ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS:
A THEORETICAL PERSPECTIVE

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ABSTRACT

Artificial Intelligence is a very large field of study with opportunities, uncertainties and challenges in emerging technological environment. India being the second largest populated country in the world has a lot of scope for leveraging the transformative technologies to have social and inclusive growth. Skill India, Make in India and Digital India initiatives are the efforts of Government of India towards modernization, innovation, adaptation and procreation in various sectors of the economy. The full potential of AI can be traced only by formulating specific AI policies including different sectors. The present paper presents a view of applications of AI in Indian context and certain challenges in its implementation.

KEYWORDS*: Artificial Intelligence, Government Policies, Opportunities, Machine Learning, Applications.*

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Introduction

Technology has influenced our daily lives in various ways such as from SIRI application to Netflix recommendations. It is impossible to avoid interactions without electronics gadgets. Computers play the role of being intelligent, generic and flexible by giving solutions to real world issues, by improving from past experiences. Intelligence is the process of acquiring knowledge and application through exposure. Alan Turing, a British polymath in his paper 'Computing Machinery and Intelligence' discussed the concept of intelligent machines and ways to test their intelligence. In 1955, Allen Newell, Cliff Shaw and Herbert Simon designed a program to mimic the problem solving skills of human, which was considered as first artificial intelligence program. John McCarthy, the father of AI had coined this term in 1956 at Dartmouth Conference Massachusetts Institute of technology. The concept of artificial intelligence gained momentum during 1957 to 1970.During this period, storage capacity of computers, machines, algorithms and interpretation of spoken language developed. In 1980s, John Hopfield and David Rumelhart gave deep learning techniques. Edward Feigenbaum introduced expert systems that imitated the decision making process of a human expert. During 1990-2000,various goals of AI were achieved worldwide focusing on development of algorithms. After that, the concept of AI has been evolving and has become an instrument of national importance across economies and resolving computer science based problems. IT and ITeS service sectors in India have been growing and accounted for 7.7% of India's GDP in 2016.In 2018, NITI Aayog launched a national programme focusing on the research in the field of AI. Government is still the largest potential customer for data science services in the country.

Artificial intelligence is a branch of computer science that deals with creating computers and machines as intelligent as human resources. It is the transcription of human intelligence procedures such as learning, reasoning and self-correction by machines, specifically computer systems. From robotic process automation to actual robotics, artificial intelligence has gained importance in various fields in the society and economies. Artificial intelligence is the process of systems' capability to gain an understanding and interpret external data with the help of algorithms and software and machines and devices to solve various problems by doing tasks in particular roles performed by humans. Machine learning, neural networks, pattern recognition, knowledge-based systems, decision support system, language processing are the interrelated terms used interchangeably with AI.With the development of information technology, AI has attained significant importance in public as well as private sector.AI internet enabled technology is impacting human beings in daily lives in different ways -the way they

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interact in the digital world, their working with each other in the presence of socio-economic institutions. Artificial creation of human like intelligence-planning, perceiving, problem solving, processing natural languages, internet of things and collection and use of data has made an environment for AI application services to grow. Indian economy is at the adoption stage to transform businesses to create thousands of jobs for people.

Review of Literature

Dhavare and Kulkarni (2015) in their paper discussed the concept of natural language processing and understanding of human language by computers. Syntactic analysis, semantic analysis, discourse integration, programmatic analysis and morphological analysis have been discussed.

Kapoor and Gupta (2016) discusses the use of the artificial neural network-based software cost estimation technique .The proposed model performance has been analysed in terms of Correlation Coefficient, Mean Absolute Error, Root Mean Square Error. The proposed technique used adaptive neuro-fuzzy influence system to improve the estimation of software cost.

Mousami Sahu (2016) has discussed the new plagiarism technique based on K- nearest neighbour algorithm which clusters the string and matches words with neighbours. A file is compared with the existing set of files and searches the frequency of every matched copied word and calculates the percentage of matched copied words.

Ashish and Ghongade (2016) has proposed artificial intelligence-based check signature verification system. In this study, actual and forged signatures of 10 persons have been taken to train the artificial neural network and for testing purposes. This proposed system used less time as compared to verification system.

Shivramet al(2018)in their paper have discussed the role of Artificial Intelligence in shaping India's growth and development levels. In this study, opportunities and various challenges have also been described such as risk factors with long term implications on society, poor infra-structure and bureaucracy.

Methodology

This paper is based on secondary data and existing literature available online-various websites and journals.

