Artificial Intelligence and India: Applications in Public Service Delivery

Artificial Intelligence (AI) is one of those rare fields which has attracted academics as well as massive private investment principally from tech giants. Due to the multiple & perhaps unexplored opportunities in AI, it has become an innovation playground for start-ups, tech giants as well as governments. The USP of AI-based tools and systems lies in their ability to make predictive as well as prescriptive analysis based on massive date sets. This analysis could be carried out based on set patterns which are fed into the system i.e. Machine Learning or new patterns/directions identified by the system itself derived from an algorithm i.e. Deep Learning. Based on these principle feature, Google, Facebook and the Chinese search engine Baidu have invested heavily in AI tools either through setting up research labs or acquiring startups. Presently the field is dominated by private entities, however governments of South Korea, Canada and China have invested or plan to invest heavily in AI research and application of AI-based tools in small scale public service delivery systems.

As more countries are exploring AI usage across sectors especially in the fields of Health and Finance, India is definitely lagging behind on the acceptance and utilization of this technology by a fair margin. Apart from private entrepreneurial activity, AI has not been utilized by government systems across sectors in any significant manner. With 30 Central Government schemes and innumerable State level schemes, monitoring and evaluation of the programmes especially in the remotest areas could be carried out through AI-based tools of geo-spatial visual and image recognition. For the larger picture, the country is gifted with a demographic bounty however ensuring availability of public services for all is a tedious and mammoth exercise which can be made more efficient, transparent and cost effective through intelligent technology. All possible avenues of AI usage in the public sector still remain unexplored and India can utilize this gap to adapt the technology for context and problem specific usage. This paper aims to explore the current adaptation of AI technology for public service delivery systems worldwide and makes recommendations in the Indian context. Below is a brief description of the AI technologies which are presently available.

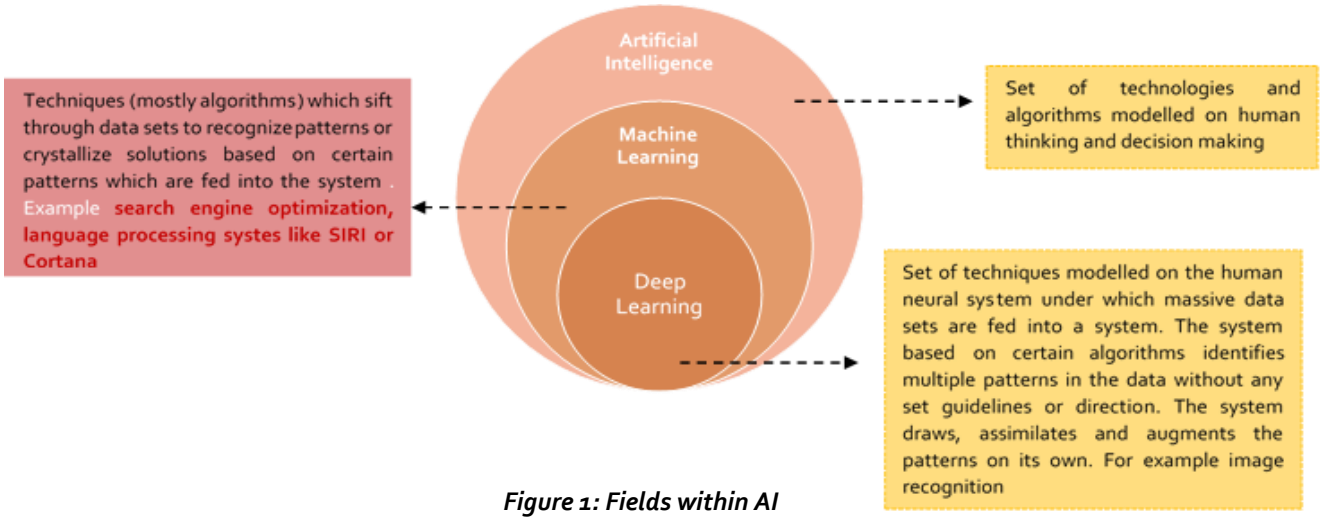

Figure 1: Fields within AI

Forms of AI currents utilized

As clear from the figure, Machine Learning (ML) is one subset of AI while Deep Learning (DL) is a further subset of ML Recently enough DL has been in public eye because of two reasons (i) the scale at which this technology has been promoted by tech giants like Google and Facebook. In fact in 2016, DL out of all AI ventures has received the maximum external investment amounting to 5-7 billion from angel investors or seed incubators[1]. (ii) Enhanced voice and image recognition options which are offered by DL. While applications based in ML are relatively well known, DL based systems are considered the next milestone within AI applications.

