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Artificial intelligence in agriculture: Current status and future need

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Abstract
Artificial intelligence had been shown its importance in other sectors. It reduces the need of man power and increase the efficiency. AI is recently entered in agriculture sector. Due to rapidly increasing in global population we need to increase the our production but problem is that we have only limited land for crop cultivation, there are other problem also like irregular monsoon, uneven rainfall, weed, pest and disease problem. Artificial intelligence paly a crucial role in overcome these problem. By the help of AI we can manage soil health, weed, pest and disease of crop. Robotics and automation reduce the farm budget and need of resources. Drones can help in irrigation, fertigation, weed management. We can also predict precipitation. This study outline the use of AI in agriculture (like drones, Robots, digital twin, chat box, disease, weed, pest management)and future scope of AI in agriculture.

Keywords: Artificial intelligence, agriculture, digital twin, drones, robots, chat box

Introduction
Previously, agricultural activities were restricted to production of food and crop and food production. (M. Fan *et al*. 2012) [1] However, over last 2 decades, it had involved in crop, production, processing, distribution, and marketing. it is also paly key role in GDP of many countries (O. Oyakhilomen *et al*. 2014) [2].
.According to Food and agriculture organization in 2020 there are 720 to 811 million people facing undernourished problem in the world. So in percentage almost 8.4 to 9.9% people are under nourished. And the population of people are increasing day by day. So we need increase the agriculture production. So for the overcome this problem we use artificial intelligence.
Artificial intelligence (AI) is a major area of study in computer science. With its rapid technological advancement and broad range of applications, AI is rapidly becoming pervasive due to its robust applicability in problems that cannot be solved well by humans or traditional computing structures. (E. Rich *et al*. 1991) [3].
Artificial intelligence (AI) has recently re-entered the public consciousness as a result of impressive demonstrations of what it can now accomplish, incorporation into commonly used digital tools such as mobile phones, and clear indications by companies that it will be a key component of their future products and services (Wolfert *et al*. 2017) [4].
Artificial intelligence Common and widespread examples include the development of powerful chatbot conversational interfaces with capabilities such as text understanding, speech interpretation, image recognition, and language translation to help humans find what they are looking for faster (Burgess 2017) [5].
The agricultural industry is also need AI because it possesses several characteristics that make it a huge target for AI; for example, their tendency to cover large and remote areas makes them good targets for AI-enabled remote-monitoring capacity (Patrício and Rieder 2018) [6] In this review I will describe the different artificial intelligence method used in agriculture like soil management, crop management, weed management, pest management, disease management and robotics and drones in agriculture

Ai used in agriculture
1. General crop management
Crop management systems serve as an interface for total crop management, encompassing all aspects of farming. First time use of artificial intelligent in crop management was

proposed by mckinion and lemon in their paper and the paper title was "expert system for agriculture" (J. M. McKinion *et al*. 1983) [7]. Boulanger proposed another corn crop protection expert system in his doctoral thesis. (A G. Boulanger. 1983) [8] Roach *et al*. proposed the POMME expert system for apple plantation management in 1987. (J. Roach *et al*. 1987) [9] Stone and Toman developed COTFLEX, an expert system for cotton crop management (N. D. Stone *et al*. 1989) [10] Lemmon developed another rule-based expert system, COMAX, for cotton crop management.] (H. Lemmon.1990) [11] Robinson and Mort developed a multi-layered feed forward artificial neural network-based system to protect citrus crops Italy form the severe frost (C. Robinson *et al*. 1997) [63].

For the train and test of the network, both the input and output were programmed in binary form. The authors used various input configurations to obtain the most accurate model. The best model discovered have 94 percept accuracy with two output classes and six inputs. Li, S. K. *et al*. proposed an image-based AI technique for wheat crop. (S. K. Li *et al*. 2002) [13, 28]. That uses a pixel labelling algorithm followed by a Laplace transformation to strengthen the image information. A finest network acquired had five hidden units that had been trained up to 300,000 iterations and average accuracy was 85.9% A scientist created a fuzzy ISSN 2319 – 195 logic-based soybean crop management system that provided crop selection advice. (C. Prakash *et al*. 2013) [14].

