICT infrastructure, they defined various green performance indicators for ICT resource use, application lifecycle, energy impact, and organizing impact.

E-governance. This component focuses on a government's performance through the electronic medium to facilitate an efficient, speedy, transparent process for disseminating information to the public and also for performing administration activities. An e-government system consists of three components: government-to-citizen, government-to-business, and government-to-government. E-government allows citizens to fulfill their civic and social responsibilities through a Web portal. A growing number of governments around the world are deploying Web 2.0 technologies, an architecture referred to as "e-government 2.0," linking citizens, businesses, and government institutions in a seamless network of resources, capabilities, and information exchange.

IV. FUNDAMENTAL TECHNOLOGIES.

The design and implementation of smart cities also involves a number of technologies:

4.1 Ubiquitous computing.Ubiquitous devices include heterogeneous ones that communicate directly through heterogeneous networks. To support a smart and ubiquitous environment, telecommunication infrastructures, Lee said, should be enhanced to provide a better understanding of networks, services, users, and users' devices with various access connections. Lee also identified six capabilities and functions of smart ubiquitous networks including context awareness, content awareness, programmability, smart resource management, autonomic network management, and ubiquity.

4.2 Big data. Traditional database management tools and data processing applications cannot process such a huge amount of information. Data from multiple sources (such as email messages, video, and text) are distributed in different systems. Copying all of it from each system to a centralized location for processing is impractical for performance reasons. In addition, the data is unstructured. Deploying thousands of sensors and devices in a city poses significant challenges in managing, processing, and interpreting the big data they generate. Big data,reflecting such properties as volume, variety, and velocity, is a broad term for complex quantitative data that requires advanced tools and techniques for analyzing and extracting relevant information. Several challenges must be addressed, including capture, storage, search, processing, analysis, and visualization.

4.3 Networking. Networking technologies enable devices and people to have reliable communications with one another. Several wireless networking technologies, including radio frequency identification (RFID), ZigBee, and Bluetooth, have been deployed, although they are limited by the number of devices they can support, along with their throughput and transmission range. New wireless technologies (such as WiMAX and Long-Term Evolution) are unsuitable due to their high energy consumption. Novel Wi-Fi technology (such as by the IEEE 802.11ah Task Group) could be an efficient solution for smart city services.

4.4 Cloud computing. Cloud computing enables network access to shared, configurable, reliable computing resources. The cloud is considered a resource environment that is dynamically configured to bring together testbeds, applets, and services in specific instances where people's social interaction would call for such services;

4.5 Service-oriented architectures (SOAs). An SoA is a principle for software structuring based on service. A smart city's development should focus on SOA-based design architectures to address its challenges. A smart city thus requires a new IT infrastructure, from both a technical and an organizational perspective.

4.6 Cybersecurity architectures. Smart cities pose challenges to the security and privacy of citizens and government alike. The security issues associated with the information produced in a smart city extend to relationships among those citizens, as well as their personal safety. Some smart cities are already confronted by identity spoofing, data tampering, eavesdropping, malicious code, and lack of e-services availability. Other related challenges include scalability, mobility, deployment, interoperability (of multiple technologies), legal, resources, and latency.

V .CHALLENGES AND RESEARCH OPPORTUNITIES

Here, we highlight some of the challenges faced by smart cities while exploring research opportunities that need more attention to assist smart city development and adoption.

5.1 Challenges.

The following are the most noteworthy challenges to be addressed. Lack of investment. The concept of smart cities reflects strong potential for investment and business opportunities. On the one hand, investment in related projects has grown in recent years, financed by both governments (including municipalities and public research agencies) and private entities (companies and citizens). Navigant Research says investment in smart cities is divided into smart government, smart building, smart transport, and smart utilities. By 2020, $13 billion in funding is expected to establish smart cities all over the world . Yet according to a 2014 research report on financing models for smart cities, Navigant Research said this infrastructure faces major financial hurdles, including the perceived high risk of investing in innovative solutions, uncertainty of energy price policies, major investment required, long-term delays before reaping profits, and limited capacity for public funding.