Governments and AI Usage

With AI being considered as the next digital frontier by many credible voices in both technology and academic, it is important for State Governments to get involved in this sphere, for only state governments can employ the usage of this technology for larger public good. One of the obvious impacts of AI technologies could be automation of a large number of tasks, which will allow human resource to be involved in higher skilled jobs. Another possible result could be precise, quick and informed decision making which would increase the efficiency of processes within delivery systems specifically in the Health, Safety & Policing sectors as well as Finance. This section will be an overview of the AI usage in countries across the world.

1) **China (Traffic Systems in Hangzhou city):** Private investment is the leader in developing AI systems in the country. The Chinese search engine Baidu has invested in voice based research to enable the country's multi lingual population to utilize the extensive voice database. Alibaba is the latest to join the band wagon of tech companies and has set up a research lab dedicated to developing AI based systems/technologies. In the Hangzhou city, Alibaba has partnered up with the Public city corporation for effective management of traffic through AI. The project termed as 'City Bain' is a system under which expansive amounts of real time traffic data is collected and combined with Alibaba's AI cloud programme. Consequently, Big Data analytics produces automatic adjustments in traffic light. These adjustments are based on live traffic movement and has led to the increase in traffic speed by 11 %[2]. The AI system has also increased the response time of traffic police to accidents. This projects is led by the city government in collaboration with other AI firms with a strong presence of Research and Development (R&D) oriented firms. The State Government is also planning to formulate a National Plan for Robotics and AI in the near future.

2) **United States (Health & Hospital Management)**: In July 2016, a subcommittee was created to study the application of AI and ML under the National Science and Technology Council (NSTC). The National Artificial Intelligence R&D Strategic Plan has also been released which emphasizes upon the Federal Government's plans

[1] Mckinsey Global Institute, Artificial Intelligence: The Next Digital Frontier?
[2] https://www.alibabacloud.com/press-room/alibaba-cloud-harnesses-ai-and-data-analytics-expertise-to-advance

to encourage research in AI technologies for the larger public usage. Major AI usage has been noticed in the Health Sector. In the John Hopkins Hospital, AI systems are utilized for hospital management. A digital landscape of the hospital has been created which predicts patients' activity for the next 24 hours. This helps in reducing the administrative tasks of the staff culminating in reduction of waiting time for patients[3]. This system is based on an algorithm, which enables the tool to detect certain patterns within the working of the hospital. Since the data is live, the system is not fed any patterns and adapts to new data. Future usage of the system are centered on monitoring risks related to hospital conditions like infections. In the Walter Reed Medical Centre, AI systems are being utilized to improve the treatment of combat wounds suffered by veterans. The system is used to better predict medical complications and reduce costs of medical emergencies and procedure.

3) **South Korea (R&D, Service Industry):** A developed robotics industry already exists in South Korea. In recent times, the government has invested in AI technology with dedicated funds and joint collaboration with private entrepreneurs. An investment of 863 million dollars has been declared by the government to build a state of the art AI research facility in collaboration with private partners. Certain thematic areas have been identified for further study by the proposed research lab. These areas range from advances in image assimilation and visual recognition which could be applied to crime prevention. Another field proposed is language processing which could be utilized for legal literacy and awareness[4].

As far as the Service sector is concerned, the country is taking advantage of the established robotics industry. The Government plans to utilize robots for the majority of guest interface during the Winter Olympics in the role of receptionists and security guards. By 2018, the Government aims to stations surgical robots in the major hospitals of the country to improve outcomes of intensive surgeries.

The developments within these countries provide an overview of the general progress of AI in service delivery systems. Two features about initial AI usage/promotion are crystallized through a perusal of the country's' programmes (i) Private entities lead the way in both R&D as well as adoption of AI-based tools for mass usage (ii) Despite the developed natures of these countries, AI usage for public service delivery or in governance systems is not wide scale. India can catch up to the developed countries by intensively promoting domestic research in AI as well as providing a supporting ecosystem for tech companies both large and small. The next section will explore the various sectors/fields in which AI research and usage can be expanded in India.

