Artificial Intelligence:
An opportunity for Smart Cities

1. Introduction

Cities are complex socio-economic entities housing centres of knowledge, trade and commerce, and important institutions of governance. By 2030, Indian cities are expected to house 40% of the total population and contribute over 70% of the nation's GDP[1]. Our cities will need to be equipped with requisite physical and social infrastructure to provide good quality of life and economic opportunities to this urban population in an equitable and sustainable manner.

Cities today are sitting on a goldmine of data, producing vast amounts of it daily through a network of video cameras, sensors, traffic management systems, smart meters, vehicles, IoT devices and mobile phones. This is in addition to the historical data they have already gathered over the years, which exists either in manual or automated forms. Using this data, emerging technologies, including AI, can revolutionize the way cities address the challenges associated with exponential urban growth. AI has the potential to make sense of the vast data and use the acquired intelligence to improve the performance of cities, optimize operational costs and resources, and enable proactive citizen engagement, thus making cities more efficient and liveable. With this ability to interoperate with existing data systems, AI can scale and evolve to generate much needed insights about the working of our cities.

That being said, a quantum leap in digital governance lies in the adoption of emerging technologies and solutions such as AI, which can exponentially improve the utility of our digital platforms and tools for a frontline decision-support system for the urban ecosystem. Thus, with the assets developed under the Smart Cities Mission and the complex dynamics of the urban ecosystem, our cities stand to benefit from AI Implementation.

2. What is AI and how it works

AI refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning, problem solving and decision making. It is a combination of technologies that enable machines to act with higher levels of intelligence and mimic human intelligence. AI works by combining large amounts of data with fast, iterative processing and intelligent algorithms (or series of instructions) that allow the software to learn automatically from patterns and features in the data. AI makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks.

The current state of AI technologies allows its use in the areas of natural language processing, machine learning, computer vision-based video-analytics, voice recognition and so on. AI has the ability to perform tasks in complex environments with minimum guidance from a user

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[1] Smart Cities Mission Statement & Guidelines, MoHUA, June 2015; Future of India the winning leap, PwC
https://www.pwc.in/assets/pdfs/future-of-india/future-of-india-the-winning-leap.pdf

(autonomous) and the ability to improve its performance by learning from experience (adaptability). These characteristics differentiate AI from other existing technologies.

Fundamental capability of AI systems lies in overcoming the limitations of traditional rule-based computing by using data to learn, identify patterns and continuously improve the learning on new data. That's why AI systems have the capability to identify objects in an image or video, learn traffic patterns or crowd movements, identify variances from normal state of objects/properties/assets etc. while it is extremely difficult to develop those capabilities from traditional programming systems. AI systems use this continuous learning from data to make accurate predictions which can enable a truly proactive governance for citizens.

Further, AI's ability for enabling multiple systems to be optimized together, detecting emergent patterns and providing new capabilities in ways that traditional analytics tools cannot, will facilitate development of smarter cities.

3. Where is it being utilized - sample use cases

Use cases of AI are numerous, ranging from maintaining a healthier environment to enhancing public transport and safety. Governments around the world are actively supporting the advancement and deployment of AI-enabled services to create smarter cities. They are directing increased investment towards AI to solve some of their biggest challenges. Some of these are highlighted below:

- **Automated traffic signals:**[2] In the **US, the City of Pittsburgh** collaborated with Rapid Flow Technologies to develop SURTRAC (Scalable Urban Traffic Control), an automated traffic optimization and control software. City traffic control departments use SURTRAC to manage traffic flows through several intersections and use AI to optimize the traffic systems leading to reduced travel times, reduced number of traffic stops, and reduced wait times.

- **Conversational chatbot:** The **Infocomm Development Authority of Singapore (IDA)**[3], along with Microsoft have developed a virtual assistant called "Ask Jamie", with an aim to make online public service websites more accessible and engaging for all citizens. The chatbot can be implemented on the websites of other governmental agencies to answer questions in specific domains. When users visit the agency website, a chat window automatically opens up, and Jamie can respond to user inquiries by way of natural language generation leading to a seamless interaction experience.

