

Artificial Intelligence: Challenges and Opportunities for India

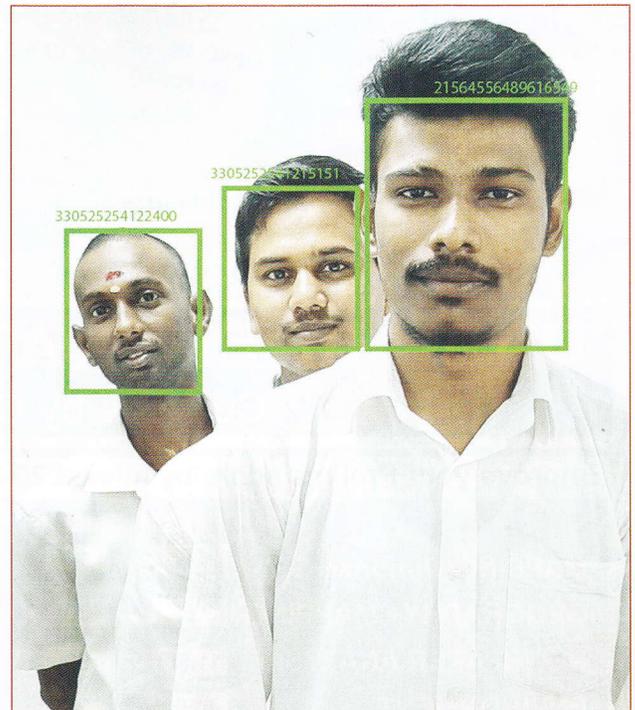
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The recent developments in Artificial Intelligence (AI) offer the potential for significant opportunities for industry, governments and society. Within the education sector, AI can be deployed to improve teacher effectiveness and student engagement by offering capabilities such as intelligent game-based learning environments, tutoring systems and intelligent narrative technologies. In this article, the authors aim to outline the opportunities and challenges, particularly focusing on elements of policy that need to be formulated to ensure development and further diffusion of AI-based systems.

Artificial Intelligence can be described as a system's ability to learn and interpret external data via software/algorithms or machines/devices for problem solving by performing specific roles and tasks currently executed by humans.^{1, 2} The term AI has been used interchangeably with other closely related terms such as expert systems, decision-support system, knowledge-based systems, machine learning, natural language processing, neural networks, pattern recognition, recommender systems and text mining.^{1, 3}

Although the origin of the term AI can be traced back to early 1950s, the relatively recent advancement in information technology (such as big data, improved computing, storage capability and super-fast speed of data processing machines) and robotics has enabled AI to gain significant momentum in terms of its development, application and use within public and private sector organisations.^{1, 3}

The recent developments in AI offer the potential for significant opportunities for industry, governments and society, but there are many challenges and subsequent risks as AI-based systems are adopted for an ever increasing



The Tamil Nadu government is using AI-based face recognition for recording attendance

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range of tasks and duties. In this article, we aim to briefly outline the opportunities and challenges, particularly focusing on elements of policy that could act as a major roadblock for development and further diffusion of AI-based systems.

Opportunities and Applications

A multitude of opportunities have been presented for the application and use of AI-based systems in various domains particularly to assist where structured decision making is needed.³ The ability of AI to overcome some of the computationally intensive, intellectual and perhaps creative limitations of humans opens up new application domains within manufacturing, law, medicine, healthcare, education, government, agriculture, marketing, sales, finance, operations and supply chain management, public service delivery and cyber security.¹

Within the education sector, AI can be deployed to improve teacher effectiveness and student engagement by offering capabilities such as intelligent game-based learning environments, tutoring systems and intelligent narrative technologies.⁴ Schmelzer⁵ suggested that AI can impact education in three ways. Firstly, AI-enabled hyper-personalisation helps in developing student-specific learning profile and in developing customised learning environments based on ability, preferred mode of learning and experience. Secondly, the use of smart assistants (Amazon Alexa, Google Home, Apple Siri, and Microsoft Cortana) and associated technologies offer significant potential to help students. Universities are already using voice assistants to help answer common questions about campus, student schedules and courses. Thirdly, AI systems can assist educators with secondary tasks such as grading activities, providing personalised responses to students, handling routine and repetitive paperwork and dealing with logistics-related matters.⁵ AI-based analytics can help with academic research within various disciplines and potentially transform library processes and staffing requirements with aim to provide a richer user experience.¹