[3] http://newsroom.gehealthcare.com/wp-content/uploads/2016/12/GE-Healthcare-White-Paper_FINAL.pdf
[4] https://www.rvo.nl/sites/default/files/2016/04/Artificial%20Intelligence%20industry%20in%20South%20Korea.pdf

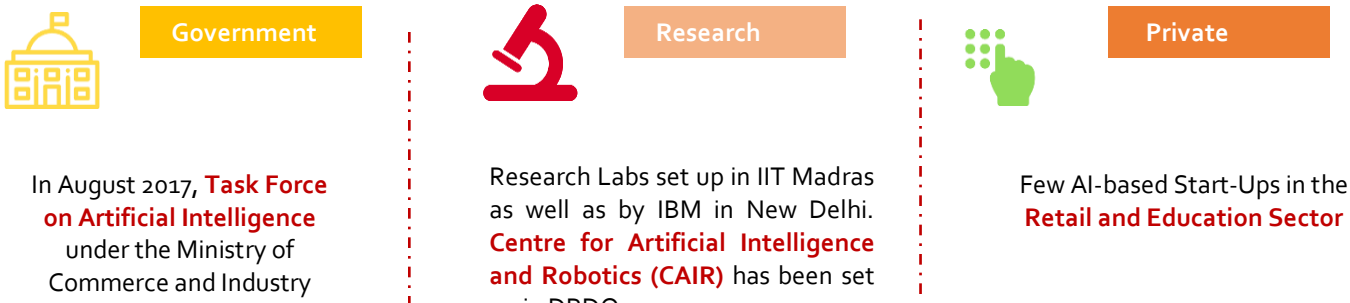

Figure II: Progress so Far in India

Possible Sectors for AI research and adoption in India

The critical feature of AI systems which can be expanded for enhancing public service delivery is the ability of AI technologies to assimilate expansive amounts of data and identify patters/problems and suggest solutions from the present data system. Hence systems based on AI can be devoted to sectors which have large scale operations (in terms of people and logistics) and involve quick and precise decision making. Precision decision making or identifications of patterns in large scale operations would remove human error, administrative delays as well as other issues like corruption. In this paper the application of AI is examined across three sectors like (i) Health: Utilizing the massive data generated for the sector (ii) Traffic Systems: Utilizing real time data for identification of patterns (iii) Subsidy Disbursal: Expansive operations in the sector require a technological approach for precisions decision making.

1) **Health (Utilizing Deep Learning so that systems can identify patterns in health record):** While most countries like France and United States have utilized AI for hospital management, there is a growing body of research which indicates that AI-based tools can be utilized for diagnostic services also. This is especially relevant in a country like India where the publicly funded Health Sector is understaffed. The doctor to population ratio in India stands at 1: 674, incredibly lower than the WHO prescribed norms of 1:1000[5].

The majority of doctors are based in the urban areas leading to significant sections of the population relying on expensive and unaccountable private health care. While adequate human resource in medicine needs to be developed, it is also advisable to devise strategies which can go beyond the traditional method of plugging this shortage by additional human resource. AI systems can be customized to identify symptoms based on Deep Learning where the system will accommodate itself to structured and unstructured data. For simple assessments such as, general checkup, X ray reports, MRI scans and blood test results machine learning based AI systems could be utilized. Within the field of pathology, advanced technologies for image interpretation can be

[5] Department-Related Parliamentary Standing Committee On Health And Family Welfare, 92nd Report, March 8th 2016

utilized for early recognition of cancers, as AI based tools have been proven to showcase a reduced error rate in detection of breast cancer[6].Institutionalizing AI-tools within the public health set up even in a localized context could lead to increase in access of health care as well as lower costs for the patients & families.

