

Internet of Things and Sustainable Urban Development in India

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ABSTRACT - In the era of digitalization, smart technologies are revolutionizing life where the people all over the world can connect anything with internet. The concept of smart cities is gaining impetus which integrates both Information and Communication Technology (ICT) and Internet of Things (IoT) in one platform. Smart cities will bring together technology and infrastructure to improve the quality of life of citizens and enhance their interactions with the urban environment. In India, the governments have taken measures to transform urban areas into SMART cities in order to manage their resources while meeting the challenges of urbanization. The IoT services are transforming cities by improving quality of life of the people by infrastructure development and efficient public service delivery. This article discusses different urban development initiatives in India and the application of IoT tools for the development of sustainable transport system in smart cities.

Keywords: Urban Development, Smart Cities, Internet of Things, Information and Communication Technology, Intelligent Transport Management System.

I. INTRODUCTION

Urbanization is a recent phenomenon all over the world. In the year 1900 only fifteen percent of the world's population lived in cities, but it has been increased to thirty percent by 1950 and presently fifty five percent of the world's population lives in urban areas. It is expected that the urban population will increase to 68% by 2050. The UNDESA projections show that urbanization shift from rural to urban areas combined could add another 2.5 billion people to urban areas by 2050, with close to 90 per cent of this increase taking place in Asia and Africa [9]. The increase in urban population has not been evenly spread throughout the world. Different regions have seen their urban populations grow more quickly, or less quickly, although virtually no region of the world can report a decrease in urbanization [10]. Asia has highest number of people living in urban areas, followed by Europe, Africa and Latin America Together, India, China and Nigeria will account for 35% of the projected growth of the world's urban population between 2018 and 2050. By 2050, it is projected that India will have added 416 million urban dwellers, China 255 million and Nigeria 189 million [9].

Rapid urbanization and growing urban population has put pressure on the existing resources in the urban areas. The urban areas especially in developing and under developed nations faces many challenges like growth of slums,

increasing natural resource constraints, pressure on infrastructure, strain on basic services like education and health, housing and environment. The urban Governments mainly need to handle the pressure in three spheres simultaneously which includes environmental impact, economic growth, and social evolution. In order to handle the challenges in urban areas, governments have to be smarter to manage complexities by increasing efficiency in the governance through cost reduction and improvements in service delivery and quality of life. Over, the past two decades, the technological advancements have changed the procedures and functions of the governments by using Information and Communication Technologies (ICTs) in urban and spatial planning. ICTs have been providing greater opportunities to overcome the urban challenges and improve overall economic well-being of urban population. ICT can be used to make urban centers more resource efficient, citizen friendly and sustainable.

In the recent years, urban planners started utilizing latest technologies to address these urban issues while developing the ability to effectively predict and respond to day-to-day problems in the urban areas. Thus, the emergence of cloud-based services, powerful mobile devices, sensors, big data and analytics present a huge opportunity for cities to enter a new phase of technological development and enable new ways to deliver services to citizens. These technologies can help administrators and urban planners to achieve their

goals of creating liveable communities and improve the overall quality of life while protecting the environment and promoting planned development [5].

II. URBANIZATION IN INDIA

Urbanization in India relatively slow but it is stable with the rate of growth in urban population since 1921. The level of urbanization has increased slowly from 11.18 percent in 1921 to about 31.15 percent in 2011. In the last decade, India's outlook on urbanization has undergone a paradigm shift with urban planning being brought to the forefront of development policymaking. The urban population in India stood at 377.1 million in 2011, has been growing at the rate of 3.35 percent per annum and projected to increase to 473 million by 2021, 600 million by 2031 and 820 million by 2051, thus adding 100 million every decade [8]. The urban areas in India are becoming central to economic growth and development of the nation with its increasing contribution to Gross Domestic Produce (GDP). The share of urban sector in country's GDP has been increased from 37.7 per cent in 1970-71 to 52 per cent in 2004-05. The mid-term appraisal of the Eleventh Plan projected the urban share of GDP at 62-63 per cent in 2009-10 [8]. According to several studies and reports, Indian cities are likely to account for nearly 70% of India's GDP by 2030 [11].

