

Artificial Intelligence

pathway for Indian Council of Agricultural Research

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John McCarthy coined the term Artificial Intelligence (AI) in 1956. It is the process of making an intelligent machine by the human. It comes under the broad domain of computer science. The essential elements of AI working are based on learning from the historical data, and the process decision that is quick and accurate.

Key words: Artificial Intelligence, ICAR, Information Technology Industry 4.0

THE journey of technological evolution could be seen from the perspectives and motives of five year plan. In the first two five year plans, India ventured in establishing industry of basic and essential commodities and later on entered in establishing heavy manufacturing industries. The borders of the economy were more or less protected during these phases. The process of protectionism of domestic industry was prevalent up to 1990's. The era of information technology (IT) revolution came after opening of economy and picked up very fast after World Trade Organisation (WTO) formation. This is the phase of more global exposure to our business and culling out best practices from global economy and imbibing in domestic environment for becoming more vibrant and competent. The development of synergy in global economic policy among nations after a decade of WTO formation generates the momentum in spontaneous internal change and many fluctuating dynamics are constantly reshaped or replaced by innovation and competition. Economists often use it to express the essential nature of capitalism as a relentless drive towards progress. This derive ultimately leads to dismantling of

long-standing practices in order to make way for innovation, generally known as Creative Destruction according to Schumpeter theory of induced innovation. In simple terms creative destruction entails eating away long-standing arrangements and free up resources and energy to be deployed for new innovative arrangements. The increasing pace of intensity of development, diffusion and adoption of innovation has led to shortening product/technology life cycle in an organic and dynamic economy. Equilibrium is no longer the end goal of market processes. Industry (4.0) is commonly referred as fourth industrial revolution. The essential elements of this revolution

are current trend of automation, data sharing, cyber security related issues, quantum communication, Internet of things (IoT), cloud computing, and cognitive computing. Because of these innovative systems, industry (4.0) is also known as “smart factory”. With fast pace of its technological advancement and vast area of application, Artificial Intelligence (AI) is becoming pervasive very rapidly because of its robust applicability in all problems of the economy in general and agriculture in particular. The applicability of AI in agriculture is seen as an opportunity in difficult situations/problems particularly that cannot be solved well

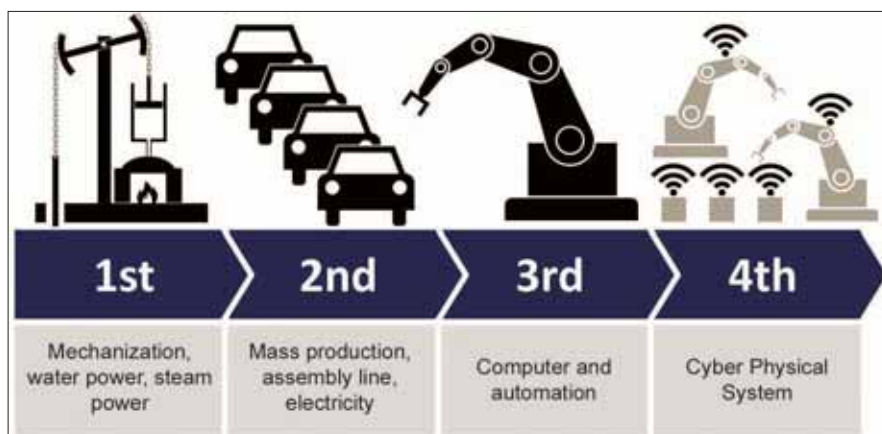


Fig. 1. Evolution of technology in the economy

Source: Christoph Roser, <http://www.allaboutlean.com>

by humans as well as traditional computing structures.

AI is extremely important in Indian agriculture due to numerous reasons. Indian agriculture is facing large number of challenges such as low irrigation efficiency, land degradation, biotic and abiotic stresses, large post-harvest losses, etc. Attracting and retaining youth in agriculture is another important challenge. Agriculture requires to be smart to address these problems by using labour-saving techniques and devices and large-scale production. Artificial intelligence can play an important role in accelerating and improving the technologies in driving India's smart agriculture, attract youth, reduce drudgery and save resources through precise application of inputs. The Internet of Things (IoT) and AI can provide farmers with real time analysis of weather, temperature, humidity, and price data and can suggest ways to maximize the value of crops by fully understanding local resources. Collection of data using field sensors and fully automated aerial vehicles can provide gigantic and valuable information on soil, water, fertilizer, seeds, livestock, crops, costs, farm equipment, etc.

