Artificial Intelligence: Master Key for Career in Emerging Technologies

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Abstract – **Artificial Intelligence is special software embedded in computing and commutation devices/equipment to mimic human brain and respond to the emerging situation. AI is an essential component for all modern technologies growing rapidly for IR4.0 applications. AI contributes significantly to the national economic growth. To ride the technology wave and stay in demand, good knowledge of AI and its various applications is a must. AI integration with robotics, drones, internet of things (IoT) and 5G technology will be the main engine for sustainability and growth of any business and strengthening of global alliances.**

AI is a lifeline for every organization to achieve enhanced efficiency, more productivity and higher profitability. According to Amit Ray, Pioneer of Compassionate AI Movement, 'The coming era of Artificial Intelligence will not be the era of war, but be the era of deep compassion, non-violence, and love'.

Keywords: Artificial intelligence, Robotics, Machine learning, Internet of things, Deep Learning, Medical diagnostics, Alexa

I. INTRODUCTION

IN today's fast-moving digital world, Artificial Intelligence (AI) is a buzzword. AI is already impacting our work environment, business processes, productivity, quality, networking and lifestyle. AI is special software developed with required functionalities and stored in the computing / communication devices and household appliances so that these can quickly sense a situation, process sensed data and act like humans. These AI-enabled devices can efficiently perform tasks like speech recognition, image processing, analysing data and assist in better decision-making. AI is based on well-designed algorithms by a multi-disciplinary team of experts. The algorithm is coded using the appropriate programing language and stored in the equipment/device as embedded software**.**

AI system has pre-stored logic to act like how humans observe, feel, learn, reason and respond to any emerging situation [1]. AI can perform many repetitive tasks tirelessly, faster and more accurately than humans. Today, AI is transforming entire systems of production, management, healthcare, entertainment, gaming, animation, robotics, drones, navigation, transportation and e-governance [4]. Due to rapid growth in mobile smart/intelligent computing devices, data processing power and embedded technologies, AI has become very efficient and affordable. AI now forms an essential component in every product, equipment, machinery, vehicle, intelligent cities / home and various healthcare procedures. In the last 15 years, AI has picked up great momentum in the field of automation, innovations, machine learning (ML), deep learning (DL), medical diagnostics (MD), record-keeping, storage, retrieval, processing, business intelligence and decision-making.

II. BACKGROUND

AI has been evolving since the early 1940's. Its initial work started during World War II when a UK scientist, Alan Turing started developing Machine Intelligence (MI) technology. He published his findings in 1943. Others who have contributed during the early stages of the AI revolution were Marvin Minsky and John McCarthy. However, a major part of AI implementation was carried out from 1955 onwards. During the 1960s, AI was used in two-sided games like Chess [1].

Since the early 1970s, AI is being taught as a subject of computer science at UG/PG level in most engineering colleges and universities. During the 1970s, LISP was used for AI programming to solve simple problems related to healthcare, speech recognition and image processing. During the 1990s, PROLOG became a popular language for AI. Despite its popularity, AI still remained limited to academic interest in areas like speech recognition, neural networks, healthcare and chess. In 1995, IBM's Deep Blue (chess computer) defeated Garry Kasparov (Russia). Since 2005, AI researchers in the USA, UK, France, China and Japan focused mainly on learning, reasoning, problem-solving, perception, pattern matching, image processing and language translation. From 2010 onward, AI has its presence in robotics, drones, navigation, aviation, animation, IoT and digital marketing.

AI Definition: AI is defined as the development of computer systems that are capable of performing tasks that normally require human intelligence for visual perception, matchmaking, speech recognition, translation between languages and decision-making. AI is a combination of technologies that enables machines to emulate the human capabilities of sensing, comprehending and acting.

Scope: AI is a vast subject involving software engineering, advanced programming for developing algorithms, embedded software for sensors, microcontrollers and microprocessors. Therefore, the scope of this article is limited to highlighting the potential of AI for riding the technology wave during the current Industry Revolution (IR4.0).

