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Explorative State-Wise Study of Smart Cities in India

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***Abstract*—This paper discusses the smart cities in India and its features with the Smart City Mission and its strategy on state-wise basis considering its dimensions, duration, finances and challenges. The dimensions of smart cities and its empirical features are acknowledged and discussed. Then study the smart cities of India regarding its critical aspects such as function, features, technologies and its development stages. A comparison is made and then bring forth the problems of smart cities and how it can be tackled. Specific issues are discussed with a conclusion for its future prospect. With all the analysed data, the future scope of smart cities is discussed. All the work is for finding better ways to transform the digital cities of India.**

Keywords*— *Smart city, smart solutions, IOT, Digital technology, Wireless technology, Intelligent business.

I. INTRODUCTION

Smart city is defined as a city that enhances the life of citizens by utilizing digital technologies. It analyses and calculates the present and the future challenges with the features of various distributed wireless technologies, communication networks and intelligent business management systems. This analysis requires large amount of data in order to calculate the day-to-day issues. The Indian govt. has invested ₹ 98,000 crore (US$14 billion) to distribute across different state-wise missions over time [15] [16]. In India, MOUD launched the Smart City Mission, focusing initially on developing 100 cities all over the country to increase the efficiency of economic condition and also to achieve better lifestyle of its citizen by developing local infrastructure and utilize the technology in order to make liveability much efficient for the citizens. [12].

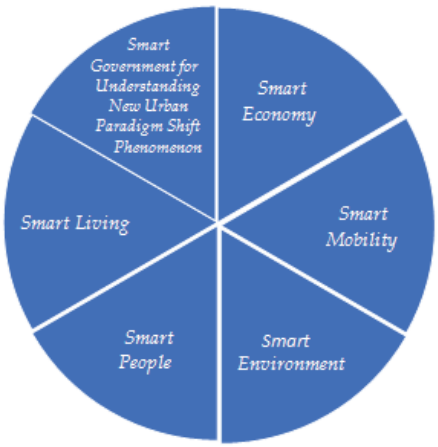

Fig. 1. Six Dimensions of Smart Cities.

II. LITERATURE REVIEW

*Smart cities in India: Key areas and challenges – Case study of Chandigarh city by Kuldeep Singh and Neha Sharma (2016)***:** In this paper, smart city concept as per the Indian government is discussed, also concentration on the key challenges with a case study on the city of Chandigarh. *The Indian perspective of Smart Cities by Khusboo Gupta and Ralph P.Hall (2017)* **:** It shows us an overview of the working of smart city evolving in India. It considers both the citizen's and the official's point of view. It shows us that the citizens give more importance to livelihood, transportability, habitat, administration and wealth respectively, whereas the officials give more importance to livelihood, habitat, wealth, transportability and then administration respectively. According to the paper, it also proves that the size of the city matters in prioritizing what aspect of smart city is important to them.