The speed and scale of urbanization brings challenges before the Governments in India. Urban sector in India faces two distinct set of challenges. The first set of challenge is to find means to step up the creation of jobs in urban sector to the rising number of urban poor. The second set of challenge before the Government is to ensure provision of basic urban services like affordable housing, well-connected transport systems, sanitation and water supply and other infrastructure facilities to the urban citizens. As per Census of India 2011 data, there are 13.7 million slum households in India that live amidst inadequate basic amenities, poor health outcomes, insecurity as well as unstable incomes. Today, slums are located across urban areas in the country with 63% of statutory towns in India being home to these dwellings [1]. Over the last four decades, the total headcount of the poor in the share of urban poverty has gone up from 18.7 to 26.8% [1]. If these challenges are not addressed properly the Indian cities will be overcrowded with no improvements of livelihoods of growing population.

URBAN DEVELOPMENT INITIATIVES IN INDIA

Under the five year plans (FYP) in India, the governments have been focusing on infrastructure development and reduction/alleviation of poverty in urban areas. Several initiatives were launched by the governments to promote urban infrastructure in the country. However, this was brought into the core of planning exercise only during the Fifth FYP. The analysis of government policies and programmes and the investment pattern under the FYPs till

1980s reveals that there was a distinct bias for urban areas in the country. The level of infrastructure facilities and basic services in urban areas has been improved with the public sector investments allocated after the fifth FYP. In the subsequent FYPs it was stressed that poverty reduction is possible only by promoting economic growth and through proper implementation of the different programmes. Subsequently many initiatives were launched such as Minimum Needs Programme (MNP), Integrated Urban Development Programme (IUDP), Integrated Development of Small and Medium Towns (IDSMT), Urban Basic Services (UBS), Urban Basic Services for Poor (UBSP), Nehru Rozgar Yojana (NRY), Scheme for Educated Unemployed of Employment Generation in Urban Localities (SEEGUL), Prime Minister's Integrated Urban Poverty Eradication Programme (PMIUEP), 74th Constitutional Amendment Act (CAA), Swarna Jayanti Shahari Rozgar Yojana (SJSRA), National Slum Development Programme (NSDP), Valmiki Ambedkar Awas Yojana (VAMBAY), etc for urban areas.

The process of the comprehensive urban reforms in India started with the 74th CAA in 1992 and it has reached its highest point when the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) was launched in December 2005. The JNNURM was basically a reform linked incentive scheme for providing assistance to state governments and urban local bodies (ULBs) with over one million population, state capitals and a few other cities of religious and tourist importance for the purpose of reforming urban governance, facilitating urban infrastructure and providing basic services to the urban poor [2]. It was the first major urban development programme in India which was established the foundation for large-scale central assistance to the urban sector. The main objective of the project was to lead a reforms driven, accelerated development of Indian cities, with a particular focus on urban infrastructure [4]. The Mission comprises of two sub-missions namely Urban Infrastructure and Governance (UIG), and Basic Services for the Urban Poor (BSUP).

The two sub-missions of JNNURM were focused on 65 selected cities which include 35 cities with million plus population and 30 others urban areas including capital cities/ the cities of religious/ historic/ tourist importance. In addition to these, two other schemes namely Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) and Integrated Housing and Slum Development Programme (IHSDP) were launched for all other medium and small towns in the country. These two sub-missions and programs replaced a couple of earlier government programmes like AUWSP, IDSMT under UIG and UIDSSMT, and VAMBAY, NSDP under BSUP and IHSDP programs. The main thrust of the UIG and UIDSSMT programmes was financing major urban infrastructure projects relating to water supply, sewerage,

drainage, solid waste management, road network, urban transport and redevelopment of old city areas. The BSUP and IHS DP, on the other hand, focus on shelter for the urban poor, including re-development of slums.

The major contribution of the JNNURM programme was highlighting the importance of urban areas by bringing the urban problems to the forefront. The JNNURM programme made a difference to the size of investments for infrastructure development in urban areas covering across cities and sectors and reforms in urban governance with development of service level benchmarks for most of the basic services. During 2014 - 15, the central government launched four mission mode schemes to expedite urban infrastructure and service provision by replacing JNNURM. The mission mode schemes are: (i) Atal Mission for Rejuvenation and Urban Transformation (AMRUT) which focuses on water supply and sewerage improvement; (ii) Smart Cities Mission (SCM) which aimed at developing smart solutions for selected urban areas; (iii) Swachh Bharat Mission (SBM) that focuses on waste management and sanitation; and (4) Heritage City Development and Augmentation Yojana (HRIDAY) for addressing the development of heritage cities.

