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Survey on Smart City Essentials Using Artificial Intelligence

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ABSTRACT: The rapid growth of urbanization demands services and infrastructure to meet the needs of citizens. This growth in population also leads to variety of problems in existing cities like transportation, employment, technology, infrastructure etc. The concept of “smart city” emerged as a city which can sustain urban rapid growth by providing physical, social, business and IT infrastructures to influence the collective intelligence of the city. In this digital era, artificial intelligence and machine learning techniques can be utilized in economy, environment, mobility and governance of a smart city to provide sustainable development and a high quality of life. In this paper we discuss different ICT factors and also the key themes of smart city through artificial intelligence which will act as the pillars of smart city.

KEYWORDS: Smart city, Artificial intelligence, ICT (information communication technology).

I. INTRODUCTION

The population in urban areas is increasing very rapidly. This shift from a rural to urban is projected to continue for the future decades. Such shifting of people inevitably tends to become messy and disordered Cities. These megacities generate new kinds of problems such as difficulty in waste management, scarcity of resources, air pollution, human health concerns, traffic congestions, and inadequate, deteriorating and aging infrastructures are among the more basic technical, physical, and material problems. Another set of problems are more social and organizational in nature rather than technical, physical or material. Information Technology is changing the evolution of cities. The notion of “growing” cities based on implementing correct urban planning is being replaced with the idea of making a city “smart”. The Internet is changing the traditional urban planning model and compelling planners to not only consider the physical planning of a city but also to consider the use of Information Technology to make the economy, environment, mobility and governance of a city more efficient and effective.[4]

“Smart Computing technologies can be used in all aspects of city development like Critical infrastructure components and services like city administration, education, Healthcare, public safety, real estate, Transportation, and Utilities to build it more intelligent, interconnected, and efficient”.[6]

One of the most widely used definitions of smart city is “cities that utilize information and communication technologies with the aim to increase the life quality of their inhabitants while providing sustainable development”.[7] From this definition we can see that ICT plays a pivotal role in making a city more adapted to the contemporary needs of its citizens.

In this paper we discuss major ICT factors which are the building blocks and the key themes of smart city through artificial intelligence and machine learning techniques with some barriers.



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II. ICT FACTORS FOR SMART CITY

- 1. Broad band networks:** When considering the implementation of a smart ICT plan for a city, one needs to focus on communication. Cities can use broadband wireless networks to enable a wide range of smart city applications that enhance safety and security, improve efficiency of municipal services and promote a better quality of life for residents and visitors.
- 2. Sensor technology--** The smart city planners need to consider the real data collection to ensure that the physical space and infrastructures of the city are enriched with embedded systems, smart devices, sensors, and actuators, offering real-time data management, alerts, and information processing.
- 3. Developing Web-based Applications and E-Services-** The availability of ubiquitous ICT Infrastructures stimulates the development of new services and applications by various types of users, E-services should be used as building blocks for the more efficient development of smart cities.
- 4. Cloud software:** Smart City developers need to store the vast amounts of data that are collected through municipal sensor systems. The rise in cloud storage availability and increases in cloud storage security have made the technology attractive to IOT. Clouds act as a Smart City's most important IT structure.
- 5. IOT (internet of things):** IOT is the interlinking of heterogeneous devices with each other together over the Internet. The Internet of Things is the network created by embedding objects with chips or sensors that can relay information to the operator or other connected devices creating a system that is more valuable than the sum of its parts individually. IOT can be used everywhere to achieve smart homes, parking, weather and water systems, vehicular traffic, environmental pollution and surveillance systems.[8]
- 6. Artificial intelligence and machine learning:** Smart cities power a digital revolution that is generating a huge amount of data. This massive amount of data should be processed to take further action. AI allows machine to machine interaction by processing the data and making sense out of that with less human interactions. Algorithms used in AI and machine learning are created to learn from past experiences, the applications are endless. AI and smart cities are a perfect fit along with other ICT factors.

III. KEY THEMES RELATED TO SMART CITY

1. Smart Mobility: Traditionally, urban mobility is about moving people from one location to another location within or between urban areas, due to business, job etc it is a big challenge for planners, and engineers to improve urban mobility. The major requirements of urban mobility are:

- Improved Accessibility.
- Safe Transportation
- More efficient and intelligent transportation systems
- Leveraging networks for efficient movement of vehicles, people, and goods, to reduce gridlock
- New 'social' attitudes such as car sharing, car pooling, and car-bike combinations

Smart cities commonly deploy online services across different sectors of the city. Sensors can be used to manage the mobility needs of citizens with an appropriate Intelligent Transport System (ITS) that takes care of congestion, predicts the arrival of trains, buses or other public transportation options. Managing parking space availability, expired meters, reserved lanes, and so on.[1]

2. Smart Economy: Smart Economy is defined as a series of concepts to promote the development, sustainability and attractiveness for new investment. Models like e-business, e-commerce increase productivity, employment and innovation in it and opportunities for business and entrepreneurship. The main objectives of the performance of these



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tasks are a return on the investment, economic impact of the projects to be carried out and savings for the community and make it sustainable over time. The key factors of smart economy are:

- Regional/global competitiveness
- Entrepreneurship & Innovation Momentum
- High Levels of Productivity
- Broadband access for all citizens and businesses for business opportunities
- Independent of location, helping maintain population in rural areas,
- Electronic business processes (e.g., e-banking, e-shopping, e-auction).

