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TRANSFORMING FARMERS AND FARMING BY ARTIFICIAL INTELLIGENCE IN AGRICULTURAL ENVIRONMENT

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Abstract– The agricultural industry contributes significantly to the economy. The primary issue and a hot topic globally is the automation of agriculture. The population is growing rapidly, and this growth is also increasing the demand for food and jobs. Farmers have been employing traditional methods but were insufficient to meet these demands. New automated techniques were consequently introduced. These innovative techniques supplied the world's food needs while simultaneously giving billions of people access to jobs. Agriculture has undergone a revolution thanks to artificial intelligence. The agricultural output has been shielded by this technique from a number of circumstances, including population expansion, job issues, and food security concerns. Recently, the agriculture industry is witnessing the application of artificial intelligence (AI). To increase production, the industry must overcome a number of obstacles, including poor soil management, insect and disease infestation, the need for large amounts of data, low output, and a knowledge gap between farmers and technology. The major ideas behind AI in agriculture are its adaptability, excellence, accuracy, and economy. This essay provides an overview of the ways artificial intelligence has been applied to managing weeds, diseases, crops, and soil. The application's advantages and disadvantages are highlighted and also how to use expert systems to increase productivity.

INTRODUCTION

The world's population is projected to reach close to 10 billion in 2050, which will result in an increase in agricultural production of up to 50% compared to 2013 despite the world's modest economic development (FAO, 2017). Currently, crop production occupies around 37.7% of the earth's surface. Agriculture plays a significant role in both job creation and national income. In addition to making a significant contribution to the economic success of industrialized countries, it is also actively involved in the economies of emerging countries. The rural community's per-capita income has significantly increased as a result of the expansion of agriculture. Therefore, giving the agriculture sector more attention will be sensible and appropriate.In nations like India, the agricultural industry contributes 18% of the country's GDP and employs 50% of the labour force. Agricultural sector growth will accelerate rural development, resulting in further rural transformation and ultimately structural transformation (Mogili and Deepak, 2018; Shah *et al.,* 2019). Many sectors around the world have seen a significant transition as a result of technology (Kakkad *et al*., 2019). Surprisingly, despite being the least digitalized sector, the research and commercialization of agricultural technology have gathered steam. With the power to expand our perceptions and change the environment around us, artificial intelligence (AI) has started to play a significant part in daily life (Kundalia *et al.,* 2020; Gandhi *et al*., 2020; Ahir *et al*., 2020). Plessen (2019) provided a system for harvest planning that is based on the pre- sensation of crop assignment and vehicle routing. The workforce, which was formerly restricted to just a few industrial sectors, is now contributing to a variety of industries thanks to these rising technologies. Artificial intelligence is built on a wide range of

fields, including biology, linguistics, computer science, mathematics, psychology, and engineering. Jha *et al.* (2019) provide a succinct review of how agricultural automation is currently being used. The paper also discusses a system that has been developed for use in the botanical farm to identify flowers and leaves and irrigate them using IOT (Patel *et al.,* 2020; Albaji *et al.,* 2010). The fundamental idea behind AI is to create technology that works similarly to the human brain (Parekh et al., 2020; Jani *et al.,* 2019).These software programs get training data, and like the human brain, these clever machines then give us the desired outcome for every legitimate input.The core of AI encompasses a wide range of fields, including machine learning and deep learning (Patel *et al*., 2020a, 2020b; Pandya *et al.,* 2019; Sukhadia *et al*., 2020). While DL is the learning of deep neural networks, ML is the ability to learn something without being explicitly programmed (Kodali and Sahu, 2016; Kulkarni and Deshmukh, 2013), and AI is the study of creating intelligent machines and programmes. AI's primary goal is to simplify problem solving, which may involve using ANN (Shah *et al.,* 2020a, 2020b).Agriculture is one industry where AI is still a developing technology. A new level has been reached in today's agriculture sector thanks to AI-based machinery and equipment. The most recent automated systems, which include drones and agricultural robots, have greatly benefited the agriculture-based industry. In order to identify crucial factors like weed detection, yield detection, crop quality, and many other ways, various high-tech computer-based systems are used (Liakos *et al*., 2018). The technologies utilized for automated irrigation, weeding, and spraying to increase productivity and lighten the workload of farmers are covered in this study. There is a discussion of various automated soil sensing methods (Wall and King, 2004). Temperature and moisture sensors were combined by Hemalatha and Sujatha (2015) to plug the gaps in the vehicle forecasts. The location of the sensing robots was tracked using Google Maps after they were localized by GPS modules. The Zigbee wireless protocol was used to retrieve the robots' data. The 16 x 2 LCD display, which was integrated with the LPC2148 microcontroller, showed the readings.

