AN OVERVIEW OF SMART SUSTAINABLE CITIES AND THEIR APPLICATIONS

Divya Saraswat
Department Of Computer Science Engineering
Bhagwati Institute of Technology & Science
Ghaziabad U.P. India
E-Mail: conference@bits.ac.in

Abstract: Making a city "smart" is emerging as a strategy to mitigate the problems generated by the urban population growth and rapid urbanization. Yet little academic research has sparingly discussed the phenomenon. To close the gap in the literature about smart cities and in response to the increasing use of the concept, this paper discusses challenges, features and construction of smart city applications.

Keywords: Smart City, Internet of Things, ICT's

Introduction: The first question is what is meant by a 'smart city'. The answer is, there is no universally accepted definition of a smart city[1]. It means different things to different people. The conceptualization of Smart City, therefore, varies from city to city and country to country, depending on the level of development, willingness to change and reform, resources and aspirations of the city residents. A smart city would have a different connotation in India than, say, Europe. Even in India, there is no one way of defining a smart city. Some definitional boundaries are required to guide cities in the Mission. In the imagination of any city dweller in India, the picture of a smart city contains a wish list of infrastructure and services that describes his or her level of aspiration. To provide for the aspirations and needs of the citizens, urban planners ideally aim at developing the entire urban eco-system, which is represented by the four pillars of comprehensive development-institutional, physical, social and economic infrastructure. This can be a long term goal and cities can work towards developing such comprehensive infrastructure incrementally, adding on layers of 'smartness'. In the approach of the Smart Cities Mission, the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions. The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a light house to other aspiring cities. The Smart Cities Mission of the Government is a bold, new initiative. It is meant to set examples that can be replicated both within and outside the Smart City, catalyzing the creation of similar Smart Cities in various regions and parts of the country. The core infrastructure elements in a smart city would include:

i. Adequate water supply,
ii. Assured electricity supply,
iii. Sanitation, including solid waste management,
iv. Efficient urban mobility and public transport,

v. Affordable housing, especially for the poor,
vi. Robust IT connectivity and digitalization, vii. good governance, especially e-Governance and citizen participation[2].
vii. Sustainable environment,
viii. Safety and security of citizens, particularly women, children and the elderly, and x. health and education. As far as Smart Solutions are concerned, an illustrative list is given below. This is not, however, an exhaustive list, and cities are free to add more applications.

There is also considerable overlap of the Smart City concept with related city concepts such as:

- Intelligent City
- Knowledge City
- Sustainable City
- Talented City
- Wired City
- Digital City
- Eco-City

Features of a Smart City

A Smart City is a solution that allows the city to avoid a chaotic development and thus sustains its attractiveness, and supports its positive development, to assure an efficient management of resources, to show case the citizens' consultation in order to stimulate innovation and collaborative creativity, to sustain an enjoyable quality of life to its citizens, to promote a sustainable development, etc. [3]

1. Services to citizens

The growing urbanization challenges the governance structures of the city and the new tools offered by the use of ICTs may add flexibility to respond to citizens' needs of services. A smart city aims to deliver better services to citizens, to give them real-time information that may help them to make the good choices and contributes to solve everyday problems in a city.[4] Transportation, security, available parking places, water or energy consumption, information about traffic jams, and alternative routes, snow removal, goods, services, events. These are a few examples why ICTs are needed to give quick information to citizens and to deliver services more efficiently. On time and well provided information can simplify everyday life in a city and help people make decisions.

2. Citizen participation

Because people live more and more in cities, they are concerned by all the changes that may take place around them. They want to participate in the debates, to be considered and listened to by the decision makers. They want to be actors of change as much as decision makers and businessmen are. ICTs enable access to information and may enable the citizens to play a new and more active role.

3. Open government, transparency and confidence

Because of the need to pay attention to the way citizens want to interact with the city administration, open government and transparency are requested to maintain or to increase the confidence of citizens.