2. Soil management

Soil management is an essential component of agricultural operations. A thorough understanding of various soil types and conditions will increase crop yield while conserving soil resources. It refers to the application of operations, practises, and treatments to improve soil performance. Pollutants in urban soils can be investigated using a traditional soil survey strategy (C.R.D. Kimpe *et al*. 2000) [15] Compost and manure application improves soil porosity and aggregation. A higher level of aggregation indicates the presence of organic materials, which play an important role in preventing soil crust formation. To prevent soil physical degradation, alternative tillage systems can be used. The use of organic materials C.R.D is critical for improving soil quality. (M. Pagliai *et al*. 2004) [16] Several soil-borne pathogens that require control through soil management frequently have a significant impact on the production of vegetables and other edible crops. (G.S. Abawi *et al*. 2000) [17] A remote sensing device integrated in a higher-order neural network (HONN) characterises and estimates soil moisture dynamics. (A. Elsorbagy *et al*. 2008) [18] Based on features obtained from existing coarse resolution soil maps combined with hydro graphic parameters derived from a digital elevation model (DEM), an artificial neural network (ANN) model suggests soil texture (sand, clay, and silt contents. (Z. Zhao *et al*. 2009) [19] A researcher modelled a fuzzy-based system to recommend crops based on land suitability maps generated by the fuzzy system using farmers' knowledge. Other systems based on fuzzy logic (R.S. Sicat *et al*. (2005) [20]. Researcher developed an artificial neural network-based system for estimating soil moisture in paddy (C. Arif *et al*. 2013) [21].

3. Insect pest

Insect pest infection is among the most concerning issues in agriculture, resulting in significant economic losses. Over decades, researchers have attempted to mitigate this threat by developing computerised systems capable of identifying active pests and recommending control measures. Many rule-based expert systems have been proposed, including Pasqual and Mansfield, 1998, W.D. Batchelor *et al*. 1989, M. Mozny *et al*. 1993, J. D. Knight *et al*. 1994, B.D. Mahaman *et al*. 2003, M. Li *et al*. 2002, A.K. Chakra borty *et al*. 2013, Ghosh, 2015 [23, 27, 13, 28, 29, 30].

Because the knowledge involved in agricultural management is frequently imperfect, vague, and imprecise, the rule-based expert system may lead to uncertainty. Several Fuzzy logic-based expert systems, including Saini, have been proposed to capture this uncertainty

Ghosh *et al*. (2003) [31] developed TEAPEST, an expert system for pest management in tea, using an object-oriented approach to frame a rule base. A phase-by-phase identification and consultation process was also used in this case. After that Samanta and Ghosh modified this system using a multi-layered back propagation neural network (R. K. Samanta, and Indrajit Ghosh, 2012) [32].

4. Disease management

There are many factors that affect the yield of the farm in which plant and animal disease are the main factor. So we need to control the diease of palnt for better yield. To completely control diseases and minimise losses, a farmer should use an integrated disease control and management model that integrates physical, chemical, and biological controls. (BEA, 2018) [33]. Chemical and biological testing It will take time to accomplish these goals. Consuming and not very cost effective (Weed science society of America)

Computer-aided systems are being used all over the world to diagnose diseases and recommend control measures. Rule-based systems, such as those developed by D.W. Boyd *et al*. 1994, S.K. Sarma *et al*., 2010, K, Balleda *et al*. 2014, [35, 36, 37, 38]. were developed at an early stage

Thus we need the use of an AI approach for disease control and management. The explanation block (EB) provides a clear picture of the A kernel of the expert system is followed by logic. (K. Balleda *et al*. 2014) [37, 38].

Some hybrid systems have also been proposed. To classify phalanopsis seedling diseases, an image processing model combined with an artificial neural network model designed by (K. Y. Huang *et al*. 2007) [39], (SS. Sannakki, *et al*. 2011) [40].

A SICNTIEST used a fuzzy logic approach in conjunction with image processing to detect the percentage of infection in a leaf. H. Al-Hiary, *et al*. 2011 [41], D. Al Bashish *et al*. 2011 [42] created a system based on the k-means segmentation algorithm.

