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REVIEW ARTICLE

Application of Artificial Intelligence for Next Generation Agriculture

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ABSTRACT
Artificial Intelligence (AI) is no longer an emerging trend or technology. It has been widely adopted medical sciences, data driven applications, natural language processing and linguistics. Recently, prosthetics, self-driven or autonomous cars are applying similar techniques. Artificial intelligence in agriculture is groundbreaking phenomena. AI techniques and Machine Learning Algorithms (MLA) increases the efficiency of the agricultural products and in-field farming techniques. With the advent of IOT (Internet-of-Things) and advances of sensor technology it bridged the gap between real environment and AI. It can interpret nature and process difficult learning situations to formulate datasets and produce desired outcomes. For instance, it can assess and evaluate soil conditions based on weather patterns, recent soil reports, rainfall, pest infections and generate optimal results for farmers to grow relevant crops with quality and quantity production and reduce loses.Using image-based disease detection, crop crisis response identification, field management can be done. This paper provides overview of various AI and Machine Learning techniques leveraged in Agriculture sector. This includes methods and approaches in Proximity Sensing (PS), Remote Sensing (RS), Precision Agriculture farming (PA), Autonomous Robotics, Drones in agriculture sector, Crop field irrigation and weeding. Precision farming opens the right place, the right time, the right product. It guides crop rotation, optimal planting, water management, nutrient management, pest control, and so on.
***Key words**: Precision farming, Robotics, Artificial intelligence, Agriculture, Wireless Sensor Networks (WSNs).*

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INTRODUCTION

Agriculture is the primary source of income and livelihood for approximately 58% of India's population. Problems that agriculture sector facing today that AI might solve are soil erosion, manures, fertilizers and biocides, efficient irrigation techniques, optimal pesticides usage and advanced watering techniques especially in drought hit areas. This paper briefly describes potential AI Techniques and that agriculture sector benefits from especially farmers and dependent entities to produce quality crops by applying them systematically with proper education, empowering seminars and webinars [5-9].

PROXIMITY SENSING (PS) AND REMOTE SENSING (RS)

Proximity Sensing and Remote Sensing technologies are mainly used for the purpose of intelligent data fusion. Soil testing is one user case for this high-resolution data. For proximity sensing, sensors in contact with the soil or at a very close range are required.This helps to define soil in a location based on the soil below the surface. While remote sensing requires sensors to be integrated into airborne or satellite systems. Moreover, using remote sensing health monitoring of crops can be achieved without a farmer's investment in time and effort. The cognitive approach may make recommendations to farmers for the best selection of crops and seeds based on local requirements [10, 13, 14].

Drone-based solutions in agriculture are of vital importance for the management of adverse weather conditions, productivity gains, precision farming and yield management. Aerial spraying of seed pods and

plant nutrients into the soil provides the necessary plant supplements. In addition, drones can be programmed to spray liquids by adjusting the distance from the ground to the ground.

In combination with AI and Computer Vision Technologies (CVT), Crop monitoring and health assessment remain one of the most relevant areas of agriculture for the delivery of drone-based solutions. High-resolution drone cameras collect accurate field images that can be passed through convolution neural networks to identify areas with weeds, plants that need water, plant stress levels in middle of the growth stage. Technology transfer can be done with feasibility [8, 5].

Precision farming (PA) is an agricultural management framework that focuses on the observation, estimation and reflex of intra-field and inter-field heterogeneity of crops. The aim of precision agricultural research is to define a decision-making support system (DSS) for whole-farm management, in order to maximize input returns while retaining energy [6].

Goal for precision farming:

Identification of crops and business strategies.

Examples of precision farming management:

1. High-resolution images and multiple sensor data on plants provide the detection of stress levels in a plant. To allow data fusion and stress-recognition functionality, this broad collection of data from multiple sources needs to be used as input for machine learning.

2. To identify plant stress levels, machine learning models trained on plant pictures can be used. To make better decisions, the method as a whole can be divided into four phases of detection, description, quantification, and prediction.

ROBOTICS AND AUTONOMOUS SYSTEMS (RAS)

As with Agri-food, economic sectors with considerably lower production are implemented with RAS. Significant role of robotics in agricultural development and management has led the researchers to emphasize technologies for the design of autonomous agricultural instruments as there was a lack of inefficiency in traditional agricultural machinery [4] .The objective in this case is to substitute manual input with providing efficient results for minor and major production [11].

The robots independently execute multiple agricultural operations, like weeding, water management, farm shielding for efficient reporting, helping to ensure that unfavorable climatic conditions do not influence production, improving accuracy and treating plant species in several unusual ways. Automated machines often record the state or progression of the plant.In order to track growth of crop and to identify diseases in plants, various biosensors were developed. Automated irrigation systems have also been established to use water efficiently.

