

Artificial Intelligence (AI) and Sensors: Tools For Next Generation Horticulture

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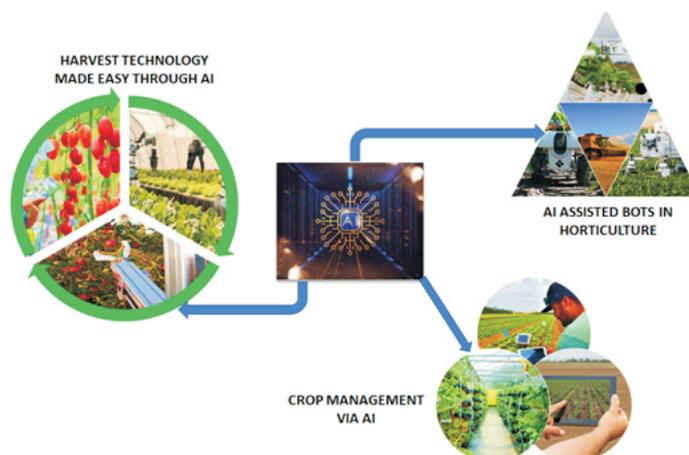
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SUMMARY

A major shift in area towards the horticultural crop cultivation has been witnessed in India. Various factors such as rainfall, temperature, humidity, geographical conditions play an important role in this decision-making process and to make the farming profitable. With the need for better crops, the adoption of years old agricultural methodologies would no longer suffice. Necessity to cope with the tremendous need for healthy food, automated farming practices came into picture in the early twentieth century. With the advent of AI, scientists/farmers can manage/ solve various complex problems without human intervention. AI could also assist the farmers to predict the expected financial trend for any particular crop and plan accordingly. A major part of horticultural revolution happened with the introduction of soft computing, sensors and artificial intelligence (AI). An efficient public-private partnership model can enable to bridge the gap between technological advancements and India's horticultural sector.

INTRODUCTION

In this modern era, with the ever-growing pace of sophisticated advancements in every field, there has been an unprecedented growth in the amalgamation of engineering aspects in the horticultural domain which covers perennial as well as annual crops, including variety of fruits, nuts, vegetables, flowers, spices, plantation crops, exotic crops etc. When compared with other agricultural domains, horticulture, though grown in relatively smaller crop zone, remains hot in terms of high financial value as well as rich nutritional value. A major shift in area from food grain cultivation towards the horticultural crop cultivation has been witnessed in India. Over the last decade, the area under horticulture in India grew by 2.6% per annum and annual production increased by 4.8%. As per the estimates of Area and Production of various Horticulture Crops, released by the Department of Agriculture, Cooperation and Farmers Welfare, total horticultural production of 2019-2020 was expected to be at 320.48 million tons (i.e) a surge of 3.13% higher than the last year. Fruit production in particular was expected to be 99.07 million tons. This is due to the increased production of Banana, Apple, Citrus and Watermelon. In traditional horticultural practices, critical decision-making necessity exists among the cultivators to decide on how effectively to prepare the soil, sow the seeds, cultivate crops and harvest crops at the right time.

Various factors such as rainfall, temperature, humidity, geographical

conditions play an important role in this decision-making process. In addition, resource management, including water, nutrient resources should be effectively handled to have healthy crops. Lack of proper irrigation and nutrients could lead to perish besides, weed and pest control also plays an important role. Inclusion of technological methods and current ideas into the horticulture sector to circumvent the above issues in managing variability, crop production as well as crop protection has opened up new ventures to ease out human intervention in the entire process. With the need for better crops, the adoption of years old agricultural methodologies would no longer suffice. Necessity to cope with the tremendous need for healthy food, automated farming practices came into picture in the early twentieth century.

Soft computing techniques and Artificial Intelligence – a gist:

Soft computing is a term that is coined for computational decision-making techniques based on knowledge and observations mimicking human thinking capability. Such techniques are different from the conventional decision-making computing methods as the conventional methods require approximate mathematical or physical model of the subject under consideration for arriving at conclusions. Some of the few techniques of soft

computing include fuzzy logic, Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Evolutionary programming (EP), Artificial Neural Networks (ANN), and machine learning (ML) techniques. Artificial Intelligence, the recent buzz word revolving in almost all domains of human life could be explained in simple words as an intelligent machine like system which has capability to think, act and decide like humans. With the advent of AI, scientists/farmers can manage/ solve various complex problems without human intervention; provided, the AI machine is given the required updated information.