ICT AND SUSTAINABLE URBAN DEVELOPMENT

Urban areas are facing unprecedented challenges. To address these challenges, the concept of the smart city has been conceived with the aim to integrate the technology with a strategic approach to sustainability, cost reduction, citizen well-being and economic development. Technological innovation has the potential to provide some of the solutions to the issues of urbanization by helping to reduce environmental impact and promote growth and citizen engagement in the development process. ICT can be used to mitigate environmental issues such as traffic congestion, energy consumption, and behavioral change. The technology-enabled city is an untapped source of sustainable growth. By unlocking technology, infrastructure, and public data, cities can open up new value chains that spawn innovative applications and information products that make possible sustainable modes of city living and working [7]. Governments across the globe including India have taken measures to transform urban areas into 'SMART cities' in order to manage their resources while meeting the challenges of urbanization. The 'SMART city' notion has become synonymous with the visions of future urban development, which is marked by the widespread digitization of services. The need for smart cities has been emerging for some time, in particular due to the increasing urbanization during the last 50 years. Cities now account for 75% of the world's greenhouse emissions, but take only 2% of the earth's surface area. At the same time, the size and economic outputs of cities is on par with small nations - only 600 urban centers generate about 60% of global GDP. For example, Tokyo ranks as one of the

world's top 15 economies with 35 million people and nearly \$1.2 trillion in economic output - this is larger than either India or Mexico [7].

Efforts to utilize ICT in urban centers are often referred to as "Smart Cities" initiatives. This has been accompanied by deeper connectivity and networking of cities and citizens at both the local and global levels. The need to build smart cities became a requirement that relies on urban development that should take charge of the new infrastructures for smart cities (broadband infrastructures, wireless sensor networks, internet-based networked applications, open data and open platforms) and provide various smart services and enablers in various domains including healthcare, energy, education, environmental management, transportation, mobility and public safety [6]. The international telecommunication union (ITU) defines smart sustainable city as "an innovative city that uses ICTs to improve quality of life, the efficiency of urban operations and services and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental and cultural aspects" [10].

Smart Cities rely on a host of different ICT applications. The two recent technological developments underlying these efforts are the Internet of Things (IoT) and Cloud Computing. IoT is the set of technologies that can interconnect virtually anything, from daily life objects to more sophisticated networked devices. IoT devices can capture not only the environmental context (temperature, air quality, presence, movement etc.), but also the context of users (preferences, friends, intentions etc.). Some of them may be actuator devices, i.e. acting to change the environment, then giving the power to users of controlling it in accordance with his/her desire. IoT democratizes the way users interact with information, often in real time and related to the physical environment. Efficient integration of this information into existing processes, from business processes to citizens' daily tasks, may have a great potential to increase the smartness of the city [10].

Cloud Computing provides a flexible virtual execution environment for processing any application over a potentially infinite number of resources, scaling up and down according to usage behaviors. Its decentralized nature enables high reliability and accessibility to information from anywhere at any time. Cloud centers can provide on-demand metered services at different granularities with a requested quality of service level. Besides new technological enablers, the Cloud paradigm brings new economic models based on pay-per-use that reduce initial investments and related operational costs to the actual use of service, the cost and time for new service providers, in particular for SMEs, enabling entry into a wide market with minimum infrastructure management requirements. They

can thus experiment with novel and innovative services whilst reducing the risk of wasting resources [10].

In the backdrop of above discussion, the present study focuses on embracing the potential of IoT through smart solutions in urban development in India.

INTERNET OF THINGS AND SUSTAINABLE URBAN DEVELOPMENT

The Internet of Things (IoT) has rapidly become one of the most familiar and most hyped terms across the different areas of business and technology. Kevin Ashton coined the term Internet of Things in 1999 who used the term first time while delivering a presentation at Procter & Gamble (P&G) [3] about sensor-based technologies wire-less connectivity with a fascinating title named “Internet of Things”. The IoT, enabled by the already ubiquitous internet technology, is the next major step in delivering Internet’s promise of making the world a connected place. IoT is a concept and a paradigm that considers pervasive presence in the environment of a variety of things/ objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/ objects to create new applications/ services and reach common goals. The goal of the IoT is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any network and any service.