AI technology can be used within several other sectors for enhancing both efficiency and effectiveness. Dwivedi et al.¹ has elaborated on how AI-based systems can help in achieving United Nations Sustainable Development Goals (SDGs). Specifically, AI can help in achieving good health and well-being goals within rural and remote areas in developing countries where access to medical care is limited. In such scenarios, AI-based systems can be utilised for conducting remote diagnosis supporting doctors to help improve health service delivery. AI-based systems can also help achieve the “Zero Poverty and Zero Hunger” (SDG 2) by assisting in resource allocation for predicting adverse environmental conditions, diagnose crop diseases and identify pests in timely manner to

mitigate the risk of catastrophic agricultural events. Similarly, AI-based systems can be used to predict energy and utility demand to help in achieving SDGs such as “Clean water, sanitation” and “Affordable clean energy”.

Application of AI in India

Within the Indian context, a number of key indicators from health, education and agriculture sectors are important to highlight as AI is further adopted. India has 0.8 per thousand doctor-to-patient ratio (UK: 2.8, Australia: 5, China: approximately 4). This low ratio implies a heavy workload on Indian doctors. In India, doctors spend just 2 minutes per patient, whereas in the US it is close to 20 minutes. AI could be a valuable assistive tool for doctors in helping reduce their workload and assisting in diagnosis. AI-assisted diagnostics can provide access to quality healthcare for people in remote areas. The per hectare cereal productivity in India is almost half that of China and UK (3000 kg/ha vs. over 6000 kg/ha). There is a significant loss of productivity due to pests and diseases. Within the education sector, India has about 50% less teachers per thousand students when compared with developed countries (India 2.4/thousand vs. UK 6.3/thousand). But there is a silver lining in all this: India has 1.18 billion mobile phone users with 600 million internet users and 374 million smartphone users. It has one of the cheapest data rates in the world (\$0.24/GB) and an average data speed of 6 Mbps. These factors open up huge potential for adoption of AI technology in India.

The Tamil Nadu e-Governance Agency has partnered with Anna University to launch a Tamil smart assistant called “Anil”. This NLP-based smart assistant provides a step-by-step guide to people in helping them apply online for scores of critical government services. The Tamil Nadu Government has been one of the pioneers in using AI for public service delivery. The agency has recently launched an AI-based agricultural pest and disease identification system and made it available to over half a million farmer families through a mobile app. The farmer clicks an image of diseased crop or a pest and the system processes the image through an AI algorithm to identify the pest or disease and sends a message to the farmer advising the remedial measure. This system is gaining a good field response in which nearly 400 farmers are posting identification requests and getting answers every day.

The Tamil Nadu Government is implementing an innovative use of AI through face recognition for recording attendance. The system is saving more than 45 minutes per day and is freeing up extra time for core educational activities in schools. Within healthcare, AI solutions such as radiographic diagnostics like “detection of internal bleeding in brain from CT scans” are being tried to assist doctors and increase their reach to serve remote areas of India.



AI-based agricultural pest and disease identification system is helping farmers in Tamil Nadu

Job losses – Increasing automation will lead to significant job losses particularly at operational and lower skill levels for repetitive tasks. This critical consequence of AI use will continue to impact all sectors and countries across the world but particularly developing economies where employment opportunities are already limited. This emphasises the need for strategic management of AI transition requiring organisations to carefully consider a number of major challenges: how to select tasks for automation; how to select the level of automation for each task; how to manage the impact of AI-enabled automation on human performance and how to manage AI-enabled automation errors.¹

Challenges and Shortcomings

There exists a number of challenges and limitations of successfully implementing and utilising AI in both public and private sector organisations. Some of the key challenges are briefly outlined here.

Lack of explainability – Generally AI operates effectively as a black-box-based system that does not transparently provide the reasoning behind a particular decision, classification or forecast made by the systems.¹ This is a major limitation of this technology as it has direct impact on transparency, hence trust and confidence of using decisions made.