While the field exhibits amazing potential, it needs to be emphasized that AI-based tools require massive and hopefully functional data sets. In this regard the development of Electronic Health Records (EHR) for the population takes on a new and weighted importance. The legislative and policy framework already exists for the expansion of EHR. The Clinical Establishments (Registration and Regulation) Act 2010, which were notified on 23rd May 2012, mandated "maintenance and provision of EMR or EHR for every patient" for registration and continuation of every clinical establishment. The Ministry of Health and Family Welfare (MoHFW) notified the "Electronic Health Records Standards for India" in September 2013 based on the recommendations of an expert committee. However, these standards have not been mandated. All the State/UT Governments have been advised to adopt the EMR Standards in all the Information & Communication Technology applications in healthcare including in rural areas.

With this macro policy framework and consequent holistic implementation of EHR, AI-based tools could definitely be adopted in a localized urban region to understand the modalities of implementing the system on a larger scale. Currently, the HMIS system is collecting institution level data (accuracy of data in questionable) from over 5 lakh health centers across the India. This data can first be fed into an AI system so that certain infrastructural gaps (based on population) can be identified. At a later stage this system can be further developed and integrated with EHR to prepare institutions for upcoming epidemic or have a health supply of drugs based on past requirements.

2) **SMART Traffic Management**: Traffic congestion is a bane to city life. It leads to low traffic speed and loss of productivity. As per a study conducted by IIT Madras, traffic congestions costs in New Delhi amounted to INR 54,000 crore in 2013. Traffic speed in the city is 35-48 % slower than the regulated speed. The number of traffic accidents have risen from 6937 in 2012 to 7375 in 2016, by 6 %. While the rising vehicular population can be blamed for the congestions, other systemic issues also exist. Traffic intersection plans are largely managed on set plans, they are not managed in real time. Traffic systems produce massive amounts of real time data. Algorithms can be designed in a way, which can sift through the real-time data and identify the best signal pattern which will suit the quick movement of traffic. An ideal set of traffic conditions can be fed into the system and based on ML, prescriptive actions generated from AI-based machines could be applied. These algorithms can also be designed to increase police responsiveness to accidents or to prevent accidents by increasing police presence in 'accidents hotspot' as has been carried out by the Swaniti Team.

[6] https://arxiv.org/pdf/1606.05718v1.pdf

Swaniti Experience: Identifying Traffic Accident Hot Spots in Kolhapur through Data and AI

The Swaniti Team worked with the Deputy Superintendent of Police (DSP) Karveer Subdivision, Kolhapur to reduce the traffic accidents on National Highway 4. In order to understand and introduce interventions to reduce accidents, data had to be collected and analyzed. Considerable data collection took place based on various parameters like the time and place of the accident as well as the type of the vehicles. Only a pen and paper version of the data existed, hence the data had to be collected manually from all police stations. Data was collected for the last three years based on 6-7 metrics, focusing on the time and the location of the accidents. Post the collection, an algorithm was applied on the data so as to locate the accident hotspots. Set instructions were fed into the algorithm so that it could isolate the time and location of the accidents. Identifying the time and place of the most frequent accidents i.e. hotspots enabled the administration to deploy more personnel at these places. **Identification of these hotspots led to 33% reduction in accidents in three months.**

For the above example the data set which was collected was small however in order to carry out traffic management over a larger area, an automated system can be developed which ingests all traffic related data. This system can further account for popular events from social media pages and analyze resultant impact on traffic. Google Maps already provides real time traffic and travel time data, an ML system on top can use this and integrate it with police force deployment numbers to ideally distribute the officers and city traffic.

3) **Fertilizer Subsidy (Utilizing a technological approach for precision decisions making):** AI systems are best suited to streamline operations which are multi varied in nature and spread geographically and administratively. Subsidy disbursements and management is a field which can benefit from the new technology. Currently fertilizer subsidy accounts for 0.8 % of the GDP. At present the subsidy is divided into two types depending on different types of fertilizer. Urea is provided at a lower cost to the farmer, while for NPK fertilizer subsidy is provided to the manufacturers based on the nutrient content i.e. Nitrogen, Potassium and Phosphate. Considering the massive expenditure on the subsidy, it is imperative that the subsidy disbursement is managed well. AI based systems can support the management in assessing the requirement for fertilizers at a granular level i.e. district.