Impact of AI on Agriculture

The technologies that are based on artificial intelligence (AI) help to increase efficiency in all fields and manage the challenges faced by various industries, including the various fields in the agricultural sector, such as crop yield, irrigation, soil content sensing, crop monitoring, weeding, and crop establishment (Kim *et al.,* 2008). In order to supply high-value AI applications in the aforementioned industry, agricultural robots are constructed. The agriculture industry is in trouble as a result of the rising global population, but AI has the ability to provide a critical remedy. AI-based technical advancements have allowed farmers to increase output while using less input, improve output quality, and ensure a quicker go-to-market for the produced crops. Farmers will use 75 million linked devices by 2020. The typical farm is anticipated to produce an average of 4.1 million data points per day by 2050. Artificial intelligence (AI) is increasingly being applied to agriculture, with the potential to revolutionize the industry by improving efficiency, productivity, and sustainability. Here are some examples of how AI is being used in agriculture.

Utility of Robots in Farming

Large economic sectors with poor productivity, including agri-food, are introducing robotics and autonomous systems (RAS). This technology's primary goal is to replace human labor and provide tangible advantages for both small- and large-scale productions (Manivannan and Priyadharshini, 2016). The availability of robotic technologies in this industry has significantly increased productivity (Pedersen *et al.,* 2008).The employment of a computer-controlled mobile-focused infrared light beam to destroy the weeds' cell walls has replaced the manual weeding procedure known as laser weeding (Griepentrog *et al.,* 2006).

Applications of Drones in Farming

Drones are being used in agriculture for weed detection, cattle and animal monitoring, crop health monitoring, disaster management, and monitoring irrigation equipment (Veroustraete, 2015; Ahirwar *et al.,* 2019; Natu and Kulkarni, 2016). Agriculture is being significantly impacted by remote sensing, which makes use of UAVs for picture collecting, processing, and analysis by Abdullahi *et al*. (2015). Pederi and Cheporniuk (2015), the rural sector appears to have embraced technological innovation with great enthusiasm, using these powered tools to alter traditional agricultural practices.

Monitoring of Soil, Land, and Crop Yield

Crop health and both the amount and quality of the yield depend heavily on the micro- and macronutrients in the soil. Once crops are planted, it is also crucial to keep track of their growth stages in order to maximize production efficiency. Understanding how crop growth and the environment interact will help you make changes for better crop health. Now, historically, human observation and judgment were used to assess soil quality and crop health. This approach, however, is neither precise nor timely. In its place, we may now employ unmanned aerial vehicles (UAVs) to collect aerial picture data and train computer vision models to use for intelligent crop and soil condition monitoring. It can anticipate yield accurately, monitor crop health, and identify crop malnutrition much more quickly than people. AI can analyze data from drones, satellites, and other sensors to provide farmers with detailed information on crop health, soil moisture, and weather conditions. This helps farmers make informed decisions about when to plant, irrigate, and harvest their crops, as well as identify potential problems before they become serious.

Returning to the significance of soil, different research examined the accuracy with which soil texture and soil organic matter (SOM) can be described by computer vision. Farmers often have to collect soil samples from the ground and transport them to a lab for labor and energy-intensive examination. Instead, researchers chose to investigate whether they could train an algorithm to perform the same task using picture data from a low-cost portable microscope. Indeed, the computer vision model was able to produce estimations of sand content and SOM that were as accurate as costly lab processing. AI can be used to create detailed maps of farms, which can be used to optimize planting, fertilization, and irrigation practices. By identifying areas of the field with different soil types, moisture levels, and nutrient needs, farmers can apply inputs more precisely and reduce waste. Therefore, not only can computer vision eliminate a significant portion of the labor-intensive, manual work needed in crop and soil monitoring, it often does it more efficiently than people.

Detection of pests and plant Diseases

In present days AI computer vision can identify and evaluate crop maturity and soil quality. We can now automatically identify plant illnesses and pests using picture recognition technology based on deep learning. To create models that can "keep an eye" on plant health, this technique uses picture categorization, detection, and segmentation techniques. Farmers can readily learn about illnesses thanks to AI forecasts. They can quickly and effectively detect illnesses with the use of this. Plants' lives and farmers' time may be saved (Abawi and Widmer, 2000). In order to do this, initially, computer vision technology is used to pre-process photos of plants. By doing this, it is made sure that plant photos of damaged and healthy portions are appropriately separated. Following discovery, the affected area is removed and sent to the laboratory for additional diagnosis. Additionally, this method aids in the identification of pests, vitamin deficiencies, and many other issues.AI can analyze data from sensors, cameras, and other sources to detect pests and diseases in crops, allowing farmers to respond quickly and reduce the use of pesticides and other chemicals.