AI can be used to study the structure of economy, what kinds of industry one can have, what's the capacity of research and development, what kind of ecosystems do they have around innovation...you look at the underlying economic data and a lot of those factors and dig a little deeper and say, for categories of jobs and work that are important in their economy.

3. Smart Living: We want to live in cities that are smart, safe, clean, healthy, inclusive and resilient; cities that provide economic opportunity and a high quality of life. Smart living focus on

- Better Quality of Life
- Social Aspects - Education, healthcare, Public Safety, Housing
- Access to high-quality healthcare services (including e-health or remote healthcare monitoring), electronic health records management
- Home automation, smart home and smart building services
- Access to social services of all kinds.

AI can also be used in improving the health of citizens through telemedicine, electronic records, and health information exchanges and in remote assistance and medical surveillance for disabled or elderly people. When providing public Safety and Security, sensor-activated video surveillance systems can be employed along with location aware enhanced security systems, and estimation and risk prevention systems (e.g. sensitivity to pollution, extreme summer heating).[9]

4. Smart Governance: The aim of smart or e-governance is to make the system more transparent and citizens more informed. Government information will no longer be a repository of few public officials or servants but accessible by all sections of society. E-governance and involvement of the public in decision making process is the most important aspect of smart governance. The tools used to achieve them are following:

- Participatory Decision Making
- Improve community related services
- Public & Social Services
- Transparency
- Democratic processes and inclusion
- Interconnecting governmental organizations and administrations

AI can be effectively used in this area to focus on multidimensional improvement of governance by learning through large data sets that are available. It helps in decision making during critical conditions.

5. Smart People: The level of connectivity and the speed of technological change make us to reassess how we interact with each other, what we value, how we work, and how we view ourselves. Privacy, consumption, ownership, and human interactions are only a few of the fundamental issues impacted. Smart planning for smart cities includes recognizing the need we all have to look up from our screens, unplug, breathe fresh air, enjoy some green space, and have face-to-face interactions. Some important parameters are:



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- Social & Human Capital
- Qualified, Creative and Educated Citizenry
- Able to utilize the ICT based smart services
- Delivering a more consistent educational experience in both urban and rural areas
- E-education solutions (remote learning and collaboration) to have citizens better informed.

Artificial intelligence is poised to radically shift the way professionals use technology to get work done. With the proper dataset behind it, AI can help alleviate many repetitive and redundant tasks, changing the way humans approach work.[2]

6. Smart Environment: The effective implementation of the smart cities requires an integrated and interdisciplinary approach to sustainable development. To ensure a low carbon, a low water and low ecological footprint with infrastructure designed to adapt to the present and future impacts of climate change, developers need to consider the following as very important factors.

- Pollution Monitoring
- Use of Sustainable Technologies
- Environmental/ sustainable /Energy consumption
- Reducing energy consumption through novel technology innovations while promoting energy conservation

AI can be used for environmental and energy monitoring such as using sensors to detect when waste disposal pick-ups are needed, or to measure energy consumption and emissions. In building management services like smart meters and monitoring devices to help monitor and manage water consumption, heating, air-conditioning, lighting and physical security.

For instance, energy use data can be utilized to manage energy production and real time traffic data can help in visualization and decongesting prime areas in the city. This also sheds light on the population's behavior which can be predicted well after several iterations. The city can then preempt its population's needs and serve them better.

IV. BARRIERS

Development of smart city needs a reliable and accurate system. Usage of ICT and artificial intelligence has some barriers, which should be taken care well in advance. some of them are as follows[13]

1. Big Data Analytics:

In a smart city context, huge amount of data is generated. Some of them are with time sensitive applications. So one need to have frame works that support big data analytics.

2. Preserving Security:

As there is large amount of data that is generated and collected through machines, one should take care of the security against hacking. Security is major concern for smart city data.

3. Privacy:

In smart city context large amount of individual data will be collected. Which in turn create a concern for individuals who may not prefer their data to be publicly available.



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4. Big Dataset Shortage:

Development and evaluation of smart city applications need real-world datasets, which are not readily available for many application domains.

5. Coordination failures:

In smart city scenario, all components are interconnected with different organizations. This integrated approach demands coordination for successful working of smart city.

V. CONCLUSION

The Smart City concept has been revolutionized and has evolved into a new era with recent developments in Information and Communication Technologies (ICT). All the elements are closely related and build upon each other to ultimately provide a comprehensive ICT solution. This solution takes a major role in almost all aspects of smart living like communication, transportation, infrastructure, health, security etc. The paper concludes that artificial intelligence as ICT technology uses the data that comes in from different applications and converts it into actionable information to improve the city's operational efficiency and cut down costs in the process in understanding of social interactions which will improve the effectiveness of smart city environment.

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