Lack of contextual awareness and inability to learn – AI-based systems are good at performing with given parameters and rules. However, they still have major limitations in terms of making decisions where context plays a critical role. Unlike human, AI-based systems cannot learn from their environment. This limits the application of AI to specific types of domains.

Lack of standardisation – AI-based systems that may have utilised different types of technologies/techniques are increasingly being embedded in variety of products and services (for example, smart assistants, modules for enterprise products, widely available cloud libraries and bespoke datascience-driven applications). This poses a critical question: how can the inferences delivered by different AI components be integrated coherently when they may be based on different data and subject to different ecosystem conventions (and the associated quality differences)? Furthermore, organisations face challenges on how to ensure AI and human work together successfully.^{1,6}

Lack of competency and need for re-skilling and up-skilling workers – A large number of organisations still lack in-house competency to successfully develop and implement AI-based systems. In such a scenario, organisations utilise specialised consultancy firms which can be very resource intensive. But this restricts organisations having limited resources in using such systems. Similarly, using or working with AI-based systems requires workers to be equipped with a new and advanced set of skills, which is a challenge for government, organisations and individuals.

Lack of trust and resistance to change – Due to above mentioned issues and negative media coverage on the consequences of AI, people are generally apprehensive about its implementation. This poses a major challenge on how to establish trust among workers and stakeholders in the management of resistance to change in adopting AI systems.

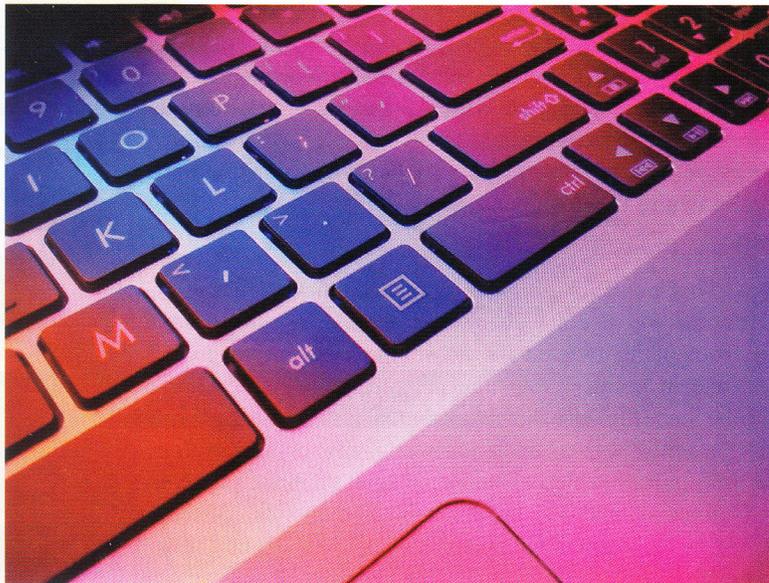
Public policy is facing unprecedented uncertainty and challenges in this dynamic world of AI. The velocity and scale of impact of AI is so high that it creates an interesting dynamics in terms of the need to predict its impact and inability to draw boundaries. We have identified six key public policy challenges of AI.

Ethics

Ethics for machines has been an area of immense interest for the researchers. However, defining has proven to be problematic and difficult to make it computable. To tackle this, we need to deal with ethics purely from an AI perspective. There are two dimensions of ethics in AI: (i) Privacy and data protection and (ii) Human and environmental values.

(i) Privacy and Data Protection: Privacy is possibly the top-most concern while using AI systems. Users' sensitive and highly granular data is likely to be stored and shared across the AI network (for example, a person's location for the day based on face recognition and CCTV feeds, food habits, shopping preferences, movies, music etc.).

(ii) Human and Environmental Values: Any AI system has to conform to human value system and the policymakers need to ask: Has the AI system been sensitised to human values such as respect, dignity, kindness, compassion, equity or not? Does the system know that it has a preferential duty towards children, elderly, pregnant women, sick and the vulnerable? An important aspect which needs to be built into AI systems is the overall cost of their decisions on the society.



