



AI Solutions for Sustainable Agriculture Enhancement

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ABSTRACT:

Agriculture currently faces many serious problems. According to the World Bank, the global population is projected to reach 9 billion people by 2050, and the demand for agricultural products is expected to grow by 70%. It must be acknowledged that our economy is also dependent on agriculture, just as about 58% of India's population relies on agriculture for their livelihood. Agriculture accounts for 17 percent of India's Gross Domestic Product (GDP), employs more than 60 percent of India's total workforce, and contributes to the country's economic growth. Indian agriculture has achieved great success in the last few decades. It is believed that technology can solve some agricultural problems, and within the next 50 years, intelligent workers are expected to replace humans and usher in a new era of human evolution. In this article, we look at how AI is changing many aspects of the agriculture industry and explore the AI-driven challenges and strategies that will shape the future of agriculture.

Keywords: agriculture, artificial intelligence, robotics, IoT, and drones.

Introduction :

Agriculture is changing thanks to artificial intelligence (AI), which is changing the way farmers run their businesses and grow their crops. AI that can analyze big data and predict future outcomes has the potential to improve agricultural performance, productivity, and sustainability.

Artificial intelligence has many applications in agriculture, including crop monitoring, yield prediction, optimization, waste reduction, and development. Take it all in on agricultural sustainability. To predict future agricultural yields, AI algorithms can analyze data from multiple sources, such as weather conditions, moisture levels, and crop yields. With this knowledge, farmers can better manage their crops, allocate their resources, and identify issues early.

Also, intelligence can be used to monitor crops and detect pests and diseases. By analyzing images of crops and detecting signs of disease or damage, AI algorithms can help farmers respond quickly and effectively to threats to their crops.

Crop Monitoring :

The daily process of maintaining crop health is laborious and time-consuming. Using artificial intelligence to monitor and identify plant health problems or nutrient deficiencies in soil has proven to be an effective method. With the help of deep learning, applications are being created to analyze the health status of plants in agriculture. These intelligence applications play an important role in improving our understanding of plant diseases, pests, and soil health. Agriculture thrives on the health of the soil, which is the primary source of nutrients for growing crops.

Disease Detection :

Disease control plays an important role in increasing agricultural productivity. Both plants and animals have resistance to diseases that can affect the entire production. Genetics, soil type, climate, etc. can cause diseases. Controlling the effects of these diseases is particularly difficult, especially in large-scale agriculture, due to the scarcity of their causes. Plant diseases pose a major risk to the environment, economy, and food supply. Early detection of plant diseases is important for effective disease management.

Mobile devices such as smartphones equipped with artificial intelligence-based image recognition systems can accurately detect crop diseases in the

field. By analyzing the shape of the leaves, this system can distinguish between the background, the affected area and the unaffected area. If an area is found to be unhealthy or infected, action can be taken, such as using plant protection or identifying food shortages. The completion of the process is shown in Figure 3.1.

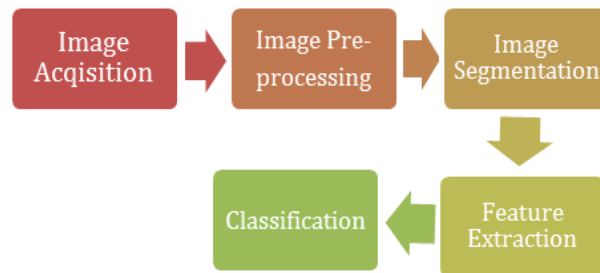


Fig. 3.1. Phases of a Plant Disease System

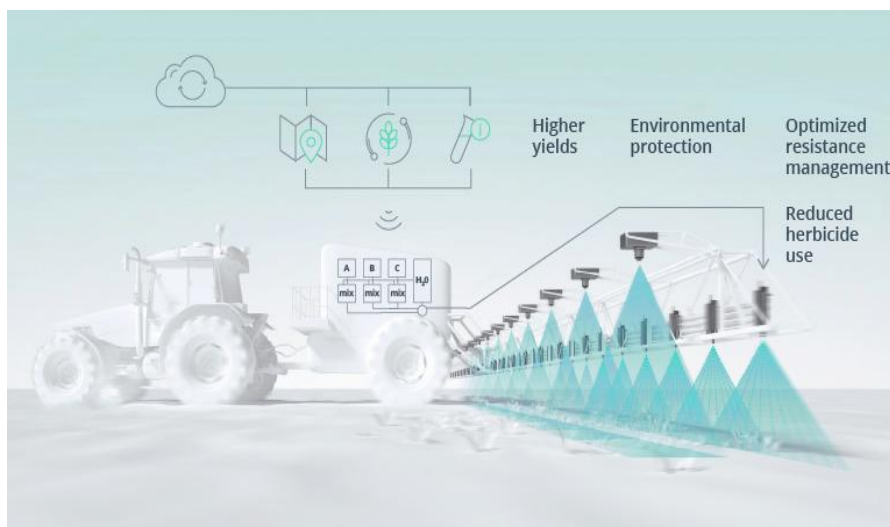
Predictive Analytics :