IoT introduces new opportunities such as the capability to monitor and manage devices remotely, analyze and take actions based on the information received from various real-time data streams. IoT is changing the way the city is upgrading itself to enhance infrastructure, creating more effective and cost-efficient municipal services, improving transportation services by decreasing road traffic congestion, and improving citizens’ safety. The urban planners and service providers must recognize the potential of IoT in delivering scalable and secure IoT solutions that include efficient IoT system for making smart cities. Further smart cities concentrate on several supporting IoT devices in the domains like public safety, infrastructure monitoring, logistic management, waste and water management, traffic analysis etc. These transformations will require radical changes in the urban governance.

Initiatives and Application areas of IoT in Urban areas

Digital tools are revolutionizing urban planning and governance which allows collecting and exchanging the data without human interference. The IoT solutions can be applied in different domains like buildings, energy, environment, agriculture, logistics, home automation, manufacturing and smart cities. Smart city is one of the applications of IoT in urban areas and the examples of IoT applications for smart cities includes smart surveillance, smart mobility, smart energy management systems, smart environment, smart living, smart economy, smart

governance and smart people. The aim of the smart cities is to make urban life easier by increasing the efficiency, quality, and accessibility of public services. Smart cities build upon the IoT are allowing the urban planners and service providers to revolutionize urban life by connecting everything with electronics, software and sensor to internet. In the pursuit of smarter, local governments have started experimenting with IoT across all dimensions of urban life by providing more responsive city services.

Some of the key sectors covered by smart city are smart parking, Intelligent Transport System, tele-medicine, woman safety, smart grids, smart urban lighting, waste management, smart city maintenance, digital-signage and water Management. Some of the key application domains using IoT solutions to improve the quality of life in urban areas are discussed in the following:

Smart Health

Use of technologies in healthcare can provide better medical facilities to the patients, doctors and hospital as well. Sensors and web based or mobile based applications which communicate via network connect devices and helps to monitor and record patients’ health data and medical information and various vital parameters of patients like subtle changes in pulse, respiration, heart condition, temperature etc. Further IoT sensors can be used to support dementia and other mentally unhealthy patients from getting lost.

Smart Water

Managing the supply of water has become a critical task for the governments in the urban areas. IoT can be used to create improved water system by setting up water monitoring tools to monitor the quality of tap water in all public places and government institutions. An IoT smart water sensor can be used to track the flow of water across the city and distribution channels. It will also help in detecting real-time leakages and wastage of water. IoT can be used for monitoring water level variations in rivers, dams and reservoirs, for proactive disaster management.

Smart Home Automation System

In the electronic age, we use number of electronic devices in our daily routine life and all these devices need electricity to function. In order to reduce electricity consumption and save power, proper energy management system should be implemented at household level. Smart IoT system facilitates controlling of all home appliances via smart phone itself. By using the device, one can switch ON/OFF the electronic devices using an Android App installed on their mobile with Bluetooth technology. The IoT system will also send the data collected like device’s usage time, pattern and frequency to cloud for storage and analysis. The stored data will provide valuable insights

about the power consumption and will help individuals for monitoring the electricity usage.

Smart Street Lights

The manual system of street lights wastes the power will up to some extent. Under the Smart Street Lights system the manual operation of the lighting system is completely eliminated and it provides a solution for energy saving by reducing the wasted energy 50% energy savings and 20% operational savings. The smart street lighting is the ideal starting point for a smart city initiative. The installation of smart lighting solutions can play a key role in a smart city strategy and these solutions will help cities in monitoring the environment, to increase public- and traffic-safety, to upgrade connectivity as WiFi hotspots or to deliver location-based services like smart parking and smart navigation. Smart lights enable cities to ensure illumination in different locations based on lighting demands. Smart street lights conserve energy by only turning on whenever a vehicle or person passes through their vicinity. They also reduce energy consumption by dimming out light in areas with low occupancies, like parking lots.