AI Database: AI database is quite different from traditional RDBMS. AI database combines data warehousing, analytics, and visualization. Technology leading companies have developed a special AI Chip to speedily handle large volumes and complex data. AI chip has an embedded algorithm that will help in pattern recognition, image classification and Natural Language Processing (NLP). As per Radalj, Vice President of Kinetica's Technology Group, AI database should be able to concurrently ingest, explore and analyse huge volumes of complex data, within milliseconds. AI database has the following different features:

- *Accelerated data intake*: Ability to quickly intake and process real-time streaming data and enable users to take fast action.
- *Co-locality of in-memory data*: This feature is essential for parallel processing and achieving higher performance and greater throughput.
- *Common platform*: AI database provides a common platform for data scientists, software engineers, and database administrators to iterate and test AI/ML models faster and arrive at the expected outcomes.
- *Parallel Processing*: AI database supports parallel processing which mimics the human brain's ability to concurrently process multiple inputs.

AI for Digital Economy: AI is essential for giving a boost to IR4.0. In October 2017, Chinese President Xi, Jin-Ping had declared promoting further integration of the Internet, Big Data and AI to become a leading world economy. China had plans to catch up with the West in AI by 2020 and lead the world in AI by 2030. As per the 2021 economic survey, China has already surpassed the USA and now China is the richest country in the world. Since 2019, the US, Russia, Japan, England, France, Germany, Holland, Israel, Canada, Sweden and India have given priority to various AI initiatives to accelerate their economic growth. Recently, more countries like Belgium, Denmark, Ireland, and Spain have made their commitment to providing adequate funds for their AI initiatives.

III. ATTRIBUTES OF A TRUSTWORTHY AI SYSTEM

Human intelligence and interpretation are based on knowledge of technology, domain, intuition and social knowledge. AI designers extrapolate human judgment (ideas) and embed those in the AI system. AI system must be very fast, secure, safe and reliable. IBM proposed the following attributes of a trustworthy AI system:

- *Reliability*: A reliable AI system must create knowledge that faithfully incorporates business rules, government policies and regulations, policies of the organization and norms of the society.
- *Security*: Cyber hackers often attempt to alter specific input to disrupt the outcome of the AI system. To detect and protect AI systems from cyber-attacks, periodic testing and benchmarking of AI models is necessary.
- *Traceability*: AI systems should include details of their development, deployment and maintenance instructions so that these can be audited throughout their lifecycle.
- *Understandability*: AI systems should provide information that can be easily explained and understood by users.
- *Unbiased*: Training data sets should have the least bias to establish user confidence in the AI system.

IV. CONTRIBUTING TO AI GROWTH

Some major factors contributing to the rapid growth of AI are:

- *Algorithms*: With the availability of large and reliable data for training and validating ML algorithms, the quality of outcome and decision making has improved considerably.
- *Academic Institute›s participation*: Active participation by the educational institutes/universities to quickly evolve industry-oriented curriculum and offer courses related to AI skills.
- *Availability of large data*: AI model needs very large and authentic data for validation. This is now possible with easy access to Big Data, generated from e-commerce, government departments, science institutes, research labs and social media [5].
- *Cloud Computing Services*: Running/validating ML algorithms requires flexible storage and scalable computing power for fast retrieval. This is possible with the easy availability of affordable cloud-based services.
- *Improved Response Time*: AI is needed for fast accessing and interpreting digitized legal proceedings, medical diagnostics and insurance claims. By integrating AI systems with Cloud Computing and Big Data, the response time greatly improved.
- *Industry Participation*: Industry participation has increased as they now consider that AI-based systems will have higher productivity, better efficiency, and greater Quality Assurance (QA). Active participation by the industry in recent years for validating AI-related products and processes has boosted AI development.
- *Programming Languages*: Emergence of new OOP languages, like Python, C++, Kotin and GO helped in the speedy development of AI algorithms and embedding those in the microchips.

V. FUNCTIONAL GROUPING OF AI APPLICATIONS

AI is a very versatile and useful software tool, used in all technology-driven digital applications. AI can help to solve complex problems related to various organizations/ departments like the judiciary, security, entertainment, education, healthcare, commerce, transport, agriculture, and defence. AI applications can be categorized into the following functional groups:

- *Image Processing*: Ability to carry out image processing with great speed and good resolution
- *Knowledge*: Ability to present real-world knowledge. *e.g.* financial market trading, purchase prediction, fraud prevention, drug creation and medical diagnosis.
- *Language Translation*: Ability to understand spoken and written language for real-time translation to any specified language. This is very helpful in international conferences. AI can also understand sign language, interpreting gestures and facial expressions.
- *Planning***:** AI is helpful in planning inventory management, customer demand forecasting, predictive maintenance of machinery, navigation, scheduling and logistics.
- *Prediction and forecast* : Ability of AI tools to quickly sift through large data related to weather, industry production, sales, project management, healthcare, education, agriculture, and employment and carry out prediction/ forecast.
- *Perception*: Ability to quickly infer things through sounds, images and other sensory inputs which are needed for medical diagnosis, autonomous vehicles and surveillance.
- *Reasoning*: Ability to solve problems through logical deduction in areas like financial application processing, financial asset management, legal assessment, business alliance and entertainment games.