The objectives of this paper are:

- To study the meaning of Artificial Intelligence and its applications in various sectors in the context of Indian Economy
- To study various challenges in the implementation of the concept of Artificial Intelligence

Need for AI

Nations in the world are focusing their attention on developing technologies, especially AI. India being the fastest growing centre and second largest populated country in the world provides ample opportunities for business investments representing a significant stake in the development of AI. By leveraging demographic dividend, massive changes in the economy can be introduced across various sectors. NITI Aayog has also proposed to create a cloud computing platform called **AIRAWAT** to ensure the effective implementation of AI alongwith leading AI technology based entrepreneurs to implement AI projects in different sectors of the economy for the social and inclusive growth. Artificial Intelligence integrated with advances in data collection, analytics and cognitive processes presents opportunities to enhance human capabilities and enriching the lives of people. Intelligent systems can take over a number of tasks, increase efficiency and improve connectivity. Intelligent behaviour is aimed at learning, demonstrating, explaining, advising, giving solutions to complex problems like human beings by drawing concepts from algorithms, computer science, mathematics, artificial psychology, linguistics, philosophy, neuroscience, optimisation models, probability, economics etc. and presenting information in computer friendly manner. Indian start-ups and tech firms implement artificial intelligence in product and services. AI has the capacity to handle vast data and has proved fruitful in introducing new factors of production, augmenting traditional factors of production with technological innovations and improving factor productivity. AI opens up new sources of growth, value, improving capital efficiencies, intelligent automation, required adaptability and agility across industrial sector. Bright career opportunities can be explored in the field of AI- game development, speech recognition, robotics, language detection, computer analytics, development of solutions and many more.

Stuart Shapiro has given three approaches to AI:

- **Computational Psychology:** to make computer programs imitating human behaviour.
- **Computational Philosophy:** to develop adaptive and flexible computer mind.
- **Computer Science:** to create computers to perform tasks that previously only under the purview of human beings.

Artificial Intelligence

Machine Learning	Deep Learning
- To enable machines to learn processed information by using existing data and make informed decisions with the help of algorithms without human assistance - Supervised learning-learning algorithm given labelled data and desired output(input-output) - Unsupervised learning-learning algorithm unlabelled to identify patterns in the input data and classify the data - Reinforcement Learning- algorithm interacts with dynamic environment, provides feedback - Predictions and prescriptions, online recommender system, google search algorithms, applications likeAlexa, Siri, Cortana, Google Now - Making inferences to learn new tasks based on certain instructions, working on small amount of data	ANNS-Artificial neural networks A kind of machine learning - Artificial neural networks working like human brain - layered structured algorithms focus on information processing patterns and make intelligent decisions - Image analysis ,caption generation, speech recognition, object recognition - speech control - class performance

AI can be categorised in different ways on the basis of performance of the system:

- **Weak AI vs. Strong AI**

Weak AI	Strong AI
- Simulated thinking- appearing to behave intelligently but no consciousness about what it's doing.	- Actual thinking- behaving intelligently with a conscious and subjective mind.

- **Narrow AI vs. General AI**

Narrow AI	General AI
- Limited to a single task or a fixed number of tasks.	- Used to complete a wide range of tasks in diverse environments.

Neural Networks

It is a computing system based on interconnected units like neurons**.** It is used for processing information from undefined data and reacting to external inputs.

Applications of AI

There has been a significant interest of various stakeholders in Artificial Intelligence applications across different sectors in the economy. Business organisations are focusing on training their manpower to compete globally. Everyone is comfortable in improving their own skills.

Healthcare

AI can address issues of high barriers to access of healthcare facilities, particularly in rural areas as these areas experience poor connectivity, inadequate infrastructure and limited supply of healthcare professionals. With the application of AI, Robotics and Internet of Medical Things, technology and innovators, India can solve various existing healthcare challenges and help large percentage of population. Artificial intelligence can supplement the laboratory facilities, online appointment in the hospitals, resolving scarce personal issues, early diagnosis, detection, decision making in treatment, helpline call, studying symptomatic case reports, improving screening facilities, framing behaviour focused on educational campaigns, identifying various patterns depending on gender, age, disease,

treatment, analysis and making healthcare services more proactive with preventive techniques with the use of advanced technology, thus saving time. AI can help in understanding medical data —diagnostics processes, treatment protocols, patient monitoring and care, predicting future events of patients, making possible consultations with doctors abroad as well as locally to improve planning procedures resulting in saving of time and quality treatment.AI can also help in tracking stock position of medicines in dispensaries and support supply chain management. NitiAayog is working on early diagnosis of diabetes -based on AI models, bringing down healthcare costs and better chances of recovery.NHS (National Health Stack)-a digital platform and Ayushman Bharat Scheme emphasise on tele-health development ideology to save travel and wait time of patients through consultation facility from home.