- **Spread of infectious diseases:**[4] **Canada**-based BlueDot has leveraged machine learning and natural language processing to track, recognize, and report the spread of the virus quicker than the World Health Organization and the US Centre for Disease Control and Prevention. In the near and distant future, such a technology may be used to predict zoonotic infection risk to humans considering variables such as climate

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[2] Surtrac for the People, US DOT, https://www.transportation.gov/utc/surtrac-people-upgrading-surtrac-pittsburgh-deployment-incorporate-pedestrian-friendly

[3] 'Ask Jamie' Virtual Assistant, GovTech Singapore, https://www.tech.gov.sg/products-and-services/ask-jamie/

[4] Bluedot, https://bluedot.global/

change and human activity. **Republic of Korea's** Center for Disease Control and Prevention combined the analysis of personal, clinical, travel and social data including family history and lifestyle habits obtained from sources like social media to enable more accurate and precise predictions of individual risk profiles and healthcare results.

Some of the Indian cities/states have also begun utilizing AI technology for their current challenges. Some examples are as follows:

- **Crowd management[5]:** AI and Analytics used in the Kumbh Mela, an event attended by about 20 crore devotees, was aimed at predicting crowd behaviour and possibility of a stampede. Analysis of feeds from over 1,000 CCTV cameras and monitors gave insight on various movements across the 3,200 hectares area. Utilising existing data on crowd behaviour from previous events and mass religious gatherings in the state, the UP State government was able to predict crowd behaviour under scenarios of stampede, natural calamity etc. and put in place effective response management and enforcement mechanisms. Similarly, deep learning techniques, where AI system is trained with data on thousands of videos (segments of videos), helped the state enforcement agency to identify any suspicious activity in the crowd.

- **Facial recognition-based attendance system[6]:** The **Tamil Nadu** e-Governance Agency (TNeGA) has launched an AI and Analytics based Face Recognition-based Attendance System (FRAS). This system is currently running in two Chennai corporation schools to mark daily attendance since August 2019. FRAS is a robust system with an accuracy of over 99.5%. It is designed to save an average of 45 minutes per day spent in taking attendance.

- **The AI sowing app to improve harvest[7]:** Microsoft, in partnership between Andhra Pradesh's government and International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), developed an AI-based sowing app for farmers in India. The App uses AI and historic weather data, soil condition and other indicators, to predict the best time for sowing seeds and other stages of the farming process and passes on that information to farmers via SMS, thus helping them achieve optimal harvests. Pilot showcased a 30% higher average in yield per hectare.

Moreover, some other Indian cities/states are planning to explore the use of AI:

- **Public service delivery[8]:** The Information Technology, Electronics and Communications (ITE&C) Department of **Telangana** is working on chatbots which will work on robotic process automation (RPA) and AI. This will help in extracting details like locations of sub-registrar offices, the fee for marriage, property and society registrations, among others. The vast majority of calls coming in are fairly basic, repeat

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[5] Artificial Intelligence real showstopper of Kumbh Mela 2019, India Today, https://www.indiatoday.in/india/story/kumbh-2019-mela-artificial-intelligence-record-1477774-2019-03-14

[6] TNeGA launches Face Recognition System for attendance in two Chennai Schools, TNeGA, https://tnega.tn.gov.in/latestnews/29

[7] Microsoft and ICRISAT's intelligent cloud pilot for agriculture in Andhra Pradesh increase crop yield for farmers, ICRISAT, https://www.icrisat.org/microsoft-and-icrisats-intelligent-cloud-pilot-for-agriculture-in-andhra-pradesh-increase-crop-yield-for-farmers/

[8] Telangana's new chatbot to facilitate registration process in the State, Analytics India Magazine, https://analyticsindiamag.com/telanganas-new-chatbot-to-facilitate-registration-process-in-the-state/

questions or routine reports. Thus, use of chatbot will improve time to service as well as citizen experience.

- **Improving education sector[9]:** Keeping in mind the shortage of teachers and use of unfair means during examinations, the **Uttar Pradesh** government is planning to use AI-bots to upgrade the education system in the state and make education corruption-free and less negligent. AI might be trained with images and video segments of students engaging in malpractices, tracking their activity and behaviour to check for any deviations from the normal pattern, which can then be rejected or reviewed by the invigilator. Similar experiments have also been conducted in various schools, especially in **Andhra Pradesh,** to track the performance of the student and prevent school dropouts.

- **Improving road safety[10]:** The Governments of **Uttar Pradesh and Karnataka** announced plans to install AI systems in the buses in order to alert sleepy drivers and avoid collisions. The AI-powered anti-collision systems comprise two sensors, one at the front bumper to alert the bus driver of any danger or the possibility of a collision and the second sensor is fitted near the headlight switch in order to alert inattentive or sleepy-head drivers.