VI. IMPLEMENTING AI

Thankfully it is now well understood that AI is not a threat to jobs but a lifeline for every organization for achieving enhanced efficiency, more productivity, and higher profitability. AI will supplement human effort in many fields leaving human beings to do more creative thinking and innovation, better integration/ interfacing systems and sub-systems.

For successful implementation of AI, the top management and all staff should be fully acquainted with AI so that they become enthusiastic to get the best out of AI. Many CIOs, CKOs of technology companies have recognized that AI will not totally disrupt their business model. Instead, AI will enable them to remodel their various processes and make their business cost-efficient, more productive and more profitable. However, educating the top management, about the capabilities, limitations, and requirements of AI is a difficult task. To prepare the new young workforce for AI, most of the engineering colleges/universities and other institutes of higher learning have already introduced UG (4 Years) / PG(2 Years) level programs in AI and related areas.

- *Existing AI Utilities*: Some of the popular gadgets/devices, vehicles using AI are briefly given below:
- *Alexa*: Alexa is a handy device from Amazon with the ability to receive speech from anywhere in the room. Alexa can help to browse web information, do online shopping, schedule appointments, set alarms, support smart homes.
- *Netflix*: It provides an accurate prediction of customers' reactions to films/movies. It analyses millions of records to suggest films that you might like to watch, based on your previous reactions and choices of films.
- *Nest*: It is**,** a learning tool acquired by Google in January 2014 for $3.2 billion. Nest learning can now be voice-controlled by Alexa, Nest uses behavioural algorithms to learn from your room heating and cooling level and adjust room/office temperature as per your personal needs.
- *Siri.* It is a very handy digital personal assistant introduced by Apple and is available on all Apple smartphones. It helps us find information like directions, add events to our calendars, helps us to send messages. Siri uses ML technology to understand our questions and requests made using our natural language.
- *Tesla*: Today Tesla is possibly one of the best AI-enabled cars. It is equipped with very advanced predictive capabilities, road safety and self-driving features.

VII. INDIAN INITIATIVES FOR AI

As most of the countries are now becoming Digital Economies, AI has a big role to play. In 2015, India had taken a very bold initiative "Digital India". To give further impetus to its digital economy, NITI Aayog (Planning Commission) of India had formulated comprehensive guidelines in June 2018, for introducing AI, ML and Robotics in various sectors**.** This document is available on www.nitiayog.com [4]. In the last five years, India has given a special boost to AI by implementing AI in agriculture, processing, transportation, education, and research. Indian industry has made significant progress in implementing AI in its various business units.

VIII. AI APPLICATIONS TRENDS

AI is impacting our work environment, our lives and the growth of the national economy. A popular example of an AI-based system is GPS tracking of moving vehicles, indicating their progress of journey and traffic congestion locations. GPS also gives suggestions about approaching, resting places, gas stations, shopping malls and restaurants. The designers of AI systems are embedding behavioural algorithms, tracking shopping potential/habits and wish-list of customers [2]. AI is also helping in self-driving vehicles, predictive models

for Healthcare services, Weather prediction and Agriculture growth. AI applications are unlimited and it all depends on how we utilize its potential and integrate AI with other emerging technologies, like Robotics, Drones, G5 networks and IoT. Technology majors like Google, Facebook, Apple, Amazon and Microsoft are investing a lot in AI to accelerate their global growth. Future trends of AI use in major sectors are briefly covered below.

Healthcare: AI and ML technologies have been very useful in healthcare services because it generates large data to train and validate algorithms. This helps in locating of disease patterns faster than human analysts. Some prominent utilization of AI and ML is in diagnostics of cancer, eye ailments, diabetes, drug effect, DNA analysis, patient symptoms and suggested treatment. AI is already embedded in many surgical instruments and devices which help in speedy, safe and cost-effective surgical procedures. AI has already proved its utility during 2020 to accelerate research to find new vaccines against the Covid-19 pandemic [3].