Cost. Many cities are committing large budgets to get smarter. In India, the national government's annual budget for development of 100 smart citiesh is $1.27 billion, adding 11.5 million homes annually. In the European Union, smart city market projections are expected to exceed $1 trillion by the end of 2016. China's future smart cities allocations exceed $322 billion for more than 600 cities nationwide. All these projects demonstrate how substantial is the rate of investment in smart cities. However, if some of the challenges (such as cybersecurity) are not addressed early, the ultimate cost of smart cities will only increase.

High energy consumption. The U.S. Energy Information Administration estimates approximately 21% of the world's electricity generation was from renewable energy in 2011, with a projected increase to nearly 25% by 2040. The absence of natural resources in the estimation of energy consumption for the rest of the 21st century plays a negative role in smart cities investments (see Figure 3). The future of energy cost and access is uncertain due primarily to their dependence on projected geopolitical, socioeconomic, and demographic scenarios.

Smart citizens. Social dimensions must also be taken into consideration. A city's "smartness" greatly depends on citizens' participation in smart city projects, through multiple communication tools (such as a municipality's Web portal, social networks, and smartphone applications). Smart cities need citizens to be continuously connected—in public places, in public transportation, and at home—in order to share their knowledge and experience. The objective is effective management of natural resources and a higher quality of life for citizens; for example, they can compare their household use of electricity, gas, and water through their smartphones.

Privacy. Privacy will play a pivotal role in any smart city strategy. Citizens interact with smart city services through their smartphones and computers connected through heterogeneous networks and systems. It is thus imperative smart cities, founded on the use of ICT, be adept at handling important privacy issues (such as eavesdropping and confidentiality).

Cyberattacks.As with any infrastructure, smart cities are prone to cyberattack, and the current attack surface for cities is wide open. In 2015 identified several challenges, including vulnerabilities in the transfer of data, physical consequences for cyberattacks, collection and storage of large amounts of data in the cloud, and exploitation of city data by attackers. Detecting behavioral anomalies in daily human life is very important for developing smart systems.

5.2 Research opportunities.

IoT management. The IoT needs an efficient, secure architecture that enhances urban data harvesting. As others have noted, ubiquitous and collaborative urban sensing integrated with smart objects can provide an intelligent environment. Otherwise, packet latencies and packet loss are inevitably not controllable. One such proposal is the Mobile Ad hoc Networks (MANET) coordination protocol to opportunistically exploit MANET nodes as mobile relays for the fast collection of urgent data from wireless sensor networks without sacrificing battery lifetime. Simulation results show that their cluster formation protocol is reliable and always delivers over 98% of packets in street and square scenarios. Other issues, including the convergence of IoT and intelligent transportation systems require further investigation.

Data management. Data plays a key role in a smart city. A huge quantity of data will be generated by smart cities; understanding, handling, and treating it will be a challenge. However, mobile phone data can help achieve several smart city objectives. Smartphone data can be used to develop a variety of urban applications. For example, transportation analysis through mobile phone data can be applied for estimating road traffic volume and transport demands. Real-time information from mobile-phone data about the origins of visitors combined with taxis' Global

Positioning System data could help manage transportation resources, as in, say, the public's future demand for taxis.

VANET security. In smart cities, efficient security support is an important requirement of VANETs. One consideration is how to secure them by designing solutions that reduce the likelihood of network attacks or even how to diminish the effect a successful attack could have on them. Several security challenges persist in the realm of authentication and driver-behavior analysis. A smart city needs lightweight, scalable authentication frameworks that protect drivers from internal and external attackers.

VI. CONCLUSION

The strong interest by municipal and local governments worldwide in smart cities stems from their ability to improve their citizens' quality of life. Here, we described some of the basic concepts of smart cities, identifying challenges and future research opportunities to enable large-scale deployment of smart cities. Developers, architects, and designers should now focus on aspects of IoT management, data management, smart city assessment, VANET security, and renewable technologies (such as solar power). We underscore when designing smart cities, security and privacy remain considerable challenges that demand proactive solutions.