Agriculture

With advancement in Machine and Deep learning technologies, remote sensing and overhead imagery data-crop type, crop state, geographical distribution, market for yields, climatic fluctuations, detection of crop diseases, care systems, soil mapping for cultivation, automatic weed identification, personalised advice to farmers, credit models for smarter lending, farm automation, assured irrigation, misuse of pesticides, meeting increased demand for food, real-time advisory and much more facilities can be attained. In 2017, International Crops Research Institute for the Semi-Arid Tropics(ICRISAT)in collaboration with Microsoft launched an AI Sowing App for sowing advisory to cover more than 3000 farmers in the states of Karnataka and Andhra Pradesh. NITI Aayog with IBM has developed a Crop Yield Prediction Model using AI to give real time advisory to farmers to improve crop productivity, soil yield,soil moisture, pest attacks. States of Assam, Bihar, Madhya Pradesh, Maharashtra Rajasthan, UP and Jharkhand are using this model.

AI also contributes towards development of techniques for inspection of food and allied material sand checking unhealthy practices in fruits and vegetables and coordinated storage facilities. Packing and transportation can also be improved to minimise post- harvest losses. Digital farming, connected farm services and digital ecosystem comprising of start-ups, software and service organisation, Original Equipment Manufacturers, open source platforms and other stakeholders can help in improving efficiency in farm operations .With AI technologies, farmers have become aware of soil health monitoring and restoration of soil health, pest control, sowing impact, high resolution weather data, early disease identification, timely planting, predictions, use of fertilisers and automation of farming activities.

Due to increased FDI and government initiatives, agriculture sector is finding ways to leverage technology for better crop yield.

Agro-based solutions useful for farmers include:

- Crop and soil monitoring-sensors and various IOT-based technologies
- Predictive agricultural analytics, machine learning tools/AI used to predict the optimal time to sow seeds and pest attack alerts
- Supply chain efficiencies
- Agricultural product grading
- Alerts on crop infestation
- Image recognition for soil science
- Smart agricultural market place

Water Resources

AI can make accurate predictions regarding ground water levels, water usage patterns, flood predictions with the use of river basin models, remote sensing, meteorological data, topology etc.

Environmental Pollution

Appropriate framing of algorithms can help in regular monitoring and prediction of air-quality, monitoring of water quality in public places, predicting forest fires with remote sensing, monitoring animal and bird movements and identifying endangered species.

Smart Mobility (Transportation and Logistics)

Artificial Intelligence can help the society in enabling efficient and safe transportation of people and goods, improved traffic management, autonomous trucking, autonomous fleets, delivery and ridesharing.

AI can be used in the following areas in different ways:

Autonomous trucking/vehicles	Intelligent transportation systems	Travel route /flow optimisation	Community-based parking
• Driving assistance technology • Sensing and communication technologies to reduce fuel consumption • Safety and energy efficiency	• Traffic management solutions –shorter lead time • Safety of citizens • Toll pricing • Smart ticketing • Lane violation detection system • Vehicle detection for extension of red and green phase	• Optimisation of total travel time including access /waiting /travel time • Alternative flows and strategies to divert traffic • Convenient access path	• Parking guidance system to locate vacant parking spaces by minimising vehicle downtime and maximising driving time • Concept of self-driven cars

Mobile applications and public displays for disseminating information related to schedules of public transport system and traffic status on roads will benefit a large number of people. Open Maps for localization needs and simulator models for roads, traffic jams, participants' behaviour, speed control, recognising accident prone areas should be created. Automated monitoring systems can also help in estimating the state of roads such as potholes, wastages and other damages.

Railways

AI has widely been used to undertake remote condition monitoring, track circuits and power supply system including the current levels, timers etc.

Retail and Manufacturing

Machine Learning Algorithms can provide for preference based browsing, image-based product search, customer demand anticipation, improved inventory management, efficient delivery management, CRM and services, chat bots of various websites for immediate service to customers improving user experience and personalised suggestions. Automation of job positions and more advanced exponential technologies have revolutionised manufacturing supply chain ecosystems.AI can also help in effective warehouse operations, delivery efficiency, reducing shipping costs, demand forecasting and deal recommendations and fraud detection. Organisations, by applying AI techniques, can predict the performance of products and profits.

Energy

The potential of AI in energy sector includes:
* Energy system modelling and forecasting to decrease unpredictability
* Increase efficiency in power balancing and usage
* Storage of energy through intelligent goods enabled by smart meters photovoltaic energy
* Predictive maintenance of grid infrastructure

Smart Cities

In case of developed smart cities, AI can help in meeting the demands of rapidly urbanising population, enhanced quality of life and traffic control to reduce congestion. The concept of smart cities can be extended to smart rooftops, water saving applications, smart parks etc. Other areas where AI can be integrated are:
* City improvement, city renewal, city extension
* **Service Delivery:** rationalisation of administrative personnel on the basis of service demand and migration trend analysis and grievance redressal
* **Crowd Management:** prediction and advance management to know crowd behaviour, crowd size estimation and object detection
* Pavement lighting, maintenance of parks safety/accessibility ,check on people movement and maintaining public peace
* Cyber-attacks: detection of threat to online systems and highly sensitive data.