AI in crop planning

Crop planning is the process of how optimally horticultural land is allotted among various competing crops that are desired to be grown on the land. This is highly essential as ignorance of topographical conditions and prediction of weather changes can cause a huge loss in produce and finance. Farmers are bound to take critical decisions on which horticultural crop variety to be grown in what proportion in order to enhance the productivity. Owing to the influence of various external factors on this

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application ranging from monitoring a small plant cell to a larger hectare level of global remote survey and automated decision-making systems. Of late, observation and remote monitoring of crops involving environmental machinery and incorporating an advanced intelligent technology has gained more attention. Also, lacking horticultural infrastructure and the unorganized retail market has made India stand one among the top nations of post-harvest food losses. In addition, the degrading natural resources, the demanding competition for its usage and the exacerbating climatic pattern make the horticultural economy stumble upon.

AI could also assist the farmers to predict the expected financial trend for any particular crop and plan accordingly. A major part of horticultural revolution happened with the introduction of soft computing, sensors and artificial intelligence (AI). Combination of machine learning (ML) and AIs nowadays used in precision horticulture to impart data. It helps farmers to monitor and optimize crops and keep up with changing environmental factors. AI has deep benefited applications in all parts of horticulture right from crop calendar planning, sowing, irrigation, weeding, pesticide application and crop quality management. This article provides an insight of current state of various soft computing techniques and next generation AI in agricultural practices for better crop protection and improvement.

ANN based prediction of crop quality

Crop yield forecasting is an important step in effective farming and plant management system. Numerous factors such as the area under cultivation, proper irrigation system, amount of rainfall, quality of seeds, topographic attributes, application of pesticides and fertilizers, disease occurrences in plants etc. contribute its effect on the crop yield. Although accurate crop yield estimation is highly tedious, artificial neural networks have been trained using statistical data to bring out a relationship between crop yield and some of the above said contributing factors. Multi-layer perceptron (MLP), a feedforward neural network is trained initially with already existing different plantation area and the crop yield of a particular crop being grown. The network learns and updates itself based on the huge sum of training data given by the expert system, (i.e) human knowledge. Upon effective training, multi-layer perceptron neural network is able to predict the crop yield given, a particular cultivation area and few other supporting data.

AI in post-harvest handling

Post-harvest loss is a major challenge hampering production of horticultural crops in most developing countries with country losing more than 75000 crore every year due to poor handling of the produces. Incorporation of specialized post-harvest technological practices and treatment methodologies are necessary to enhance the shelf life of the produce. When such specialized techniques are failed to be practiced, loss in a huge rate is experienced. AI techniques including Block chain management and traceability are employed in post-harvest technology to enhance better crop quality improvement. The main objectives of including AI systems in post-harvest technology includes, implementing effective crop management system that maximizes the yield without affecting the quality, employing optimal post harvest handling practices to maintain quality and safety of the produce. AI are also developed to predict the storage conditions and hence suitable preventive actions to be taken to avoid rotting of the stored food products. AI systems are also engaged in the micro management of storage environment remotely with the use help of sophisticated smart sensors and other AI machinery.

CONCLUSION

In a nutshell, soft computing and AI is an integration of biological human thinking ability with computational techniques. In all the above stated techniques, human expert knowledge of crop yield, management and protection are converted as machine readable information. The intelligent system operated with soft computing techniques is made to read and trained with the information from expert system. With the adequate information about the crops and effective training, the AI assisted machine is now independent enough to take decisions without manual intervention. AI and soft computing techniques are continuously doing wonders with horticulture thus making farming cozier and more comfortable. Hence, AI assisted horticultural practices could be effectively used in, “**Next generation Horticulture**” with intelligent sensors and decision-making support system. Employment of such advance technologies not only ease out the farmers work but also enable them to improve the yield and protection measures of the farms. An efficient public-private partnership model can enable to bridge the gap between technological advancements and India's horticultural sectors. AI joined hands with horticulture can create a big transformation in terms of uplifting its level of production. In a country where suicide of farmers is a day to day news, introduction of such cutting edge technological AI s could

actually allow farmers to minimize risk and loss in terms of prediction of weather as well as market demand. AI on the whole, is definite to usher the horticultural community massively.

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