The above-mentioned examples clearly illustrate how AI can improve government services.

3. What are the benefits for cities

The application of AI systems in cities will impact internally the process efficiency and externally improve upon the services delivered to the larger citizenry. AI along with other systems in the cities will work in unison to enhance the quality of life for residents, improve avenues for economic growth in an equitable manner and better sustainability in cities.

Governments, in this background can leverage the power of AI to offer citizens personalized public services, derive actionable insights of policy decisions, make forecasts and predict future trends, and simulate adoption of various policy options and determine unintended consequences before policy implementation. This will make the governments more responsive, more efficient, all the while improving sustainability in cities and enhancing quality of life for its residents.

Thus, AI is more suited to the urban environment and can help to:

- **Enable personalized delivery of services** in a proactive manner in scenarios where a high volume of human-centric transactions is required such as issuing certificates, challans, scholarships and tax assessments on the parameters of cost, time, quality, access etc.

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[9] Uttar Pradesh planning to use AI-bots to upgrade secondary school exam system, India Today, https://www.indiatoday.in/education-today/news/story/uttar-pradesh-planning-to-use-ai-bots-to-upgrade-secondary-school-exam-system-1600462-2019-09-18

[10] UP and Karnataka to use AI-enabled buses to prevent road accidents, Times Now, https://www.timesnownews.com/auto/features/article/up-and-karnataka-to-use-ai-enabled-buses-to-prevent-road-accidents/463955

- **Improve city planning** by appropriate allocation of budgets based on previous trends and predictions, better disaster management by uncovering prone areas, etc. leading to dynamic planning tools instead of long-term static plans.

- **Improve city's finance management** by improving revenue collection, reducing evasion through identifying clusters and targeted predictions, and expenditure management/allocation and disbursal using better targeting of beneficiaries as per proactive anticipation of their needs, increasing transparency and accountability.

- **Improve planning and coordination** between departments through automated data management, collation and sharing.

- **Manage resource constraints** by automation of routine administrative tasks, enabling employees to maximise time spent on mission critical tasks.

- **Increase the utility of existing services and platforms** by cross-linkage of data and patterns generated by AI systems by incorporating innovation.

- **Enhance equity in cities** by tracking welfare interventions among the city's economically weaker sections classes and suggest/take action on welfare systems such as public distribution system, primary healthcare and education.

- **Improve access to infrastructure and services like Health, Education etc.:** through AI-driven diagnostics, early disease detection, personalised learning, automated rationalisation of teachers, etc.

- **Improve climate outcomes** through predictive tools that analyse environmental data and create self-configuring weather forecasts, and help cities build more adaptive systems.

- **Help plan for economic growth** by augmenting labour productivity and innovation with creation of new products and services, and reducing inefficiency in their design and delivery, thereby facilitating businesses.

As it continues to be enhanced, AI can truly transform this arena, generating new insights and predictions, increasing speed and productivity, and creating entirely new approaches to citizen interactions.

4. Way Forward

The introduction of AI in management of cities has the potential to provide significant direct and indirect benefits to citizens and the government alike. With swift, scalable and evolvable solutions the cities will be in a better position to improve operations and enhance service delivery for its citizens. AI-backed technologies, with capacity to adapt to situations and predict scenarios or solutions for the decision-maker to act upon, will be a crucial asset for cities in future-planning and deployment of services.

Nevertheless, cities cannot do this on their own. The adoption of the AI would require support from multiple stakeholders in building the larger systemic culture for problem discovery, design and deployment of solutions. Deploying such AI solutions would require enabling an ecosystem that drives AI innovation and adoption across the cities. To facilitate this, the Smart Cities Mission plans to formulate an AI strategy for cities, in partnership with MeitY, to further the NITI Aayog's "AI for All" strategy for India. Recognizing that AI is the logical next step to

maximizing potential of data, the broad tenets of AI strategy for cities would revolve around the core drivers of existing DataSmart Cities Strategy, i.e. People, Process and Platform.

In this background, a working committee comprising of experts, would be established to provide a roadmap for designing, implementing and assessing the AI solutions for Urban India. This strategy will establish an AI ecosystem by leveraging the quadruple-helix to enable innovation and co-creation, nurture talent and workforce for AI, create a trusting environment for the AI solution discovery and foster international collaborations to drive cross-learning. Further, the strategy will look at detailed processes that need to be customized around enabling requisite data architecture, system design, infrastructure and procurement routes as well as regulatory checks for accelerating innovation and making AI accessible and inclusive for all. The strategy would also cover unleashing the AI makerspace environment encompassing a suite of AI tools, APIs and pre-built solutions, leveraging open source resources, involving developer community and finally building upon the DataSmart Cities existing platforms as a powerhouse of data.