5. Farmer chatbots

Chatbots are communicative virtual assistants that automate interactions to end customers. Chatbots powered by artificial intelligence and machine learning techniques have enabled us to understand their native language and interact with users in a more personalised manner. (Tanha Talaviya *et al*. 2020) [43].

6. Weed management

Herbicide use has a direct impact on both human health and the environment. Modern AI methods are being used to reduce herbicide use through proper and precise weed management. Pasqual. (G. M. Pasqual, 1994) [44].

Researcher created a rule-based expert system for weed detection and elimination in crops such as oats, barley, triticale, and wheat. (T. F. Burks, *et al*. 2000) [45] used machine vision and a back propagation trained neural network to identify five different species of weeds. (T. F. Burks, *et al*. 2005) [46].

Compared three different neural network models, primarily back propagation, counter propagation, and radial basis function-based models, with the same set of inputs as the previous paper and discovered that back propagation networks outperformed the others.

7. Agricultural drones

Agricultural Drones In a mechanical setting, driverless aeronautical vehicles (UAVs) or (UAS), also known as automatons, are unmanned aircrafts that are controlled by remote They communicate with the GPS and other sensors that are mounted on the Drones are being used in agriculture to monitor crop health, irrigation equipment, identification of weed, wildlife monitoring, and disaster management. (Veroustraete, 2015, Ahirwar et. al, 2019, Tu and Kulkarni, 2016) [47, 48, 49]. in agriculture we can use remote sensing by the help of UAVs for the purpose of image captures, process and analysis. (Abdullahi et. Al, 2015) [50].

Wireless Sensor Networks are used in the development of UAS (WSN). The data recovered by the WSN allows the UAS to advance in their use. For example, it could limit its use of synthetic compounds to specific areas. Because ecological conditions are constantly changing, the control circle must almost certainly respond as quickly as can be reasonably expected. The reconciliation with WSN can contribute to this goal. (B.S., Costa *et al*. 2014) [47].

Table 1: drones classification for agriculture application

Uav	Rotary wings	Fixed wings
Flight Duration	Duration Fly upto20 minutes	Fly up to an hour
Wind Pressure	Can be flown from in winds gusting from 20 to 50 mph	Fly in and out of the wind for satisfactory image
Flexibility in changing direction	Allow new direction during flight for re –direction	Allow new direction upload during flight for re –direction
Price range	$500 to $100,000	$500 to $100,000
Deployable option	Highly deployable	Highly deployable

Source**:** Tanha Talaviya *et al.* 2020 [43].

8. Digital Twin

On a farm, the amount of data about any one entity grows over time. The 'digital twin' is a new paradigm for organising such information. (The digital twin is a real-world entity repetition like a specific cow, specific farm and filed. Digital twins give an organising system for determining the good response to a particular query. Such digital twins would not only provide access to entities' historical and near-real-time statuses, but would also make predictions about those entities. Such forecast could be classified as 'business as usual,' or they could be considered interventions, serving as a digital substitute for real-world experiments (Haag *et al*. 2018) [52].

As previously stated, studies of the impacts of milking machines on animal husbandry are particularly informative here, emphasising the importance and value of farmers understanding how the cows interact with the machine and trends in the data returned by the machine (Butler *et al*. 2012) [53], (Driessen C, Heutinck LF 2015) [54].

9. Use of Robotics and automation in agriculture

The agricultural sector had to adapt to new breakthroughs and inventions. In the field of automation A scientist proposed a new area of research of embedded intelligence (EI). Intelligence embedded smart crop management, smart farming and other agricultural technologies, intelligent irrigation and greenhouses for a country to grow, it must incorporate these emerging technologies into its agricultural sector. Agriculture is vital to many sectors of the economy. Furthermore, the authors of this paper demonstrated a Technology Roadmap (TRM), which clarifies the concerns about the aforementioned agricultural areas (smart farming, smart irrigation etc.) (Yong, W. *et al*. 2018) [55].

A researcher presented the use of the Losant platform for monitoring agricultural farmland and informing farmers via SMS or e-mail if some anomalies are detected by the system. Losant is by far the most powerful cloud platform based on IoT. It allows for real-time viewing of data stored in it regardless of field position. (Gondchawar *et al*. 2016) [56].