Construction of Smart City Applications

Smart City will be the future trend of urban development. Generally, the construction of smart city can be divided into three levels, including the construction of public infrastructure, construction of public platform for smart city, the construction of application systems. In this three-level, the construction of application systems is particularly important,

and has earned great concern across the country. Currently, in addition to defense and national security applications, smart city has been typically applied to various aspects. Construction of wireless cities

On the basis of powerful fiber-optic network and the technology of Wi-Fi, Mesh and WiMAX, with further extension, wireless broadband network can be built. At the same time, wireless broad base station will cover the whole city. And it can provide many functions of urban management and service systems for the public, business, foreign visitors, tourists and government agencies with its bandwidth. The functions include mobile wireless video surveillance, mobile video conferencing, mobile dispatching emergency response, and emergency telecommunications. [5]

1. Construction of smart homes

Sensor devices, including radio frequency identification devices, infrared sensors, global positioning system, laser scanners and so on, can be combined with the Internet to form the Internet of Things. Then all the items in life can be taken as a terminal to be brought into the network, achieving the centralized and remote control of electrical and mechanical equipment through the interaction of various networks and terminals, which can be convenient to user identification and management.[6] For example, the realization of smart home can be convenient for us to achieve the intelligent control of lighting and electrical appliances, as well as receive the intelligent notification of home alarm messages. At the same time, whether indoors or outdoors, we can benefit from the information technological achievements of smart city.

2. Construction of smart transportation

According to their needs and traffic situation, every city can take good advantage of sensor network, the Internet of Things and other technical means to change the traditional transport system, and establish the smart traffic management system, including adaptive traffic signal (automatic control of traffic lights according to flow time) control system, urban traffic control system and so on. At this point, the smart traffic management system can achieve the integration of urban planning, construction, management and operations, and provide comprehensive support for other subsystems of smart urban system.

Smart public services and social management

In daily life, for people's complaints, requests for assistance, personal management of social affairs and other aspects, we can establish a social service system, which can cover the intelligent management of the whole city and market operation. And on this basis, we can provide basic platform services for urban comprehensive planning, emergency response, community management, and turn the government into a one-stop service system. In this case, the government can collect and analyze real-time data in urban areas, providing more rapid and agile service to the public. At this point, the public can upload information by phone, PDA, personal computer and DV, and achieve real-time query of affair-state.[7]

3. Construction of smart urban management

Based on the ubiquitous network in the future city, we can make use of 3G, wireless network, the next generation of wireless networks with broadband or the future 4G network. At the same time, through private network of e-government, we are able to achieve the interoperability of supervision center,

command center and functions. In the private network, it can be possible to transfer data, work together, and form the core of the urban management system, achieving seamless management. [8] Smart city management can achieve the management and service of urban grid. In this case, it can bring us effective management and service of urban infrastructure, population and events through intelligent collection and analysis of data.

4. Construction of smart medical treatment

With great potential to be applied into smart medical treatment, the Internet of Things can help hospitals to achieve the smart medical care and intelligent management of medical materials, and support the digital collection, processing, storage, transmission and sharing of internal medical information, equipment information, drug information, personnel information and management information. Besides, it can also meet the needs of intelligent management and supervision in medical information, medical equipment and supplies, intelligent management and supervision of public health, solving so many issues, for example the weak support of health care platform, the overall low level of medical services and the medical safety hazards. [9]

5. Construction of green cities

Within the city limits, we can achieve the networking and interoperability of various systems posed by different devices, and make comprehensive use of various resources of monitoring and alarm to establish a new urban model and a system of green city. With the technological platform, we can achieve not only the networking, interoperability and mutual control of various devices and systems, but also the collection, transmission, storage, display and control of audio, video and alarm information. At the same time, it can also achieve the linkage with the alarm system, and provide data interface to other systems

6. Construction of smart tourism

Smart tourism is the only way to travel information. It should be based on the existing tourism information and infrastructure, taking good advantage of digital information and the Internet of Things to achieve the establishment of a set of solutions, which can consider and fulfill the management and tourism-related tasks, such as tourism online services, management of customer relation, management of operational area, development of domestic and overseas tourism market, intelligent management system of monitor, collection of tourism information and forecast of tourism development. Moreover, based on the integration of hardware and software platform for information and services of smart city, smart tourism can be taken good advantage of to fully integrated tourism market, tourist attractions, government departments and relevant information and services of enterprises to promote the development of tourism.