Smart Roads

In urban areas, the road is an often-overlooked part of the modern transport infrastructure. Roads can be upgraded with communication, lighting and power transmission technologies that can support sustainability, improve safety, and transform the driving experience. The concept of smart roads incorporates the use of sensors and IoT technology that makes driving easier and safer. These roads provide drivers with real-time information about weather and road conditions. They can also help drivers to find free parking space and prevent accidents by alerting drivers about incoming traffic. These roads are particularly useful on mountain roads where landslides are a common occurrence. Roads that are fitted with electric vehicle charging capabilities can also charge electric vehicles running over them with the help of electromagnetic effects. The roads can be connected to IoT devices which gather traffic and weather data. It can improve safety, traffic management, and energy efficiency.

Smart Parking Management

In-Ground Vehicle Detection Sensors have enabled the development of smart parking management systems. These systems help drivers to immediately identify a vacant parking spot in a mall or city center. A central parking management system uses local signal processors in parking spaces and transmits an empty parking area to the nearest vehicle. This reduces congestion in parking lots, decrease vehicle emissions, and reduce the stress a driver face to park a vehicle.

Smart Traffic Signals

Smart Traffic Lights are a part of cellular vehicle to everything (CV2X) network. By using this network a traffic light at all times remain in contact with the connected cars. Cars send real-time information to these traffic signals, enabling them to switch lights based on the traffic conditions. This avoids the congestion of vehicles on the crossings and enables smooth flow of traffic in a city.

Smart Disaster Management

IoT programs can examine data about an occasion very fast, supporting responders better become aware of incidents, determine the way to respond, and talk decisions (and critical moves) to those involved. Environmental sensors, as an instance, can sign in and report early signs of an emergency or crime; already, devices which include ShotSpotter can stumble on the sound of a gunshot and pinpoint its place. By means of automatically alerting police dispatch, the tool can tell velocity response time, in addition, to reduce reliance on witnesses to document crime, assisting to locate crimes that would by no means have been suggested.

In the light of above discussion on different domains of IoT applications in smart cities, this article discusses a success story of Intelligent Transport Management System (ITMS) in Ahmedabad city of Gujarat state in India where the IoT applications mostly used in the domain of urban mobility and brought efficiencies in the transport management system leading to smart transportation with transport network.

III. INTELLIGENT TRANSPORT MANAGEMENT SYSTEM IN AHMEDABAD

The term Intelligent Transport Management System (ITMS) refers to the application of ICTs to transport infrastructure and vehicles that improves transport outcomes such as transport safety, transport productivity, travel reliability, informed travel choices, social equity, environmental performance and network operation resilience. Ahmedabad is the seventh largest city in India and it is one of the first 20 cities selected for the Smart City Mission (SCM) of Government of India. The ITMS was launched in Ahmedabad city in 2017 with a vision to develop efficient and convenient bus transport services and transform the city into a world class smart city. The main objective of the ITMS is to upgrade the city's manually operated, often erratic bus transit infrastructure with a seamless, safe and reliable quality of transport services to citizens. The ITMS works on the applications of IoT and Big Data analysis technologies by analyzing data sets collected from different IoT tools on one dashboard, making complex decisions easier and efficient.

Before the ITMS, there were many problems in manually operated bus service system that includes poor route plans,

disorganized schedules, inconsistent and inconvenient cash collections, rough driving, etc. However, the ITMS provided solutions to tackle every aspect of the issue by building an IoT driven transport management system that had everything from software-based bus service system backed by advanced ICT to a cashless open-loop card system. There are five smart transport sub-systems integrated under the ITMS which are discussed in the following:

1. Automated Fare Collection Service (AFCS): It facilitates the easy and secure cashless payment option via prepaid RuPay card or smartphone for the passengers and ensures greater convenience, passenger safety and ridership visibility.
2. Automatic Vehicle Location System (AVLS): It allows the passengers and authorities to get the real time visualization of the vehicle location via fitted GPS system in the buses. It enabled the authorities to calculate estimated time of arrival and support bus operations from a central command center to adhere to a planned schedule.
3. Vehicle Planning Schedule and Dispatch System (VPSD): It provides a revamped and optimized schedule for the buses and the bus routes and schedules are optimized by analysis of bus travel performance and traffic volume.
4. Depot Management System (DMS): It helps with the allocation and optimization of the crew and the overall bus operations by automating the management of vehicles, fuel, inventory, personnel, and vehicle maintenance.
5. Passenger Information System (PIS): It provides real-time bus information via mobile app, website, and in-station boards to enable passengers to plan their route and estimate waiting and arrival times.

