International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 13 Issue 5, May-2024, Impact Factor: 8.375

Artificial Intelligence in Agriculture

Priyanka[1], Mr. Ankush Goyal[2]

[1]M.Tech Scholar, Satya College of Engineering & Technology Palwal, Haryana, India
[2]Associate Professor, Satya College of Engineering & Technology Palwal, Haryana, India

ABSTRACT

The agricultural industry contributes significantly to the economy. The primary issue and newly-emerging topic worldwide is agriculture automation. The primary worry and a hot topic globally is the automation of agriculture. The population is growing rapidly, and along with it, so are the need for food and work. Farmers have been employing traditional methods, but they 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. A revolution in agriculture has been sparked by 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. This paper's primary goal is to examine the many uses. The primary goal of this study is to evaluate the numerous ways artificial intelligence is being used in agriculture, including irrigation, weeding, and spraying with the use of sensors and other tools built into drones and robots. These technologies reduce the overuse of water, pesticides, and herbicides, preserve soil fertility, assist in the effective use of labour, increase output, and enhance product quality. In order to provide a brief overview of how automation is now being used in agriculture, including weeding systems using robots and drones, this study analyses the work of numerous researchers. Two automated weeding approaches are covered together with the various soil water sensing techniques. In this study, the use of drones is discussed, as well as the numerous ways they might be utilized for crop monitoring and spraying.

INTRODUCTION

By 2050, the world's population is projected to be close to 10 billion, which will result in an increase in agricultural production of up to 50% compared to 2013 despite modest economic growth (FAO, 2017). Currently, 37.7% of the earth's surface is dedicated to growing crops. Agriculture has a significant role in the nation's economy and in creating jobs. It makes a substantial contribution to the economic success of industrialised countries and actively influences the economies of developing nations as well. The per-capita income of the rural population has significantly increased as a result of the expansion of agriculture. Therefore, it will be sensible and appropriate to give the agriculture sector more attention. In nations like India, the agricultural industry contributes 18% of the country's GDP and employs 50% of the workforce. Rural development will be boosted by agricultural sector development, which will then lead to rural transformation and ultimately structural transformation (Mogili and Deepak, 2018; Shah et al., 2019) [1].

AI is an emerging technology in the field of agriculture. AI-based equipment and machines, has taken today's agriculture system to a different level. This technology has enhanced crop production and improved real-time monitoring, harvesting, processing and marketing (Yanh et al., 2007)[2]. The latest technologies of automated systems using agricultural robots and drones have made a tremendous contribution in the agro-based sector. Various hi-tech computer based systems are designed to determine various important parameters like weed detection, yield detection and crop quality and many other techniques (Liakos et al., 2018) [3]. This paper encompasses the technologies used for the automated irrigation, weeding and spraying to enhance the productivity and reduce the work load on the farmers. Various automated soil sensing techniques are discussed (Wall and King, 2004). Hemalatha and Sujatha (2015) [4] brought together temperature and moisture sensors to close the loop holes of the vehicle predictions. The robots used in sensing were localized by GPS modules and the location of these robots was tracked using the google maps. The data from the robots was fetched through Zigbee wireless protocol.

AI's effects on agriculture

The use of AI-based technologies helps to increase productivity across all industries, including the agricultural sector, by addressing issues with crop yield, irrigation, soil content sensing, crop monitoring, weeding, and crop establishment (Kim et al., 2008)[5]. 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. By 2020, farmers will be

using 75 million connected devices. By 2050, the average farm is expected to generate an average of 4.1 million data points every day.