Challenges for Smart cities

Here are the top 10 challenges for developing smart cities in india:

1. Retrofitting existing legacy city infrastructure to make it smart: There are a number of latent issues to consider when reviewing a smart city strategy. The most important is to determine the existing city's weak areas that need utmost consideration, e.g. 100-per-cent distribution of water supply and sanitation. The integration of formerly isolated legacy systems to achieve citywide efficiencies can be a significant challenge.

2. Financing smart cities: The High Power Expert Committee (HPEC) on Investment Estimates in Urban Infrastructure has assessed a per-capita investment cost (PCIC) of Rs 43,386 for a 20-year period. Using an average figure of 1 million people in each of the 100 smart cities, the total estimate of investment requirements for the smart city comes to Rs 7 lakh crore over 20 years (with an annual escalation of 10 per cent from 2009-20 to 2014-15). This translates into an annual requirement of Rs 35,000 crore. One needs to see how these projects will be financed as the majority of project need would move through complete private investment or through PPPs (public-private partnership).

3. Availability of master plan or city development plan: Most of our cities don't have master plans or a city development plan, which is the key to smart city planning and implementation and encapsulates all a city needs to improve and provide better opportunities to its citizens. Unfortunately 70-80 per cent of Indian cities don't have one.

4. Financial sustainability of ULBs: Most ULBs are not financially self-sustainable and tariff levels fixed by the ULBs for providing services often do not mirror the cost of supplying the same. Even if additional investments are recovered in a phased manner, inadequate cost recovery will lead to continued financial losses.

5. Technical constraints of ULBs: Most ULBs have limited technical capacity to ensure timely and cost-effective implementation and subsequent operations and maintenance owing to limited recruitment over a number of years along with inability of the ULBs to attract best of talent at market competitive compensation rates.

6. Three-tier governance:
Successful implementation of smart city solutions needs effective horizontal and vertical coordination between various institutions providing various municipal amenities as well as effective coordination between central government (MoUD), state government and local government agencies on various issues related to financing and sharing of best practices and service delivery processes.

7. Providing clearances in a timely manner: For timely completion of the project, all clearances should use online processes and be cleared in a time-bound manner. A regulatory body should be set up for all utility services so that a level playing field is made available to the private sector and tariffs are set in a manner that balances financial sustainability with quality.

8. Dealing with a multivendor environment: Another major challenge in the Indian smart city space is that (usually) software infrastructure in cities contains components supplied by different vendors. Hence, the ability to handle complex combinations of smart city solutions developed by multiple technology vendors becomes very significant.

9. Capacity building programme: Building capacity for 100 smart cities is not an easy task and most ambitious projects are delayed owing to lack of quality manpower, both at the centre and state levels. In terms of funds, only around 5 per cent of the central allocation may be allocated for capacity building programs that focus on training, contextual research, knowledge exchange and a rich database. Investments in capacity building programs have a multiplier effect as they help in time-bound completion of projects and in designing

programs, developing faculty, building databases as well as designing tool kits and decision support systems. As all these have a lag time, capacity building needs to be strengthened right at the beginning.

10. Reliability of utility services: For any smart city in the world, the focus is on reliability of utility services, whether it is electricity, water, telephone or broadband services. Smart cities should have universal access to electricity 24×7; this is not possible with the existing supply and distribution system. Cities need to shift towards renewable sources and focus on green buildings and green transport to reduce the need for electricity.

Value and Outlook of Smart City

Internationally, it is a good opportunity for China that smart planet starts with smart city. At present, China has achieved good development in information technology, and as to the technology covered in smart planet, including sensor technology, network technology, physical networking technology and intelligent information processing technology, our country have certain R&D infrastructure and industrial capacity. On this basis, we should combine our economic and social development needs to increase the investment in material, technical, and personnel infrastructure. At the same time, we should select a number of developing priorities in a planned way, for example smart transport, smart grid, deploying as soon as possible, achieving a more thorough sense, more comprehensive interconnection and more intelligence. In terms of our country, with the development of the Internet of Things, people's daily life will be changed dramatically. At the same time, it also brings us to the development of smart city, which is based on the Internet of Things. In the encourage of global trend of smart city and national policy, a numbers of cities, for example Beijing, Shanghai, Guangdong, Wuhan, have taken smart city as an important research, and participated in the construction of "Smart City" and "reading China", trying to stand out in the future economic competition with the layout of the Internet of Things.

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