Monitoring of Animal culture, raising and rearing

Animals are an important part of contemporary farming systems. Animals need a little bit more watchfulness than plants need. Can computer vision follow moving pigs, cows, and chickens? It goes without saying that if it can track a fly, it can also track a cow. It is possible to count animals, find illnesses, spot odd behavior, and keep an eye on significant occasions like childbirth. collecting information with cameras and UAVs. Utilize many technologies to inform farmers on animal health, food, and water availability, and other relevant information. In addition, it looks to see if they're eating, sleeping, or acting in a way that would indicate a medical condition or behavioral problems.

Benefits of Artificial Intelligence Technology in the Agriculture Sector

Better decision-making is made possible by AI

The agriculture sector truly benefits from predictive analytics. It assists farmers in overcoming the major difficulties they face in farming, including evaluating market demands, predicting prices, and determining the best window of time to plant and harvest a crop. Furthermore, AI-powered equipment can assess the health of the soil and the crops, suggest fertilizer applications, track the weather (Aubry *et al*., 1998), and assess crop quality. All of

these advantages of AI in agriculture help farmers make wiser decisions and practice effective farming.

AI helps with the workforce deficit

The agriculture sector has long struggled with a workforce deficit. This problem of farming automation can be resolved by AI. Farmers can complete tasks without adding additional workers thanks to AI and automation. Some examples are driverless tractors, intelligent irrigation and fertilizing systems, smart spraying, vertical farming software, and AI-based harvesting robots. When compared to human agricultural workers, AI-powered machinery and equipment are significantly faster and more precise (Mowforth *et al*., 1987).

Costs can be reduced with AI

Farmers may grow more crops with fewer resources and costs when they practice precision farming using AI-enabled machinery. Farmer decision-making at every level of the farming process is made possible by real-time information provided by AI. Fewer products and chemicals are lost, and time and money are used more effectively, thanks to this wise choice. The farmers can also use it to pinpoint the precise regions that require pesticide application, fertilization, and irrigation, which reduces the number of chemicals they use on the crop. These factors add up to less herbicide usage, greater crop quality, and higher profit margins while using fewer resources.

Difficulties in Acceptance of AI in Agriculture

The use of AI in farming may seem like a natural next step for every farmer after learning about its benefits for sustainable farming. Everyone is aware of a few major obstacles that remain, namely the following ones:

Inadequate familiarity with cutting-edge technology

For underdeveloped nations, using AI and cutting-edge technology in agriculture might be difficult. Selling these solutions in regions without existing agriculture technology will be exceedingly challenging. Farmers in these regions require assistance from someone in order to apply this technology.

Questions of assurance

It may pose a number of legal difficulties because there are currently unclear rules and guidelines for deploying AI. Additional privacy and security risks, such as cyberattacks and data breaches, may arise as a result of the usage of software and the internet. For farm owners or farmers, any of these difficulties might lead to serious problems.

Inconsistency of AI-powered robots

Despite the fact that using AI in agriculture has many advantages, most of the world's population is still unaware of the existence of systems and tools that are AI-enabled. AI firms should provide farmers with the fundamental tools they need to handle the problems, and then when they've become used to them, give them more sophisticated equipment.

CONCLUSION

With the use of artificial intelligence, farmers may automate their operations while also switching to precision cultivation for improved crop quality and production while consuming fewer resources. Companies working to advance machine learning or AI-based goods and services, such as training data for agriculture, drones, and automated manufacturing, will benefit from future technological advancements that will bring more beneficial applications to this industry, assisting the world in addressing issues related to food production for the expanding population.Another important development in this area is the expanding and more accessible availability of computer vision. AI has the potential to improve 21st-century agriculture by enhancing the efficiency of time, labour, and resources in light of the significant changes taking place in our climate, environment, and global food demands. environmental sustainability improvement enhancing resource allocation. Real-time monitoring is offered to improve the quality and health of food. Naturally, this will need certain changes in the agriculture sector. Increased technological and educational efforts within the agriculture industry will be necessary to transfer farmers' knowledge of their "field" into AI training.

However, agriculture has long practiced innovation and adaptability. The most recent innovations in farming include computer vision and agricultural robots. The adoption of AI technologies will have a significant impact on the future of AI in agriculture. The agricultural business is underdeveloped despite the fact that some extensive

research is ongoing and certain applications are now available. In addition, developing predictive solutions to address a genuine problem encountered by farmers in farming is still in its beginning stages.

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