AI IN AGRICULTURAL SECTOR

Few areas in agriculture wherein AI could be used.

AI in irrigation management

The prevailing water-use-efficiencies, India are very low at 30% and 55% in surface and ground water respectively as report of Central Water Commission. Therefore, irrigation is fertile ground for the application of AI to solve the problem of low water use efficiency and have per drop more crop. However, to harness this potential, we need to have quantum of data collection and processing by applying sensors and devices leveraging modern communication infrastructure. There are number of ways in which sensors and devices, more commonly known as IoT devices can be potentially applied in irrigation. Beyond the application of sensors and models for processing of soil

moisture data, AI has potential for machine learning the response of soil moisture to irrigation events under varying crops, soil, climate conditions, etc. This can be linked with irrigation control system and bring automation resulting in higher water and nutrient use efficiency. Number of sensors have been developed to sense the moisture level, temperature, humidity, etc. The data measured by these sensors can be monitored anytime and anywhere from a dedicated application. The time taken to check the water rounding can be significantly reduced. Optimal water management not only improves time efficiency but also improves quality and yield of the produce. It can help in sensing of water level and temperature in field crops and integrating data for better management of fields.

AI in sowing and plant management

Automation in sowing and transplanting can play important role not only in reducing cost of transplantation but also helps in plant geometry management and thereby improving productivity of crops. It has been reported that improved plant geometry helps in better plant establishment and improving productivity of crops than broadcasting. Conventional transplanting of paddy and some of the vegetable is one of the most labour intensive and drudgery full work. A GPS guided automated transplanter can solve the problem. Fertilizer application is another area where automation can be applied. Number of firms are developing and programming autonomous robots to handle these essential agricultural tasks with much more accuracy and faster pace than human labourers.

AI in insect pest management

Insect pest and disease infestation is one of the most alarming problems in agriculture that leads to heavy economic losses. Over the decades researchers have tried to mitigate this menace by development of computerized systems that could identify the active pests and suggest control measures. Image processing for plant disease diagnosis is one of

the areas where automation can be applied. Pesticide poisoning is a chronic problem in the country. Every year, the cases of pesticide poisoning in India are reported in thousands. Death of the farmers in Yavatmal district of Maharashtra and other places is a serious tragedy and should not happen in future. Pesticide using application of artificial intelligence such as drone technologies can reduce the impact on natural ecosystems, and increase worker safety, which in turn keeps food prices down and ensure our food production system will keep pace with population while keeping our planet safe.

AI in harvesting and post harvesting

Crop harvesting and picking fruits using robotic is an important technology in agricultural production. In some of the countries like Japan, automatic picking techniques have been mainly used. Picking of strawberry and tomatoes have been successfully implemented in Japan not only experimental field but also operational at farmers' fields. Manual picking of some of the fruits and vegetables like okra, coconut, date palm, etc. is brutish, time consuming and require skill. Automate taste and protein content sensors embedded with combine harvesters can help in generating large data, which intern help to variable rate of fertilizer application for getting quantity-adjusting feature. Similarly, grain size sensors based automation can precisely estimate the yield of crops. Automation in sorting and grades of agricultural products can offer better prices to farmers. Automation can also be used in monitoring technology such production forecasting, weather forecasting, crop loss assessment due to vagaries of nature, etc.

The constructive destruction process due to industry (4.0) inevitably results in losers and winners in agriculture in particular and economy in general. Agri-entrepreneurs and workers in new technologies will inevitably create disequilibrium and highlight new profit opportunities in business. The producers and workers committed to

the older technology in businesses will be left stranded and redundant with passage of time. The paradigm shift from IT phase to Industry (4.0) revolution led to opening new vistas of job opportunities in labour market. The constructive destruction process discerned mainly three important avenues for jobs in the economy are, viz. (1) big data analytics, (2) networking business and sharing/connecting the economic agents, and (3) use of AI to automate the process. The major employer in technology sphere is corporate, not government. The demand of fast changing skill-set of labour force needs to be aligned with adequate

supply of apt skilled labour force in the economy through policy, institution and infrastructure.