Assessing the requirement of fertilizers: For the last three years barring 2016-17, consumption of fertilizers has not managed to keep up with the demand of fertilizers by at least 5 %. The Ministry of Chemical and Fertilizers has pointed out that the demand for fertilizers is continuously over estimated. However as per the Standing Committee report, this is an unscientific explanation.[7] Presently, the calculation of the requirement of fertilizers requires coordination between the State Governments, State Departments of Agriculture as well as the Central Ministry. The process is carried out with consultations from the Indian Council of Agricultural Research (ICAR).

[7] Page 8, 19th Report, Standing Committee on Chemicals and Fertilizers, 2015-16

Calculation of the fertilizer requirement is a mammoth task which requires the computation of various climatic, environmental, policy and price metrics involving both the Central and State Governments as well as fertilizer manufacturers and importers. In order to create more efficiency and accuracy in the system, AI-based tools could be used as this whole process requires consideration of multiple factors as well as coordination with multiple stakeholders. All the required metrics can be fed into the proposed AI systems, which can provide the fertilizer requirement monthly as well as district wise while reducing man hours and increasing granularity as well as accuracy. After setting district wise requirement, it will be also be easier to manage the freight subsidy which is provided to companies for transporting fertilizer to the last mile.

Recommendations for developing AI-based systems

As AI-based tools can create efficiency in large and multifarious projects with less time employed, the application of it in Government sectors exhibits extreme potential. However it would not be advisable to pick up the technology without facilitating the requirements of AI-based systems. Certain infrastructural as well as operational features have to be developed before AI can be utilized for public service delivery.

1) **Robust Data Systems:** As has been reiterated, AI tools require real time data. Barring the Health, Education and certain schemes like Swaccch Bharat and Jan Dhan not many government departments publish real time data. Most if not all, Central Ministries have set up Management Information Systems (MIS). However the data is not updated and it is inaccessible by citizens. It is not only important to create more data regarding all aspects of the sector, but equally important to collect good quality real time data which can be fed into the system so that that it can predict or prescribe certain indicators or directions.

2) **Develop Human Resource for AI Research:** Many tech companies which are interested in developing AI hire the researchers from universities. Within India, not many Universities have set up labs dedicated to developing AI research. Only a handful of universities offer Masters Level course in Artificial Intelligence. Research labs fully dedicated to AI have been set up in very few institutions. The only government sanctioned AI research is carried out under the Defence Sector through the Centre for Artificial Intelligence and Robotics (CAIR) under Defence Research and Development Organization (DRDO). As pointed out above, China, USA and South Korea are experimenting with wide scale deployment of AI tools, with equal emphasis on developing home grown research. Within AI, research opportunities in this field are varied and numerous due to the unknown nature of many sub fields within AI. The technology can be imported, however to break new ground in devising usage of AI for the larger public good, indigenous human resource and research abilities needs to be developed. The Central Government could offer Fellowships, PhDs as well as Research Grants specifically for the development of AI. A PPP model could be encouraged for setting up of AI labs which would encourage private investment.

3) **Encourage Entrepreneurship in AI**: As with the world over, the lead for developing AI tools has been taken by private entities, especially the tech giants. As per certain media sources as well as personal interviews there are certain start-ups which have developed AI-based applications for profit. Majorly, these Startups exist in the

field of retail and health. A supportive ecosystem should be created for these enterprises as they are the first forayers in the unknown field. The AI usage model of certain Startups could be utilized for larger public scale application. The policy framework for such an enterprise already exists under the Startup India Programme, some facilitative/concessionary provisions could be made under the programme for enterprises which are adopting new and improved technology.

Developed countries as well as 'tech natives' have spent or declared to have spent massive amounts of funds for the development of AI tools. While the private tech companies have made considerable progress in ML (example image recognition, voice recognition) and DL (translation, natural language processing) even developed countries are far behind large scale application. The slow pace can be utilized by India to develop indigenous research and application and match up to the other developed countries. As has been evident in the paper, while Deep Learning requires more research, Machine Learning is a field, which can immediately be utilized to solve certain specific problems. Considering the massive leakage in subsidies as well as the dismal doctor to patient ratio in the country, automating certain processes through AI could lead to wide scale realization of services and goods offered by the government. However AI applications have to start small and cannot be utilized for a whole sector in the initial stages. A problem statement needs to be identified like better hospital management, or assessing requirement of fertilizer per month for the technology to be developed accordingly. It is also important to inculcate a support framework so that AI tools can be sustained as well as developed further in the country.