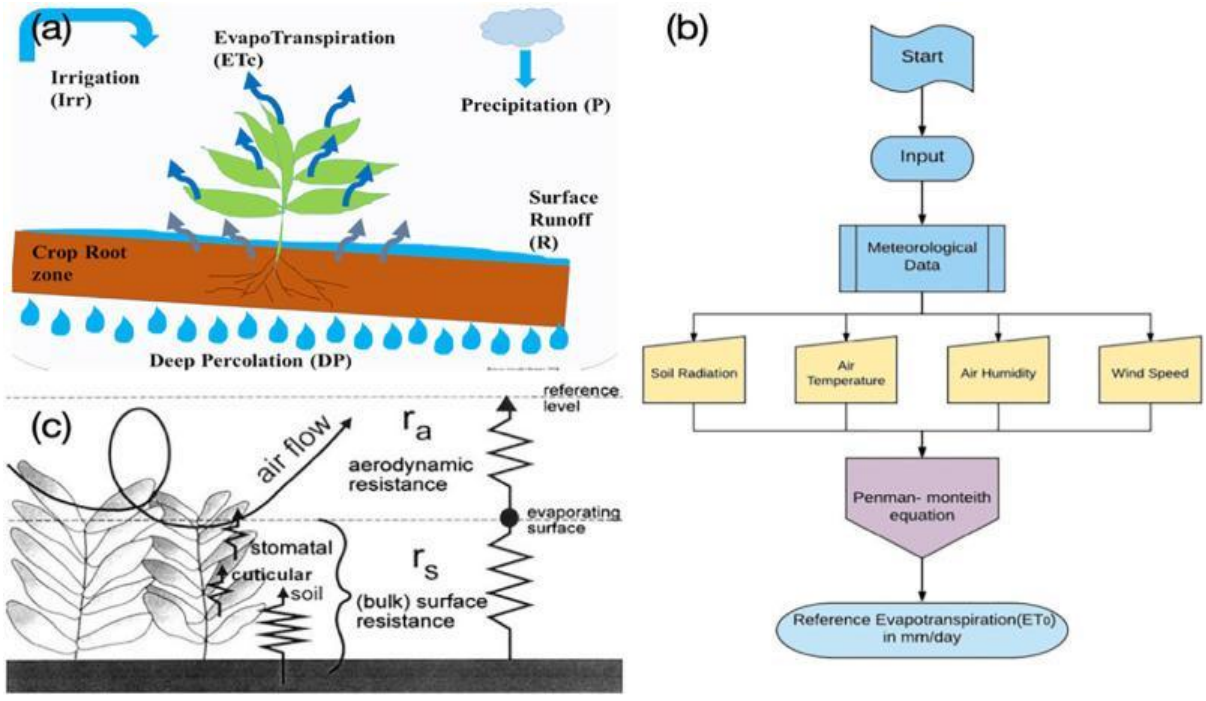
ROBOTS IN AGRICULTURE

Robotics and Autonomous Systems (RAS) are introduced in large sectors of the economy with relatively low productivity such as Agri-Food. According to UK-RAS White papers (2018) [6] the UK Agri-Food chain, from primary farming through to retail, generates over £108bn p.a., and with 3.7 m employees in a truly international industry yielding £20bn of exports in 2016. The production and management of agriculture have benefited greatly from robotic involvement. Because traditional farming machinery was inefficient, researchers have recently focused on developing autonomous agricultural instruments (Dursun and Ozden, 2011) [7]. This technology was developed primarily with the intention of replacing human labor and generating benefits on both small and big industrial scales (Manivannan and Priyadharshini, 2016) [8]. The use of robotic technologies in this industry has greatly increased production. The autonomous robots are carrying out a range of agricultural tasks, including irrigation, weeding, protecting farms to ensure efficient reporting, preventing production loss due to unfavorable environmental conditions, improving accuracy, and managing individual plants in novel ways.

Infusion of water

Around the world, 85% of the freshwater resources are used by the agricultural sector. And as the population grows and food consumption rises, this percentage is rising quickly. As a result, we must develop more effective solutions to guarantee the efficient use of water resources for irrigation. Automatic irrigation scheduling methods have taken the role of manual watering that was dependent on soil water measurement. While implementing autonomous irrigation machines, it was taken into account that plant evapotranspiration was dependent on a number of atmospheric variables, including humidity, wind speed, solar radiation, and even crop factors, such as crop stage, plant density, soil characteristics, and pest.

Soil moisture sensors use one of the several technologies used to measure the soil moisture content. It is buried near the root zones of the crops (Dukes et al., 2009)[9]. The sensors help in accurately determining the moisture level and transmit this reading to the controller for irrigation. Soil moisture sensors also help in significantly conserving water (Quails et al., 2001) [10] . One technique of moisture sensors is the water on demand irrigation in which we set the threshold according to the soil's field capacity and these sensors permits your controller to water only when required. When the scheduled time arrives, the sensor reads the moisture content or level for that particular zone, and watering will be allowed in that zone only if the moisture content is below the threshold. The other was the suspended cycle irrigation which requires irrigation duration unlike the water on demand irrigation. It requires the start time and the duration for each zone (Yong et al., 2018)[11].



(Fig. 1).Therefore, moisture sensors and microcontrollers can be used to automate the watering process.