Changes in agricultural commodity prices can negatively impact a country's GDP. Not only does this affect farmers' hard work emotionally and financially, but it also creates barriers to all agricultural products. However, by leveraging price forecasts through predictive analytics, agricultural products can be managed effectively and the risk of price fluctuation can be reduced. This is especially important as weather becomes unpredictable and global warming continues to reduce crop yields. Remote sensing has proven to be an important tool for predicting yields and yields in specific regions. Additionally, estimating the yield potential of crops under certain conditions can provide additional assistance. The development of AI-based analytics benefits farmers because it allows more harvests with fewer inputs, while also saving resources such as land, air, and water.

Intelligent Spraying :

The use of nutrients and pesticides in agriculture is an important but risky part of the production process. But there are ways to reduce the negative impact on the environment, make the drug more effective, reduce operational risks and reduce costs. One effective way is to use different spray applications and smart management. This technology can reduce pesticide use and prevent environmental conflicts. With the use of rapidly changing electronic equipment, pesticides can be used efficiently and effectively.

To achieve this goal, machine vision algorithms are used to classify plants by crops or by their characteristics. When herbs are mixed, a sorting method is needed. Plants that grow on insects are considered plants. The first step involves separating plant pixels from the background using an adaptive tool that can withstand changes in lighting and plant type. Crops and vegetation are then distinguished by analyzing the wavelet features of the image. Finally, direct the insecticide spray directly at the target location of the plant.



5.1 Source: Bosch — Smart spraying for precise herbicide application

Advanced computer vision and data analysis underlie spray selection in agriculture. This technology allows sprayers to process data, helping them identify different types of leaves and plants (Figure 5.1).

Crop Yield Prediction Using Machine Learning :

Crop forecasting has played an important role in facilitating timely decision-making by policymakers at national and regional levels (e.g. at EU level). By using accurate crop forecasting models, farmers can make informed choices about what to plant and when to plant it. There are many methods used to predict crops, and Microsoft is using its Cortana suite of intelligence, including Power BI and machine learning, to provide agricultural advice to farmers in the Indian state of Andhra Pradesh.

Working with ICRISAT, Microsoft has developed an artificial intelligence application that uses the capabilities of the Microsoft Cortana Intelligence Suite, including Power BI and machine learning. The app provides participating farmers with valuable advice on the best time to rest their crops. What is the best part of this app? All they need is a simple phone with messaging capability, as shown in Figure 6.1.



Fig.6.1: Receiving text messages

Machine learning (ML) technology is used in many different industries, from supermarkets analyzing consumer behavior to companies predicting smartphone usage patterns. Agriculture has long embraced machine learning, especially in precision agriculture, where crop prediction is a major challenge. Many models have been proposed and successfully tested to solve this problem. However, since many factors affect crop yield, such as weather, climate, soil conditions, fertilizer and seed use, the prediction process needs to be drawn on many data sets. This demonstrates the difficulty of predicting crop yield and highlights the need for more complex steps.

Although the current crop forecasting model can predict the actual yield, improvements can still be made in the forecast. United Phosphorus Limited and Microsoft are collaborating to create an application programming interface (API) for pest prediction. This innovative solution uses machine learning and artificial intelligence (AI) to predict potential pests. The frequency of the disease will vary depending on the climate and nature of the crop and will be classified as high, medium or low.

Precision Farming :

Precision farming is an agricultural management system that uses technologies such as GPS and remote sensing to improve crop quality and reduce waste. To make well-informed decisions on crop growth, fertilization, and harvesting, data must be carefully gathered, evaluated, and utilized.

Productivity and efficiency are critical components of precision agriculture. Farmers may determine the ideal time to plant, fertilize, and irrigate their crops by employing technology to gather data on crop health, soil composition, and weather patterns. This lowers waste, boosts output, and safeguards priceless goods.

Precision agriculture also plays an important role in supporting growth. By using technology, farmers can manage their resources effectively and thus reduce their impact on the environment. By using less pesticides and fertilizers, farmers may lower their risk of polluting their land and water thanks to

precision farming technologies. Additionally, the integration of precision agriculture with connected devices and electronics as part of the Internet of Things (IoT) can bring many benefits, such as increasing profits, saving resources, and ensuring food safety and quality. This combination has the potential to revolutionize crop growing and management practices.

In summary, precision agriculture holds great promise as a method that can revolutionize agriculture, helping farmers produce more food while reducing the negative impact on the environment.