The Integrated Command Control Center (ICCC) of the ITMS collects the real time information related to all the five sub-systems and analyzes uniformly against the key performance indicators to create more efficient and dynamic bus service operations, and a smarter, safer travel experience for commuters, across the ticketing, in-station and in-journey stages (Tata Trust, 2019). The personnel at ICCC will take appropriate action immediately if the analysis reveals any shortcoming according to prescribed statement of purpose. The ICCC provides two way communication and drivers also can contact the ICCC.

The introduction of ICT in public transport system made the system more efficient and transparent. Some of the benefits of ITMS are:

- It has improved bus service efficiency and commuter travel experience through reduced queues and waiting time.

- The innovative VPSD software allows modifying transit routes and dispatching vehicles according to the requirements in the city.
- The data from AVLS help government in reducing the maintenance cost and saving approximately Sixty Lakhs per month.
- The AFCS keep in check payment frauds and makes it possible to track payments.
- Analytical tools of ICCC support decision making at different levels for timely action for solutions and future investment requirements and opportunities.
- It promotes an integrated multi-modal smart transport system and operating platform.

IV. FINDINGS AND RECOMMENDATIONS

Urbanization is inevitable and it has both the advantages and disadvantages. Cities are to play a very important role in achieving faster growth with a structural transformation in India. Therefore, planning for urbanization and better management of cities is important for the quality of life of the people living in the urban areas. Moreover, Indian cities suffer from a huge deficit in meeting the needs of the growing population for housing, energy systems and other infrastructure as well as for employment and basic services such as education, education care, drinking water, waste water treatment, solid waste management and public transport. These challenges demand innovative policy responses, among them effective financing, reliable service delivery, and responsive governance institutions. The smart technologies have potential to help in talking these challenges in a better way especially during the disaster response management in urban areas. However, in order to effectively make use of smart technologies in the urban areas, it is required to first assess whether our infrastructure can sustain such changes and plan carefully with secured manner.

Urbanization has adverse impact on health, environment and natural resources. The unexpected problem of COVID-19 reveals that our society is not really ready to face the disasters. The COVID-19 experience reveals the importance of intensive policy coordination to make cities inclusive, healthy, resilient, and sustainable. In these challenging circumstances, IoT can help government in smooth transition of cities towards real time data across urban system like boosting productivity, providing better health facilities, making transport more efficient, tackling climate change etc. The IoT also can support government in providing public benefits like safety and efficiency with involvement of smart technologies. The IoT projects that have shown its full potential in some applications are healthcare, transport, smart cities, agriculture automation and energy consumption. However there is still lot of challenges and issues that has to be addressed to achieve

the full potential of IoT. The following are the few suggestions for better utilization of IoT potential in contributing towards sustainable urban development under the Smart City Project.

V. SUGGESTIONS

1. IoT applications and the data stored and processed in the cloud through IoT applications should be easily understandable for better utilization by everyone especially common man.
2. Data generated by IoT should benefit both the governments and consumers and it should be helpful in improving the performance and quality of service delivery.
3. The privacy of personal information of the citizen should not be compromised and necessary steps should be taken to avoid adversities of innovative technologies.
4. An integrated approach using IoT applications in different sectors of sustainable urban development should be planned in order to achieve maximum benefits from the Smart City projects in the country.

VI. CONCLUSION

Urbanization is a non-ending phenomenon and it is widely viewed as a key factor for economic development all over the world. But, the urban population growth gives both the opportunities and challenges especially in developing countries. The speed and scale of urbanization brings challenges which includes meeting accelerated demand for affordable housing, well-connected transport systems, and other infrastructure, basic services, job opportunities particularly for the urban poor who live in informal settlements, etc. The unprecedented urban growth demands a proactive response with a wide range of policies and practices to be conceptualized around new socially inclusive and environmentally friendly paradigms in the urban governance. With the incidence of growing urban population, the sustainable development of urban areas becomes more relevant than ever. In the present situation of COVID-19, the innovative technologies especially IoT applications holds tremendous potential for governments to tackle the problems of urban people and build cities of the future. The benefits of IoT applications in the areas of urban development especially the ITMS model in Ahmedabad encourages to make use of innovative technologies in livelihoods promotion, health services, etc for sustainable urban development. Governments should be aware of the role played by IoT applications to better utilization of IoT applications in different sectors of urban development to achieve maximum benefit from the Smart City projects.

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