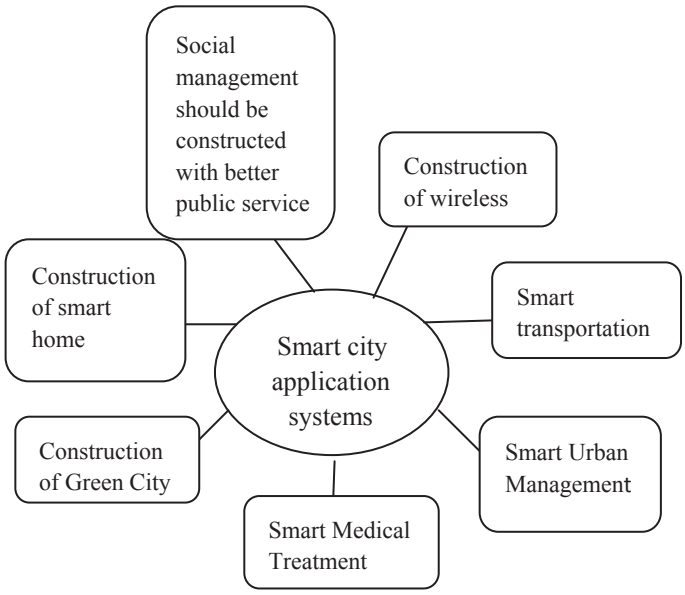

Fig. 2. Smart City Application Systems

III. METHODOLOGY

This research paper was developed in an explorative, structured manner, by making tables and charts of the available information from different sources ranging from 3rd party resources like websites, journals, other research papers etc. to our own findings, and finally analysing it and forming a possible solution and future scope.

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IV. Empirical Features of Smart Cities in India

Adequate water supply- Every household in the city should not have any shortage of safe and clean water supply. Without water, living beings let alone humans cannot survive [14]. Assured electricity supply- Electricity is also a necessity for every household as no work can be done without energy and energy comes from electricity [14]. Sanitation, including solid waste management – Without proper sanitation, the environment will become unhygienic which will cause diseases. So, it is also a necessity [14]. Good governance, specially e-Governance and citizen participation – It will make governance citizen friendlier and more cost effective [14]. Robust IT connectivity and digitalization- With better IT connectivity and better digitization, there will be more work done with lesser labour. Life will become easier. [14] Efficient urban transportability and public mobility system: With better urban mobility and public transport, commuting would be much faster, efficient and safer [14].

Sustainable Environment: Sustainability makes us work for the better future, for our children, for the next/ future generation. The environment we live needs to be developed and maintained in such a way that it will be better for our future [14].

Safety and security for the citizens, especially females, young ones and the elderly. Women in our lives are the reason we have a future generation. We need to stop living in a patriarchal society and start respecting women. The children are those who will become our future generation. The elderly people are the reason we have our current generation. So, protecting the citizens, particularly females, young ones and the elderly are very important [14]. Health and education: We all have heard about the phrase "health is wealth", without good health, we as humans fail. Education is the pillar of an intellectually developed society. Hence, we need education [14]. Housing and inclusiveness: A city without people living in it is not a city. People need houses to live in. And these people need not have any boundaries of religion, caste, race and everything else that we differentiate among us humans. With better housing and inclusiveness, we can make a brighter future [14]. Giving identity to the city based on its main economic activity: The city needs to have an identity that describes its main economic. For example, if the city produces large number of handlooms and handicrafts, it needs to be known for its good products, have its own speciality, its own identity.

Fig. 3. Empirical Features of Smart Cities in India

TABLE I. Top Indian Smart City Comparison

State	Function	Features	Technologies	Development Stage
Pune	Smart Street Lighting	Replaced 77800 ordinary street light to a much appropriate solution, that is the LED lights. Also, the feeder panels that are manual based are replaced by Energy monitor that is SCADA based and control panels. A single location in Command and Control Room will control all the street lights of Pune Municipal Corporation. A Mobile application and a free of cost service number is available so the citizens can log in and submit and kind of complaints regarding Street light not functioning and it will be immediately responded.[1]	LED Lights, SCADA based Energy Monitor and A Mobile App	Completion of installation was to be on 28th November 2017. And for the next 12 years, Operation is to be started
	Emergency Call Box	An emergency call box being deployed across 136 areas in the city, that consists of a button, so when the citizens are in danger/ need immediate assistance, they can just press the button on it and they will be provided assistance from the Smart City Operations Centre (Command and Control Centre) [2]	Location detector connected to the Smart City Operations Centre.	It has not been implemented yet. But 136 locations have been assigned for deployment.