Transparency and Audit

In the future, many of the AI-based systems could be interacting with humans in fields such as finance, education, healthcare, transportation and elderly care. The technology providers must explain the decision-making process to the user so that the AI system doesn't remain a black box. There exists a legal need to explain the decision taken by such systems in case of litigation. These AI systems must provide an audit trail of decisions made not only to meet the legal needs but also for us to learn and make improvements over past decisions.

Digital Divide and Data Deficit

Since the entire AI revolution has data at its foundation, there is a real danger of societies being left behind. Countries and governments having good quality granular data are likely to derive maximum benefit out of this disruption. Countries where the data is of poor quality or of poor granularity would be left behind in harnessing the power of AI to improve lives of its citizens adversely affecting low-resource communities.

Fairness and Equity

AI can disrupt social order and hierarchy creating new social paradigms, which could damage the social fabric exposing people lower in the bargaining hierarchy with a real threat of exploitation and unfair treatment. This could lead to commoditisation of human labour and chip away human dignity. An AI system designed with equity as a priority would ensure that no one gets left behind in this world. Another key need for autonomous systems is fairness. They must not exhibit any gender or racial bias and they must be designed to stay away from 'social profiling' (especially in law enforcement, fraud detection and crime prevention areas). The recent reports questioning the neutrality of AI systems used by police to identify crime-prone individuals has brought this issue out in sharp focus.

Accountability and Legal Issues

Without AI, any system designed by a human is only a machine under the control of the operator. Therefore, accountability has not been an issue. Almost all civil and criminal liability laws of the world fairly unanimously



The AI can be deployed to improve teacher effectiveness and student engagement.

attribute accountability to the operator, owner and manufacturer of the machine in varying degrees depending upon the facts of the case. However, once machines are equipped with AI and take autonomous decisions, the question of accountability becomes very hard to answer, more so when the algorithms are unknown to the designer.

Misuse Protection

This possibly is the toughest of all six questions. How do we insulate every new technology to prevent it from being twisted for achieving destructive goals? A case in point – how internet proliferated across the globe benefitting billions but also carried along with it a wave of cybercrime, malware, viruses and violent online games which resulted in loss of innocent lives of teens around the world. Autonomous AI systems must be designed for misuse protection. It cannot be an afterthought.

Conclusion

AI as a technology holds tremendous potential for a country like India, which is data rich and has the requisite technological capability to create AI solutions for many of its problems. States like Tamil Nadu have already started deploying AI systems at scale for addressing some of the key challenges in health, education and agriculture sectors. Public roll-out of AI systems needs to address issues of ethics, transparency, audit, fairness, equity,

accountability and misuse prevention. An effective public policy framework for AI along with a practical scorecard¹ would be needed to make this AI revolution work towards an equitable prosperity. □

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DO YOU KNOW?

Artificial Intelligence introduced as a subject in class IX in the schools affiliated with CBSE

Yojana Team

In order to enhance multidisciplinary approach in teaching-learning and to sensitise the new generation, (AI) has been introduced as a subject in class IX from the session 2019-20 in the schools affiliated with Central Board of Secondary Education (CBSE).

'Inspire' module on AI

A twelve-hour 'Inspire' module on AI has also been announced, which schools can take up with the students of class VIII. The study material for teaching AI in classes VIII and IX has already been provided to schools through the CBSE's website (<http://cbseacademic.nic.in/ai.html>).

Decision to introduce Artificial Intelligence in the States and UTs will have to be taken by the respective Boards. CBSE has collaborated with several organisations, private schools, etc. Over 40 training programmes on AI have been conducted in schools affiliated with CBSE in various parts of the country in which 1690 participants (Principals and teachers) have been trained.

AI is an overarching discipline that covers a broad range of domains and applications, and is expected to impact every field of life in the coming times. Hence, schools may opt for it to make the students AI ready. All CBSE schools are eligible to opt for the AI curriculum.

Schools may apply to opt for this curriculum through http://cbseacademic.nic.in/web_material/Circulars/2019/14_Circular_2019.pdf.

Sources: *PIB, CBSE*