Fig. 7.1:a solar-powered irrigation sprinkler used in precision farming. Photo: Getty Images

Deployed by the Internet of Things (IoT)

With real-time data and insights about crops and livestock available to farmers, the Internet of Things is transforming the agricultural industry. Farmers may monitor a variety of factors, including soil moisture, crop health, and weather, by using IoT-enabled devices like sensors, drones, and smart irrigation systems. This enables them to decide more intelligently and enhance operations.

Increasing production and efficiency in agriculture is one of the key advantages of IoT. Farmers may save waste, protect resources, and determine whether to irrigate their crops by routinely monitoring the soil. Furthermore, farmers can inspect crops with drones fitted with Internet of Things (IoT) technology, which enables them to promptly and efficiently address issues like pests and illnesses in situations where food is scarce.

Another important aspect of IoT in agriculture is improving food safety and quality. By tracking the entire food supply chain, IoT devices can provide consumers with accurate information about the origin and quality of the food they eat. This not only helps reduce food waste but also ensures food safety.

The development of agricultural IoT has the potential to transform the way we grow and manage food. It increases yield, saves resources and ensures food safety and quality. As technology continues to evolve, IoT applications in agriculture are expected to become more innovative and up-to-date.

Drones In Agriculture :

Drones are used in agriculture to enhance and improve many activities such as crop management, pesticides, soil analysis and mapping. Agriculture is important and drone use is important. Drones equipped with sensors and cameras are used for photography, mapping and agricultural monitoring. They have ground and ground drones. Land-based drones, also known as mobile robots, are used to survey fields. Known by most as aerial drones, unmanned aerial vehicles (UAVs) or unmanned aerial systems (UAS), are flying robots. Thanks to software that controls flight planning and coordination with sensors and GPS in embedded systems, drones can operate remotely or fly autonomously. Data collected by drones can provide insight into crop health, irrigation, pesticides, crop management, soil and landscape, plant numbers, yield estimation, and many other factors (Figure 9.1). Drones can be purchased and deployed near farms for easy access and maintenance, or arranged as a service for use in agricultural research. Once the evaluation is complete, the drones need to be transported to a nearby laboratory for evaluation to make the most of the Internet of Things in agriculture.



Fig. 9.1: Drones In Agriculture

Challenges That Slowed Down Adopting Of Ai In Agriculture :

A major effort towards skills adoption in agriculture must take into account the real problems that prevent the economy from growing as fast as others. Although the structure of technology in agriculture is changing rapidly, we first need to understand its origins and current situation in order to predict the future.

I Data Collections :

Despite the progress made in precision agriculture over the past three years, two major obstacles remain to the widespread use of educational forecasting in this field. First of all, not enough producers and farmers have adopted agricultural techniques and there are many studies and reasons for this.

Technology does not need to collect all the necessary information from the Internet of Things or other means to be predictable. Other pipes.



Fig. 10.1.1: AI collects information from a variety of sources.

AI systems need a lot of data to be trained, which helps their algorithms make accurate and predictive decisions. When the agricultural area is large, it is easy to collect spatial data, but it is more difficult to collect temporal data (Figure 10.1.1).

II. Data Ownership and Privacy

Who owns the data in the agricultural sector? The answer to this question is more difficult than you think. Farmers, greenhouse managers, growers, agronomists, etc. producers are independent and have access to information, but that's not all the stories. Homeowners have access to some important information, but much other important information is not readily available, including satellite data or the environmental history of the area, unless

people pay for access and receive training. place. Farmers, in particular, do not have access to environmental and satellite data that scientists and experts can easily collect and link.

III. Cost of Change in Agriculture for AI

Agriculture is one of the sectors with high variable costs. This pricing model is quite unique compared to some industries that welcome talent with open arms. If Uber launches an email campaign based on recommendations from its data research team and finds after a few days that it doesn't meet expectations, it can immediately stop or modify the campaign. Another important factor is the high value of agricultural information in the economy. To ensure that this technology reaches the agricultural society, artificial intelligence solutions need to be more efficient. If AI solutions are made available on an open platform, this will make the solutions cheaper and ultimately lead to faster adoption and deeper understanding of farmers.

Conclusion :

An overview of how artificial intelligence can power many elements of agriculture is provided in the current article. It also looks at the ideas and difficulties that AI might bring about in the future. Technology can boost productivity and provide solutions to issues in agriculture. In agriculture, artificial intelligence and the Internet of Things are crucial. The growth of agriculture has the potential to raise the GDP of the nation and provide for the 9 billion people on the planet by 2050. Artificial intelligence and other such technologies can handle crop management and anticipate disease detection, safeguarding farmers' earnings. Agriculture could undergo a revolution thanks to machine learning and artificial intelligence. This article explains issues in agriculture and how to fix them.

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