	Smart Environmental Sensors	Hotness and coldness, Amount of water present in the atmosphere, Radiation, level of noise and quality of air. All these parameters are recorded in these sensors. It is deployed across 50 areas in Pune city in order to calculate the key environmental parameters. [2]	Thermometer, hygrometers, Geiger counter, sound level meter, Air quality Index	The plan is to plant the sensors at 50 different locations throughout the city which will measure the various environmental parameters.
	Flood Sensors	Sensors are also deployed across 30 locations in the city near bridges and drains in order to measure the city water levels and give data through display channels for possible flooding in the locality. [2]	A flood sensor is a small device that detects moisture levels to monitor for potential flooding	The plan is to plant the sensors at 30 different locations throughout the city, especially near water bodies.
Jaipur	Smart Multi Modal Mobility	It combines and integrates all kinds of public transport facility available for easy accessibility to the commuters and the operators. The information integration is done at PAN city which is supported by a common payment system and integrating the nonmotorized transport connectivity in ABD area. It has 4 sub-projects 1) Variable message signage 2) Public Rapid Transport System (PRTS) 3) Integrated with Management System for transport 4) execution of Ticketing System which is common for everyone. [3]	LED, GSM/GPRS/3G, GPS, VMS display board, smart card.	Work in progress. Not yet completed.
	Automated Online water quality monitoring system, GPRS connected.	An automated online water monitoring system which measures the quality and quantity of water, which would ensure prevention from water borne diseases and would provide quick responses to water quality issues. 10 of these monitoring stations have been provided.		

Chandigarh	Smart Portable Water [4]	Additional Network line for water distribution will be made. For DMAs (District Meter Area), SCADA system will be implemented and integrate it with PLC system. Also, smart meters will be installed for smart readings.	SCADA control system. PLC system.	Reached 100% supply coverage for water. In 204 tube wells/boosters with filtration plant, SCADA system has been applied.
	Power Distribution Network [4]	Street lights has been upgraded to LED lights with brand new light poles, which can be recharged with solar panels integrated to it. Rooftops are also equipped with solar panels. Smart meters are also installed.	Solar panels, LED lights, smart meters.	All the streets, park and the rest of the public places have sensor-based lighting. Rooftop Solar Plants of 6.5 MWp have been installed on 134 Government buildings, and 59 Govt. schools and 10 government colleges has Grid interactive solar plants installed.
	Management of Solid Waste [4]	Integration of a system for managing Solid Waste. GPS system has been installed in all the solid waste collection vehicles, methanation plants.	GPS system	Sewage and solid waste disposal system has covered 100% of its objective. Door to door sewage collection is 97% efficient.
Bhubaneswar	Solar City Rooftop	Solar cells/ solar photovoltaic installed on existing public buildings, new redevelopment opportunities and retrofitting of private buildings to harness eco-friendly solar energy. [5]	Solar cell/ photovoltaic cell.	Work in progress. Total of 58.9KW has been installed at Ramadevi University.

	Bhubaneswar One portal	All the geo-spatial data from the government as well as from the private sectors are provided here. It acts as a hassle-free information provider for the residents as well as the tourists. [6]	Website Portal with all the Govt. and Private sector's information provided.	Phase 1 completed. Phase 2 will continue in another project called "smart solutions"
Uttarakhand	Digi Locker	Important documents such as Aadhar card, PAN card, Driver's License etc can be stored in a digital form securely in a digital wallet called digital locker. E-sign facility is also provided where one can digitally sign the document and share it with others. [7]	Mobile application with secure document exchange platform between issuing agency and the user.	The status is 41,000 as of June 2019.
	Aerostat Internet Balloon	Aerial platforms with connectivity range of up to or more than 10km, with rechargeable solar battery backup, that can be used for aerial surveillance, climate monitoring and providing network connectivity of up to 5mbps data speed. Specialized for emergency use and in areas where connectivity is hard to get due to its terrain etc. [8]	Solar energy, buoyant force provided by LTA gas.	1st and 2nd trial successfully completed. Project launched at ITDA, IT Park, Dehradun, Uttarakhand.
Jabalpur	Public Bike Sharing (PBS) [9]	Public Bike sharing facility for short distance/last mile transport. It supports GPS tracking system, cashless payment, locking of cycles with the help of mobile application or a website.	GPS, mobile payment application, website.	It has been 8 months since the launch of PBS and it has been successfully able to provide it's features to the citizens effectively as planned. Within 1 month of launch, 42000 rides have been taken by 36000 users generating around Rs60,0000 as revenue.
	Intelligent Traffic Management System (ITMS) [10]	Brings down travel time, reduces travel related energy consumption, much safer, more environment friendly. The system has many features out of which, some unique features are system for detecting violation of Red Light, system for recognizing number plate automatically, speed violation detection system and e-challan system.	RLVD, ANPR, SVD	It is not completed yet.
	Integrated Smart IT-Solid Waste Management System [11]	It is a big project proposal that features many functions like Smart application for SWM Resource Plan where general city-wide information like wards, households, roads, urinals etc. are mapped on its portal and any citizen can access it. Other features include sensor enabled smart bins, GPS enabled vehicles, RFID tags on each household etc.	RFID, GPS, GSM, GIS.	For the 79 wards in Jabalpur Municipal, a plant system for converting waste to energy has been built and is being operated at Kathonda in order to dispose of the garbage.