The AI strategy will act as a roadmap for cities to provide multitude of citizen services, information sharing network and creating livelihood opportunities, powering the vision of self-reliant urban India. Lastly, cities will have to take up the challenge to guarantee an ethical use of AI, to ensure the security of all data and realize the primary objective of a smart city – an improved quality of life for all its citizens.

Appendix: Sample use cases for cities where AI can be deployed

Area of City Operations	Specific Use Cases for AI/ML	What is AI/ML being used for?	Primary Owner of Data
City Revenue Management - Property Taxes	GIS- based representation of the whole property tax system Zone, ward and sector wise tax collection Property category wise tax collection Property tax collection at parcel levels Property tax defaulters Analysis of properties without name and number Analysis of multiple properties registered on single name Arrear vs current year collection comparison Mark those area where there is arrear is high comparatively collection	GIS based image object detection Pattern recognition (forming revenue clusters) Trend forecasting Natural Language Processing (to match names)	City/Municipal Organisation
Mobility - Adaptive Traffic Management	High-resolution capture of live traffic feeds Utilises cameras or loops to detect vehicles Captures traffic feeds in high-resolution Provides real-time data of traffic volume Identifies vehicle speed and density	Camera feed based object detection Pattern recognition Forecasting	City/Municipal Organisation
Traffic Enforcement System	Citation of rule violators to enforcement agencies Number plate detection and city-wide violation monitoring Video analytics of red-light violations, speeding and rule-breaking Speed violation detection	Image recognition Object detection	City/Municipal Organisation
Smart Parking	Dynamic parking regulates slot occupancy during peak hours Effective in setting dynamic rates based on algorithms that consider historical data Continuously monitors occupancy levels to adjust pricing in real-time	Forecasting Traffic data image analysis	City/Municipal Organisation
Leveraging Smart Street Infrastructure	Energy optimising lighting with a safe and secure mesh network Automatic On, Off and Dimming functionality Real-time calendar-based scheduling Inbuilt sensors to adjust light according to weather and crowd Monitor zone-wise power consumption Automatic operation functionality in case of lack of network connectivity	Sensor based data forecasting Pattern recognition	City/Municipal Organisation
Solid Waste Management	Waste segregation at source Timely collection of garbage from road-side public dustbins Avoid littering in public places after collection hours Efficient management of garbage collection operation at transfer stations assessing garbage collection pattern change Efficient resolution of complaints identifying reason of most complaints and reporting Waste not collected alert Transfer station capacity alert Fixing of route for collection vehicles Predicting amount of waste going to transfer stations	Image recognition Object detection Pattern recognition Forecasting	City/Municipal Organisation
Smart Environment	Forecasting environmental properties Forecasting and assessing effects on health of citizens Estimating contribution of sources of pollution and taking city level actions GIS led assessment of early indicators of city vegetation cover, air moisture, heat island effects Water body health and contamination assessment Carbon sequestration implemenation through planned carbon sinks and monitoring them Modeling impact of landfill sites and monitoring them	Image recognition Object detection Pattern recognition Forecasting	City/Municipal Organisation State/National environment authorities
Safety and Security	Visualizes crime trends to identify issues Reports distribution of crime by frequency, location, and more Reports and helps predict crime patterns	Pattern recognition	City/Municipal Org
Urban and Regional Planning	Utility and land planning Enables a land management system with complete ownership details Allows travel-demand modelling and road-network planning Real-time information to manage utilities Assists municipalities in collecting and maintaining accurate data and records Collects relevant data to allow the charging of correct property taxes Constantly updates record of birth and death registrations and socio-economic data	GIS based image object detection Pattern recognition Trend forecasting Natural Language Processing	City/Municipal Org
Disaster Management Managing Events/Crowds	Visualizing location intelligence through geospatial solutions Targeted disaster planning and effective communications Proactively evaluate exposure by simulating the impact of storm events on critical facilities Improve data distribution to first responders and relief agencies Track people density and traffic flow by advanced video analytics Estimating transportation wait time based on people and traffic density Suggesting optimal alternative routes for crowd dispersal	GIS based image object detection Pattern recognition Trend forecasting Natural Language Processing Dynamic optimization	City/Municipal Org State Disaster Management Authority District Administration