Immobile robots and automatic devices have already been used efficiently for some indoor farm activities, such as identifying animals and feeding them based on their nutritional needs and expected output, weighing and separating them, selectively milking cows, sheep shearing, cleaning up shelters, and slaughtering animals (Matias Collar Narock *et al*. 2009) [57].

There has also been significant progress in outdoor activities, including establishment crops, plant care, and selective harvesting. Commercially available mobile robots are capable of selectively harvesting almost all types of fruits (strawberries, pears, grapes, watermelons), legumes, and floral (Scott A., 2010) [58] Automatic guidance systems that can be installed on conventional tractors are already in use, significantly reducing driver effort and being credited with improved technological and financial efficiency (Dave Franzen, 2009). A robotic driverless tractor able to follow a predefined route and reacting to unknown obstacles has been successfully developed tested, but it cannot be used in fields unattended at this time, particularly for safety purposes (Scott A., 2010) [58].

Milking robots, which first appeared on the industry in 1992, have been the only representative category of robots widely used in farming, and they rank second (after military robots) in the service robots class, accounting for 25% of all service robots. Between 2006 and 2009, the number of connected milking robots increased by 272%, from 6,180 to 22,980 units (European Robotics Research Network, 2008, 2010), and it is estimated that milking robots now account for approximately 20% of new milking installations in the UK (Dunn, 2009) [60].

Future scope of AI in agriculture

The population of the world is projected to reach nine billion by 2050, necessitating a 70% increase in agricultural production to meet the demand. Only about 10% of this higher production may arrive from unused lands, with the rest being met by current production intensification. In this framework, the use of cutting-edge technological solutions to improve farming efficiency remains a critical requirement. Current agricultural intensification strategies necessitate high energy inputs, while the market demands high-quality food. (D. G. Panpatte, 2018) [61]. Artificial intelligence techniques have been rapidly evolving, and they can be used to detect plant disease or any unwanted weed in the farm using CNN, RNN, or any other computational network. Greenhouse farming can provide plants with a specific environment, but it is not possible without human intervention. Here, wireless technology and IOT come into play, and by utilising the most recent communication protocols and sensors, we can implement weather control and monitoring without the need for human intervention on the farm. Fruit and crop harvesting can be integrated by robots that are specialised in working tirelessly for quick harvesting. (Kirtan Jha *et al*. 2019) [62].

AI technology would be useful in predicting weather and other agricultural conditions such as land quality, crop cycle pest attack, groundwater land quality, groundwater, crop cycle, pest attack, and so on. The accurate projection or prediction made possible by AI technology will alleviate the majority of farmers' concerns. AI-powered sensors are extremely useful for extracting important agricultural data. The information will be useful in improving production. These sensors have a lot of potential in agriculture. Agriculture scientists can derive data such as soil quality, weather, and groundwater level, among other things, which will be useful in improving the cultivation process. AI-enabled sessor can also be installed in robotic harvesting equipment to collect data. (Tanha Talaviya *et al*. 2020) [43].

Conclusion

Artificial intelligence can be milestone of agriculture. It is reduce the need of man power and other resource. AI may play crucial role for increasing the yield of crops. it reduce the cost of crop cultivation. Farmers' problem had been that precision weeding methodologies outweighed the large amount of crops lost during the weeding process. These autonomous robots not only improve efficiency, but they also reduce the need for unnecessary pesticides and herbicides. Aside from that, farmers can use drones to effectively spray pesticides and herbicides on their farms, and plant monitoring is no longer necessary. A hindrance for starters, resource and job shortages may be underestimated with the assistance of man created agribusiness brain power

Farming robots and autonomous devices are still in their infancy. Only in greenhouses and dairy farms can robot activity be considered relevant; for other activities, robots have only recently become available commercially or are in the prototype phase, with little visibility and impact on global agriculture. New technologies in the robotics and automation fields still necessitate time and investment to outperform current technology. The rate and magnitude of the adoption tendency are difficult to predict. The world's socioeconomic system is not supposed to change at the same rate as technological scientific advances and communication, preserving unfair access to resources.

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