A. Problem: Area Faced in Smart-Cities

With rural to urban migration patterns accelerating in the nation, it is faced with a challenge that is very critical. And that challenge is to manage and turn this accelerating urbanization into something that is beneficial for its society and the whole country. We can see that the policymakers of the country are pressured into answering to the questions of pollution, resource constraints, overcrowding, old infrastructure and the need to continue growing**.** As we come across various states and their issues, we see a lot of common initiatives with common problems. There's also no denying that there are some unique features. But one of the crucial issues seem to be time management. As urbanization rapidly grows and rural to urban migration [13] becoming a more frequent and inevitable phenomenon, there's an undeniable problem with the traffic management. This is a simple yet, very important issue as traffic management controls everything that has to do with transportation in that area. And bad traffic management leads to disasters such as car crash, time waste and other problems which will lead to a

chain reaction/ domino reaction that will affect the functioning of public, govt. and other parties.

B. Proposed Solution:

Sensor based traffic lights. There are times when green traffic signal is being shown when no commuter is there to drive and when there are so many commuters but red traffic signal is being shown. Due to this communication gap between the traffic signal and the commuters, time is being wasted. There could be private business workers, govt. employees going to their offices, people who need medical attention and other kinds who should not lose any more time. Sensors should be installed to the traffic light, so it can sense if there are vehicles or not and provide signal for it accordingly. This will be very helpful in time management and will provide safety for the public as well as for the government. One of the main loopholes in our governance is the corruption done by the authority figures. In order to tackle this, machines such as token vending machine for anything related to ticketing can be used. If a corrupted human being is collecting the ticket, he can be bribed with money, but if a machine is used, there is no way of bribing it. Hence, it will help in decreasing the corruption in India if not destroy it at once.

C. Conclusion and Future Scope

In a country like India which is over populated and struggling with increasing congestion due to excessive rural to urban migration searching for day job and more desirable lifestyle, poor sanitation leading to contaminated food and water claiming lives of rich and poor alike, poor public health, the mission aiming to plan and build smart cities is very much need. With all the analysis of the smart-city features of India based on a state-wise study, we observe a lot of diversity and similarities with the problems and solutions in its developing features. The future points to be discussed in smart cities are as follows: - The center and state govt. bodies being cooperative ; budget of these smart cities has been increasing, so smart financing solutions are a much need of the hour ; time management, as our duration of smart projects have been expanding because projects have been coming off incomplete with the given time ; need of skilled manpower and advance technology, which India is not fully equipped with as developing 100 smart cities, let alone a whole country requires a lot of skilled efforts ; Corruption, as most of the problems in India are due to corruption, which leads to mismatch of coordination and time lag. It could be impossible to terminate corruption, but we can surely diminish it gradually. If all the above issues are taken into consideration, we could be heading towards one of the smartest cities in the world.

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