Education: There is great scope to introduce IT-related curriculum at all levels of education, say primary, secondary and higher levels. Most leading engineering institutes and universities have responded well by introducing AI as a major subject in their UG/PG curriculum.

Documentation: Translation of documents, indexing and storage for retrieval. This is particularly useful for Land records, Legal documents, Health and Insurance records.

Entertainment: Service providers of cinema screens and TV channels use AI/ML algorithms to analyse and compare their viewership with that of their competitors and recommend specific shows to retain their customers. This also helps to promote various products and services on news channels and maximize their revenue.

Finance: AI-based NLP tools help finance companies to quickly analyse brand likes from social media platforms and provide actionable information to the business houses. Another popular application of AI is fraud detection in misuse of Master-Card / Visa-Card. AI can quickly examine transactions, give approval for genuine transactions and decline fraudulent transactions with intimation to the Credit Cardholder.

Data Security: With faster and affordable internet facilities and the easy availability of smartphone-like devices, cyber-attacks are becoming a common feature. As most of the nations are moving toward Digital World, there are serious concerns about the security of data. This is being tackled on a war footing since this affects, banking/financial institutions, the stock market and even political campaigns like US presidential election in 2016. AI can help to predict the likelihood of cyber-attacks. AI algorithms can automatically do bug fixing by detecting and removing malware code.

Manufacturing: Robots loaded with AI have revolutionized the entire manufacturing sector, be it automotive, household appliances, textile, or processing industry. Some very common examples are briefly given below:

- *Collaborative Robots (Cobots)*: These robots are loaded with AI software to take fresh instructions from humans and work collaboratively with them.
- *Defect Checking*: AI/ML algorithm can assist to find microscopic defects in objects like circuit boards.
- *Inventory Management*: AI can help in inventory management and vendor management, energy consumption, and maintenance of equipment/machinery.
- *Monitoring work environment*: AI can help in monitoring operating conditions and performance of the workforce.
- *Preventive repair of vehicles/machines*. AI can assist in predicting malfunctions and breakdown of equipment/ devices and taking remedial/pre-emptive action.
- *Self-driving Robots*: These can move finished goods within the manufacturing facility without endangering anyone or anything around.
- *Supply chain*: AI can help in detecting the patterns of customer demand for various products, across geographical regions, socioeconomic segments and improve delivery time and cost.

Automotive Industry

- *Self-driven cars*: Google and Uber developed and launched self-driven cars in the US and Europe. This is helpful for elderly or handicapped people to reach their destination safely.
- *Car Safety*: The AI-based system when installed in the car will enable safety warnings, related to speed, approaching vehicle, lane changing, vehicle-to-vehicle communication. For this, sensors will be installed along the roads [2].
- *Rail safety*: To avoid rail accidents, an AI-based system can be installed in the train driver's compartment and installing sensors at level crossings and track changing points. AI system will control train speed as per rail track conditions and also avoid any head-on collision due to wrong track changing.
- *Car theft alarm*: Some cars are already loaded with a microprocessor to match the car key with a pre-stored software key. If both keys do not match, the AI system cuts off the car ignition system so that car is not stolen. In addition, AI software can recognize biometric signs.

- *Research & Development* (*R&D*): AI is playing a leading role in the field of innovations, R&D and Exploration.
- *Military Applications.* AI has many applications in military warfare**.** These could be surveillance, navigation/ tracking and autonomous operation of equipment and weapon systems, guided weapon systems, terrain mapping and analysis, weapon database, and their lethality Index.

IX. JOB POTENTIAL IN AI

There are many technical areas where you can acquire related skills, enter, build and excel in your chosen carreer. Some common areas offering jobs are given below:

Experts Systems: AI is being gainfully used in agriculture, road transportation and weather prediction.

Knowledge-Based Systems. These are being used in many Defence and some Business applications.

Speech Recognition: This is quite a common application of AI since the early 1970s. Customer-friendly, auto-response to queries for travel (Rail, Road, Sea) and hotel reservations is a well-known application.

Robots: The heart of the Robot is AI and embedded logic. Robots are already being used in many Healthcare, Business applications, animated movies, entertainment and Military activities.