Irrigation

To ensure the correct use of water supplies for irrigation, we need to build more effective technologies. Automatic irrigation scheduling techniques have replaced manual irrigation based on measurement of soil water. Extreme ambient specifications like wetness, wind speed, solar radiation, and likely crop variables were dependent on plant evapo-transpiration.

Automatic irrigation scheduling techniques have replaced manual irrigation dependent on soil water measurement, by taking the plant density, soil properties, and pests as a key factor. According to Kumar [9], the various irrigation methods are used to evaluate soil fertility that require instruments to measure soil richness and PH levels. These instruments are installed in the crop cultivation areas to identify the fraction of primary soil composition, such as potassium, phosphorus and nitrogen. Automated Drip Irrigation System (ADIS) uses Wireless Sensor Networks (WSN's) connected to installed sensors across the farms and trained data algorithms. Dynamic algorithms change drip irrigation based on data collected from sensors in real-time.

To reduce manpower and duration in the irrigation process, Jha *et al*. [8] and Savitha and Uma Maheshwari [13] worked on the same Arduino technology, and developed remote sensors that can increase output by 40 percent. After mounting digital cameras, all these tools' output is transformed to digital signal and sent to the signal generator -Zigbee and hotspot, a network without wire connectivity. Subsequent researchers came up with various sensors used as soil moisture sensors and raindrop sensors, detecting the need for the supply of water to the fields by wireless network using solar panels.

GSM module enables farmers to sensor alerts to their mobile devices about forecast of rain, soil moisture. These alerts farmers to control water supply either ON or OFF through SMS message. Embedded sensors perform precise moisture levels in the soil and forward the data to automatic irrigation unit. This mechanism is one the prominent techniques widely used in water limited or restricted crop cultivation areas with better yield and efficient water usage.

Weeding

Plants compete with the strongest competitors for water [15]. During photosynthesis plants utilize light energy to convert water, carbon dioxide and oxygen into energy-rich organic compounds. Weeds that grow tall normally obscure the light path to the plants. It is therefore of great importance to eliminate these weeds from the fields, otherwise they will not only consume the land area, but they will also have a detrimental effect on other plant growth. Before implementing an automated weed control system, differentiating crop seedlings and weeds is must and should process. [3].

Drones in agriculture

Drones are used in agriculture to track crop health, monitor irrigation machinery, identify weeds, monitor herds and wildlife, and manage disasters [1]. Spraying of pesticides [5]. They are myriad drone models available suiting unmanned aerial monitoring purposes. However, according to [11], there are few crucial factors to be ascertained successful operation and maintenance of drone for instance, flight altitude, weight, climate conditions, set-up and operational costs.

Crop spraying

Drones can be used for crop spraying to distribute equivalent amount of chemicals and calibrate and maintaining safe distance from the ground and avoid sending excessive amounts into the soil [1]. It is also responsible for guiding the calculation of the pesticide to maintain a strategic distance from intensive use. Spray fitted drones integrate with Wireless Sensor Networks (WSN's) to adjust path, speed and wind direction. Drones using machine learning algorithms based on trained datasets and communicate with WSN's effectively by adjusting routes and spray crops in optimal manner and reduce surplus consumption of fertilizers and pesticides [4, 5].

CONCLUSION

Agriculture industry challenges are continuing to persist due to lack of latest crop cultivation awareness and trends, conventional mentioned, improper water irrigation, weed and pest management, monitoring crops and unfavorable weather conditions due to global warming. With adoption of artificial intelligence, machine learning techniques and instruments and machinery governed by these technologies majority of these challenges are resolved. In conjunction to these practices by leveraging Geo-Spatial Positioning Systems (GPS) and Satellite driven weather data would assist farmers further. Weed and pest control are assessed with machine learning supervised learning and reinforced learning for accurate evaluation of chemicals required for better treatment. These methods significantly reduce excess application of pesticides and herbicides thereby fulfilling high crop-yield.

Crop monitoring is simplified with drones controlled by artificial intelligence applications. For instance, with the assistance of man-made brainpower in agricultural business problems, shortages of capital and employment can be understood. In traditional crop cultivation mechanisms require human resources to assess the crop condition physically measuring weeds growth, soil strength and take necessary steps has been tedious and not efficient. With the help of different systems studied, the benefit of adaptable and beneficial operation, on-demand access to data, and spatial targets, rapid and non-damaging high-performance phenotyping will occur. Applications of artificial intelligence in agriculture is still evolving trend and ongoing journey of providing real-time data feeds and acts to the situation more proactively rather than reactive manner.

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