REVIEW OF LITERATURE

The lack of an irrigation system, temperature changes, the density of the groundwater, food scarcity and waste, among other serious challenges, have been faced by agriculture. The acceptance of diverse cognitive strategies greatly influences how farming will turn out. The industry is currently severely underserved even though large-scale research is still ongoing and some applications are now on the market (Shobila and Mood, 2014) [12]. Agriculture is still in its infancy when it comes to dealing with the genuine difficulties encountered by farmers and adopting autonomous decision-making and predictive solutions to tackle them. Applications need to be more resilient in order to fully exploit the great potential of AI in agriculture (Slaughter et al., 2008) [13]. It won't be able to manage frequent adjustments . Only then will it be able to handle rapid changes in the environment, support real-time decision-making, and utilise an appropriate framework or platform for effectively gathering contextual data. The outrageous price of the many cognitive farming options on the market is another crucial factor. To ensure that the technology is accessible to everyone, the solutions must become more cost-effective. An open source platform would reduce the cost of the solutions, causing them to be adopted more quickly and to reach more farmers. The technology will be helpful in assisting farmers in having a better seasonal harvest at regular intervals and a high yield. Farmers in many nations, including India, rely on the monsoon for their crop production. For rain-fed agriculture, they mostly rely on forecasts from several departments regarding the weather.

The application of AI in forecasting the weather and other aspects of agriculture, such as soil quality, groundwater, crop cycles, and pest attacks, will be beneficial. The majority of the farmers' worries will be alleviated by accurate projection or forecast made with the aid of AI technology. AI-driven sensors are incredibly helpful for capturing crucial information about agriculture. The information will help increase output. There is a lot of potential for these sensors in agriculture. Scientists working in agriculture can gather information about the soil's quality, the weather, the level of the groundwater, and other factors that will help to advance crop production. Robotic harvesting equipment can also be equipped with AI-enabled sensors to collect data. AI-based advisories are thought to be effective for boosting production by 30%. Crop damage caused by calamities of any type, including pest infestations, is the main obstacle to farming. Image identification powered by AI will be helpful in this area. Drones are being used by many businesses to monitor production and spot pest assaults of any kind. The fact that such efforts have frequently been successful inspires the creation of a system to watch over and safeguard crops.

The yellow blossom of a tomato seedling is enclose by an automated lens. An artificial intelligence programme receives images from the plant and calculates the exact amount of time it will take for the flower to mature into a ripe tomato that is suitable for picking, packing, and display in the produce section of a supermarket. A 20-year-old company called NatureFresh Farms, which cultivates veggies on 185 acres between Ontario and Ohio, is developing and researching the technique. Knowing exactly how many tomatoes will be available to sell in the future makes the job of the sales team easier and directly benefits the bottom line, said Keith Bradley, IT Manager for Nature Fresh Farms.

It's only one instance of how AI is changing agriculture, a new development that will contribute to an agricultural revolution. Artificial intelligence (AI) can assist humanity in overcoming one of its greatest challenges: feeding an additional 2 billion people by 2050, despite climate change disrupting growing seasons, turning arable land into deserts, and inundating once-fertile deltas with seawater. AI can do this by detecting pests and predicting which crops will yield the best returns. By the middle of the century, the United Nations predicts that we will need to raise food production by 50%. Between 1960 and 2015, agricultural output tripled as the global population increased from 3 billion to 7 billion. While technology—in the form of herbicides, fertilisers, and machinery—played a part, the majority of the benefits may be credited to forests and diverting fresh water to fields, orchards, and rice paddies. This time, we will need to be more creative.

CONCLUSION

The lack of efficient irrigation systems, weeds, difficulties with plant monitoring owing to crop height, and harsh weather conditions are only a few of the difficulties the agricultural sector encounters. But with the help of technology, performance may be improved and these issues can be resolved. It can be improved with a variety of AI-driven strategies, such as automatic watering using GPS and remote sensors to determine soil moisture content. Farmers had the issue that precision weeding techniques outweighed the substantial number of crops lost throughout the weeding procedure. These autonomous machines not only increase productivity but also lessen the demand for pointless pesticides and herbicides. In addition, drones enable farmers to spray pesticides and herbicides efficiently on their land, and plant monitoring is no longer a bother. With the use of man-made brain power, resource and employment shortages can first be comprehended in terms of agribusiness difficulties. For agricultural parameters including plant height, soil texture, and content, traditional methods needed a significant amount of labour, which resulted in repetitive manual testing. Quick and non-destructive high throughput phenotyping with the benefit of flexible and favourable activity, on-demand information access, and spatial goals would be possible with the aid of the various systems evaluated.

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