Conclusion

The academia in the country is the major supplier of labour force in the market. On similar line, the apex umbrella agriculture research and development organization i.e. Indian Council of Agricultural Research (ICAR) has to embrace the on-going industry (4.0) revolution in its research, education and extension. Matching demand and supply of labour with changing needs of industry is a clarion call. The demand of quality labour in era of Industry

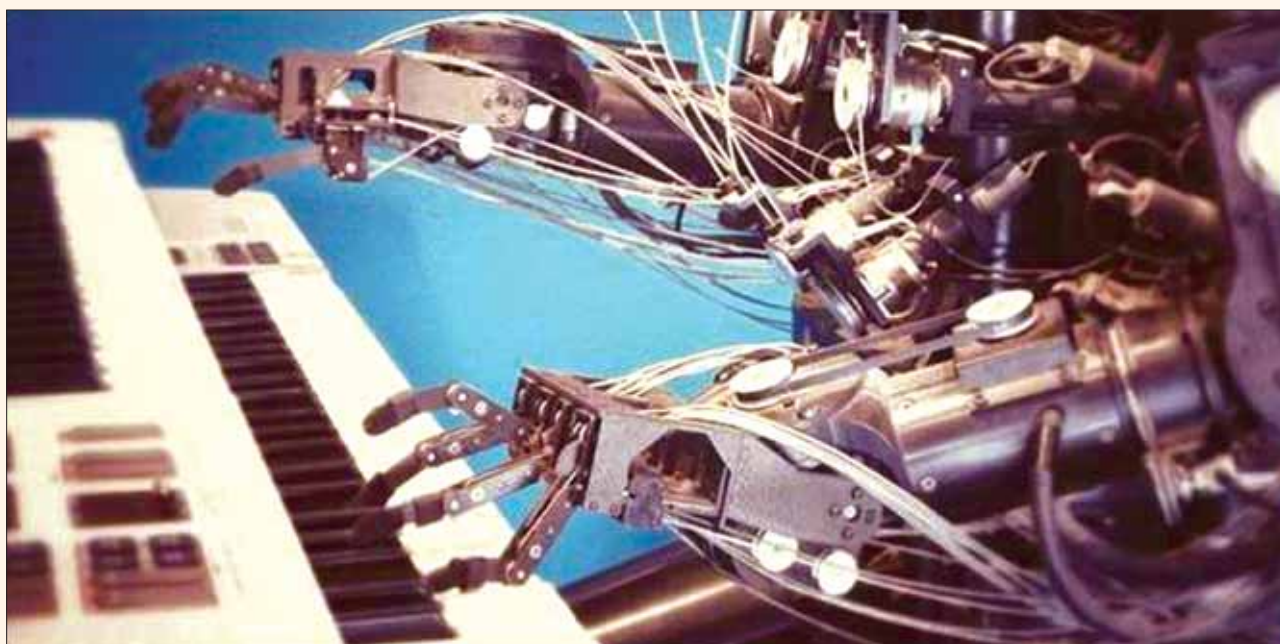
(4.0) revolution is global. This process of automation using various tools and innovations emanating from global R&D propelled us to explore the possible application of fourth generation technologies in economy in general and agricultural field in particular. This will not only reduce cost but also enhance productivity and efficiency in the economy in general and agriculture in particular. This necessitates the strong and sustainable collaboration of academia with industry.

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Machine Learning

Machine learning is a subset of Artificial Intelligence where tools are built to create the artificial Intelligence. Here a developer builds models for a computer to learn, from a large data set. Machine Learning gives computers the capability to learn without being explicitly programmed

It is used to build personalized tools specific to a certain environment or ecosystem with the data set relevant to that environment. Many areas utilize this technology to build predictive models in agriculture, finance, manufacturing, healthcare etc. In general, any machine learning problem can be solved through learning techniques such as Supervised learning and Unsupervised learning. For developing a solution through machine learning, past data in the form of text, excel, images or audio data is required.



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