Machine Learning (ML): ML is a subset of AI and is used for diagnostics and interpretation of laboratory tests. ML is also playing a major role in industrial automation [3].

Navigation and control system: This is particularly useful for aerospace missions.

Lie Detector: A lot of research in the US and UK has been carried out to accurately detect micro-expressions on the face of the accused so that police/ law enforcement agency can accurately detect if the suspect is telling a lie.

Prediction in Casinos. In leading casinos like those in Los Vegas, the owners are using AI to recognize and record facial expressions to identify risk capacity of probable losers.

Tracking Transport Fleet. AI gets integrated with satellite imageries and GPS to monitor and control the movement of transport fleets. AI helps to divert the route and optimize as per road conditions.

Web Translation: A number of internet service providers like Google and Microsoft are offering real-time machine-based translation from one language to another language.

Video Gaming and Entertainment: The Toy/Video Games industry with embedded AI features has a great market for children entertainment.

X. SOURCES FOR AI COURSES

To give impetus to AI and meet the ever-increasing demand for AI qualified workforce, most of the leading universities in USA, UK, Canada, Australia and India have revised their curriculum of UG/PG level engineering courses in Computer Science, Electronics and Communications, Instrumentation and Control. From these institutions of higher education, you can choose the full-time, part-time or weekend course at your convenient time and cost. In addition, you may search on the internet and select a suitable AI course. If you undertake any online AI course and do not pay the fee for certification, the course will be free but considered an audit. It is recommended that you pay a fee of $40 to $60 and get certified, since that will show your competency and value addition to your CV.

XI. REQUIRED SOFTWARE TOOLS

Programming Languages: Popular AI programming languages are Python, Lisp, "R", PROLOG, C++, Java-script and Java. All these languages are capable of satisfying various requirements for different AI-related applications. There are some limitations of some languages when we deal with Mobile phone devices. However, if you have mastery of one of these languages, migrating to others is quite easy. Python is the favourite programming language for AI development because of its simple syntax and supporting multi-programming and neural networks solutions. Python is very portable to many platforms including UNIX, Linux, Windows and Mac. It has a large library of many functions, which accelerates coding.

Mathematics Expertise: Building AI models for various business problems need applying mathematical/statistical techniques to express many business rules into numerical expressions. Hence Data scientists should have sound knowledge of Linear algebra, Matrix algebra, Numerical Methods, and Statistical techniques.

Business Knowledge: Having good business knowledge is as important as having knowledge of technology and algorithms. Actually, AI power comes from leveraging both technology and business knowledge.

Statistical Tools: Besides SAS, "R" has become a more popular statistical programming language. "R" is very efficient for forecasting, interpreting and decision-making.

Embedded Technologies: AI uses the embedded software in Microcontrollers, Microprocessors and Sensors which form the heart of robots, drones, guided weapon systems and navigation systems. Embedded software and optical devices are facilitating many activities in healthcare, diagnostics, physiotherapy and surgery.

XII. CONCLUSION

The idea that routine manual work can be carried out by the machine is quite old and well known. AI-based machines can perform tasks that were earlier done by the knowledge workforce. AI will continue to transform our style of working, living and doing business. It is well recognized now that AI is not a job snatcher; instead, AI will create many new jobs with a better salary but require new skills. As AI advances further, it will become faster, secure and reliable to provide human-like responses and aid in solving various problems. These problems could relate to environment, earthquakes, cyclones/tornados, aging, disease, epidemics, poverty or famine.

Though AI has been around since the 1950s, it is only during the last 15 years that AI has begun to find real-world applications in diverse fields. Since 2005, investment in AI by technology leaders like Google, Amazon, Microsoft, IBM, Cisco, Facebook and some start-ups has increased nearly three times. As per the 2017 survey, the AI business has reached nearly $40 billion. A report by World Economic Forum, Sep 2018 indicates that Machines and Algorithms are expected to create 133 million new jobs, but also take away 75 million jobs. Similarly, a report published in 2018 by Forbes suggests that by 2022, AI will create 58 million new jobs. Another report from Forrester Research indicates that organizations that use AI and related technologies will have an edge and take away $1.2 trillion per annum from their less-informed peers. AI also supports military warfare, political campaigning and psychological warfare**.** AI has also a role in controlling global warming. In the coming years, there will be more integration of technologies to reap the full benefits of AI and associated technologies.

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