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APPLICATION OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN AGRICULTURE

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Introduction

Artificial intelligence and machine learning play a significant role in the development of agriculture. Artificial Intelligence generally called as the AI, is a kind of ideology designed to perform tasks just as how a human mind thinks and does whereas machine learning is something where the data are just applied for the machine to carry out its work just without programming it explicitly. Artificial intelligence is a branch of computer science that explains how it mimics human mind. The idea of modern artificial intelligence was designed by John McCarthy.

Artificial intelligence is distinguished into three types

Artificial Narrow Intelligence – relates to machine intelligence that exceeds human intelligence for a particular domain. Examples include playing games such as chess, self-driven cars.

Artificial General Intelligence – this system is just as smart as human brain and can perform the same intellectual activities like human.

Artificial Super Intelligence – this system refers to intelligence that greatly exceeds the cognitive performance of humans.

As we already know, India is an agricultural country and most of the people are engaged in agricultural activities for their pay. All farmers are always in the motive to get high quality and good yield crops. In this way artificial intelligence being a good planner just as human minds can help the farmers attain all they want. Factors such as temperature, light, humidity, soil fertility, soil porosity, water availability etc always affect the yield of the plants. For the accurate detection of these factors artificial intelligence so called AI can be used.

Where are AI and ML Used in Agriculture?

In present days with the developing technology and facilities, AI and ML are being used everywhere in every field especially in agriculture. Some of the main managing activities that AI performs are;

1. Soil and water management
2. Identifying and management of pest and diseases
3. General crop management
4. Agricultural produce monitoring and storage control
5. Weed management

Soil and Water Management: AI identifies and predicts the climate as well as weather to determine the amount of water that must be supplied in order to produce the maximum productivity. These AI systems optimize irrigation schedule based on the real time data and ensure that the water that is available can be used throughout the agricultural practices. These AI systems also have certain challenges such as data privacy, ethical considerations etc. By tackling these challenges and leveraging AI's full potential we can significantly improve water management in agriculture and enhance the global water security. On the other hand, for the management of the soil, AI provide the precise level of pesticides and fertilizers that can be used for the given type of soil. One of the examples of an AI driven radar developed by the Worcester polytechnic institute to provide the accurate measurements of soil moisture in the root level using which we can determine if the irrigation should be increased or decreased. Another example of AI being used in agriculture for the soil and water management is the Missouri partnership in which a public-private economic development organization has paired up with Climate FieldViewTM to provide the farmers with data that will help them make decisions related to irrigation and soil management to maximise the yield and quality of the crop. Few other examples include rule-based expert systems for evaluation of the design and performance of microirrigation systems and artificial neural systems for estimation of soil moisture.

Identifying and management of pest and diseases: The identification of pests by AI are performed using cameras, sensors and again these detections if early prevents the damage of the crops by the pests. Depending on the type of pests AI can again give us a precise and accurate treatment for the pests to vanish. It also provides more eco-friendly solutions which does not produce much harm to the people consuming the plant and prevents soil pollution. Cheeti et al in 2021 proposed an insect pest detection approach using advanced deep learning techniques for the four pests of crops. they used YOLO algorithm for the detection and the classification of pests' images. Liu and Wang applied the YOLO v3 object detector model for detecting the images of disease and pests of tomato crop and classifying it. Pests create a great impact in agriculture. If the pests are in abundant then the yield will obviously decrease, creating a great loss. SMARTSOY by Batchelor et al. and CORAC by Mozny et al. are few expert systems designed for the prevention of damages caused by the pests. Crops are highly prone to diseases that can reduce the yield of the plant. The productivity of the plant can be reduced from 10% to 95% depending upon the stage of the disease and its severity. AI can detect the diseases of plants by just using the images of the plants. Early detection of the disease is possible through AI and thus the risk of loss of yield and productivity of the plant can be prevented.

The AI classifies the entire part of the suspected plant into areas such as diseased area, non-diseased area, background etc. Few examples of AI detecting the diseases are c4.5 classifier, tree bagger, and linear support vector machines. Different artificial neural network-based model was designed to control the disease of the plant. Some hybrid systems are also used. Dr. Wheat is an expert system that was designed to diagnose diseases in wheat.

General crop management: In 1985, Mc Kinion and Lemmon created an idea of using AI techniques in crop management in the paper "expert systems of agriculture ". Boulanger in his doctoral thesis proposed a corn crop protection system. Roach et al proposed an apple plantation expert system known as POMME. Stone and Toman came up with an expert system called as COTFLEX for the cotton plantations. The accuracy of the best model so far obtained is 94%. AI provides an overall management of the crops and covers the aspects of the automated mechanisms of farming aspects.

Agricultural produce monitoring and storage control: Apart from protecting the crops from harmful agents such as pests, diseases, and harsh pesticides to prevent the loss of yield, it is also essential to ensure the proper storage of the harvested crops in the right appropriate location which has appropriate environment. Some of the systems that helps in these activities were developed by Chen and Yang, Capizzi et al, etc. Weed management: Some of the Weed's act as an endoparasite where it sucks all the nutrients, water and food of the main plant by growing near it, it can be harmful for the main plant to grow as the nutrients are being consumed by the weeds. For identifying and eliminating weed in crops like oats, barley, triticale etc, Pasqual designed a rule based expert system.

Application of drones in agriculture

Drones play a vital role in the expert systems. Some of the examples of drone operations are irrigation, monitoring, spraying, inspection of the crop, and soil analysis. It can have 3D cameras, multispectral and optical imaging. Drones are effective means for spraying fields, taking aerial photos and provide data that was not previously possible. They are also used for maping land, scout ways to improve the farm and give insights about obstacles on the farm. Despite having many benefits drones also have certain challenges. The drone can fly for very short time and is costly, especially those with better software and hardware tools. Drones require permits to be used in certain countries and also must not reach, more than 400 feet, and it is affected by the weather changes.

Conclusion

The appropriate application of AI and ML in agriculture would rectify problems related to soil health, plant health and the amount of irrigation requirements. AI helps the farmers detect environmental factors such as weather, humidity, temperature etc., in the crop field. By using AI and ML, will increase the yield and farm income. In the span of the next ten years, the influence and the impact of both AI and ML will increase and would reduce the workload and expense.

References

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