REFERENCES

1. Adepetu, A., Arnautovic, E., Svetinovic, D., and de Weck, L. Complex urban systems ICT infrastructure modeling: A sustainable city case study. IEEE Transactions on Systems, Man, and Cybernetics: Systems 44, 3 (Mar. 2014), 363–374.
2. Akselrod, G., Argyropoulos, C., Hoang, T., Ciracì, C., Fang, C., and Huang, J. Probing the mechanisms of large Purcell enhancement in plasmonic nanoantennas. Nature Photonics 8 (2014), 835–840.
3. Amaba, B. Industrial and business systems for smart cities. In Proceedings of the First International Workshop on Emerging Multimedia Applications and Services for Smart Cities. ACM Press, New York, 2014, 21–22.
4. Angelidou, M. Smart cities: A conjuncture of four forces. Cities 47 (Sept. 2015), 95–106.
5. Debnath, A., Chin, H., Haque, M., and Yue, B. A methodological framework for benchmarking smart transport cities. Cities 37 (Apr. 2014), 47–56.
6. Desouza, K. and Flanery, T. Designing, planning, and managing resilient cities: A conceptual framework. Cities 35 (Dec. 2013), 89–99.
7. Domingo-Ferrer, J. A three-dimensional conceptual framework for database privacy. Chapter in Secure Data Management, W. Jonker and M. Petkovic, Eds. Springer, Berlin, Heidelberg, Germany, 2007, 193–202.
8. Ferreira, D. AWARE: A Mobile Context Instrumentation Middleware to Collaboratively Understand Human Behavior. Ph.D. dissertation, Faculty of Technology, University of Oulu, Oulu, Finland, 2013
9. Huang, L., Chen, X., Mühlenbernd, H., Zhang, H., Chen, S., Bai, B., Tan, Q., Jin, G., Cheah, K., Qiu, C., Li, J., Zentgraf, T., and Zhang, S. Three-dimensional optical holography using a plasmonic metasurface.Nature Communications 4, 2808 (Nov. 2013).
10. Jagadish, H.V., Gehrke, J., Labrinidis, A., Papakonstantinou, Y., Patel, J., Ramakrishnan, R., and Shahabi, C. Big data and its technical challenges. Commun. ACM 57, 7 (July 2014), 86–94.
11. Khorov, E., Lyakhov, A., Krotov, A., and Guschin, A. A survey on IEEE 802.11ah: An enabling networking technology for smart cities. Computer Communications 58, 1 (Mar. 2015), 53–69.
12. Lausch, A., Schmidt, A., and Tischendorf, L. Data mining and linked open data—New perspectives for data analysis in environmental research. Ecological Modelling 295, 10 (Jan. 2015), 5–17.
13. Lee, C., Gyu, M., and Woo, S. Standardization and challenges of smart ubiquitous networks. IEEE Communications Magazine 51, 10 (Oct. 2013), 102–110.
14. Lee, J., Gong, M., and Mei-Chih Hu, H. Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. Technological Forecasting and Social Change 89 (Nov. 2014), 80–99.
15. Ma, Y., Wu, H., Wang, L., Huang, B., Ranjan, R., Zomaya, A., and Jie, W. Remote sensing big data computing: Challenges and opportunities. Future Generation Computer Systems 51 (Oct. 2015), 47–60.
16. Martinez-Balleste, A., Perez-Martinez, P., and Solanas, A. The pursuit of citizens' privacy: A privacy-aware smart city is possible. IEEE Communications Magazine 51, 6 (June 2013), 136–141.
17. Mitchell, R. and Chen, I. Behavior-rule-based intrusion detection systems for safety-critical smart grid applications. IEEE Transactions on Smart Grid 4, 3 (Sept. 2013), 1254–1263.
18. Perttunen, M., Riekki, J., Kostakos, V., and Ojala, T. Spatio-temporal patterns link your digital identities. Computers, Environment and Urban Systems 47 (Sept. 2014), 58–67.
19. Pires, S., Fidélis, T., and Ramos, T. Measuring and comparing local sustainable development through common indicators: Constraints and achievements in practice. Cities 39 (Aug. 2014), 1–9.

20. Rifkin, J. The Zero Marginal Cost Society: The Internet of Things, The Collaborative Commons, and The Eclipse of Capitalism. St. Martin's Press, St. Martin's Griffin, New York, 2015.
21. Sheldon, M., Van de Groep, J., Brown, A., Polman, A., and Atwater, H. Plasmoelectric potentials in metal nanostructures. Science 346, 828 (Nov. 2014), 828–831.