Education and Skills

To achieve SDGs on education, intervention of AI can help in achieving and accelerating   the progress by meeting the demands of quality education in a better way.AI can solve quality and access issues in education sector and support personalised learning, automating administrative tasks, vocational training, automated grading of test marks, rewarding teachers in preparing customised learning material as

per students learning level, proficiency level and speed of learning, predicting probable student activities, academic performance records, enhancing teachers skilling abilities ,improving student's performance.AI tools can help in developing automated systems for teacher placements, transfers and professional development training content. Virtual networks creating perfect learning environment for students, automatic question generation and evaluation schemes make the work smarter. Integration of translation systems with the digital infrastructure for knowledge sharing and in regional languages would help in overcoming language barriers and making availability of inter-operability of teachers across states. Biometric authentication for students and teacherscan help in monitoring status of male-female enrolment in higher, technical and vocational educational courses and raise the quality of education. Introduction of Chatbot on digital platform can help teachers in solving a large number of doubts of students. Internet users in rural areas were figured at approximately 290 million by 2019. E-learning websites can also help in providing relevant content for students. Diksha, E-pathshala, Swayam, MOOC are already helping young students to learn with limited teaching resources, entertaining personalised feedback and suggestions at a large scale.AI technologies also help children with special needs enabling them to be more participative, mobility and detection of potential threats to life by creating alert systems and providing opportunities for everyone without any bias. Ministry of Electronics and Information Technology (MeitY) and National Association of Software and Service Companies (NASSCOM)have jointly developed national artificial intelligence portal for all AI related developments in India. AI enabled solutions can be introduced to support access to information and communication. In India, AI research is mainly concentrated at institutions like IIITs, IITs, CAIR, LSAIML, IITR and IISc.

Indian Languages Project

Virtual assistants due to advances in natural language processing and speech recognition are becoming more and more useful.A complete natural language platform for Indian languages can serve various applications like conversational and counselling with the help of Chatbots and assistants conversing in 22 Indian languages.

Culture

With AI technologies- rich culture, history, knowledge, classical art forms and paintings can be presented in a detailed and effective manner.

Entertainment

Due to rapid digitization, AI helps the organisations to predict customer choices, social media behaviour and identification of content data with maximum return potential.

Construction

AI applications will help the engineers in designing buildings, safety features to make lives more secure, deliverance of high-quality work in the given time limit, analysing the work and process of the construction industry.

Astronomy

AI technology can be useful in understanding the origin and working of the universe and predicting more accurate results of the long-term stability of circum binary planets. Mobile platform last number of engineers and mathematicians lack of collaboration between them finance sector is still an issue lack of broad-based expertise in research and application of AI high resource cost and low awareness for adaptation of AI ,absence of enabling data ecosystem.

Finance and Banking Sector

AI techniques can be used in activation of accounts, balance checking, chatbots for interactions with customers and in many other functions. HDFC, ICICI, AXIS, SBI and other financial institutions are using AI algorithms.

Cyber Security

In a dynamic and ever-changing environment AI can help in cyber defence, chain reducing human intervention, deployment of intelligent agents and in checking malicious practices.

Challenges

- Lack of broad-based expertise in research and application of AI
- High resource cost and low awareness for adaptation of AI
- Absence of enabling Data ecosystems and good quality data as no institutional mechanism to maintain data.
- Poor execution of policies and lack of financial support

- Major contribution from private sector and concentration on consumer goods.
- Privacy and security concerns that companies are amassing large data sets and might use it inappropriately to gain insights about consumers.
- Lack of formal regulations ,education system lacking work environment
- Uncertainty regarding success or failure of product
- Illiterate people ,women, linguistics minorities, rural people
- Absence of collaborative approach to adoption of AI technological aptitude
- Skilling and reskilling of workforce
- Developing future talent
- Changing needs of the job market:Replacing human jobs and advancements in technology would effect a large number of jobs
- Major loss in thinking ability and generation of creative ideas
- Adoption of decentralised teaching mechanisms with private sector and educational institutions.

Conclusion

Government needs to play a critical role in supporting partnerships, providing access to infrastructure, fostering innovation through research, automating manual tasks and creation of demand. Upgrading skills is fine with AI but people resist to application of technologies in tasks based on values, intuition and emotions. Only algorithm functioning without reacting to environment would restrict human performance as well experience. Machines are complex, expensive and difficult to maintain on regular basis. There is a need to update technology in every sector involving huge funding. Government authorities should prioritise sectors for investment purposes with quick outcomes. Committees should be formed to check legal frameworks, safety and quality norms, privacy and security issues. The diversity in India can prove to be an opportunity for accessing huge amount of data if all these issues are addressed.

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