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Role of artificial intelligence in advancement of agriculture

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Abstract
Artificial Intelligence and Robotics can be helpful for social needs agriculture and mainly for increasing agriculture production and productivity for fulfillment of the ever-growing demand of food requirements of burgeoning world population and to prevent starvation. Artificial Intelligence can propose efficient and practical solution for the problem and challenges of agriculture like increasing labour costs, raising cost of cultivation and crop failures associated with unpredictable yield due to diseases, unpredictable rainfall, climatic changes and degradation of soil fertility, fluctuating market price in agriculture commodities. In such condition for improving socioeconomic status of Indian agriculture artificial intelligence can develop advance farming procedures to reduce loss of farmers and provide them with high yield. Using artificial intelligence platforms, one can collect huge amount of data and information from government and public websites or real time monitoring of large data is also possible by using IoT (Internet of Things) by using advanced technology machinery and app of artificial intelligence we can solve the uncertain issues faced by farmers in the agriculture sector.

Keywords: Artificial, intelligence, advancement, farmers

Introduction
Agriculture is the most important sector of Indian economy as it accounts for 18 percent of India's gross domestic product (GDP) and it provides employment of the 50 per cent of country youth. The US Environmental Protection Agency (EPA) evaluates that agriculture give over roughly $330 billion in annual revenue to the economy. (Madhusudhan, 2015) [14] India is the world largest producer of pulses, cereals, spices and spice products and second largest producer of vegetables and fruits in the world. But due to many problems in agriculture it's a significant departure from the traditional farming practiced in the country since ages that has resulted in low yields and excessive dependency on monsoon rains which has kept Indian farming at subsistence level. Climate change population growth and food security cases are such factors which have propelled the industry into discovering more innovative outlooks to protecting and improving crop yield (Kumar and Joshiba, 2019) [1]. Day by day increasing consumption and rising need of better yield of vegetation and food are estimated to be one of the essential factors calling for robots in agriculture (Smith, 2019) [28]. Increasing intake motivates farmers to increase farming operations and provide an upward push to the requirement of automating farming operations. In such situation the use of cutting-edge technologies like Artificial Intelligence may help Indian farmers to choose the right crop and minimise the risks. As a result, AI is steadily appearing as part of the industry's technological evolution. The success was that AI can identify a disease with 98% accuracy, AI gives growers a tool against cereal-hungry bugs, Sensors monitor the fruit's headway toward perfect ripeness, adjusting the light to accelerate or slow the pace of maturation, This kind of farming requires considerable processing power. AI-powered solutions will improve quality & ensure faster go-to-market for crops (Soffar, 2019) [29]. Artificial intelligence offers data sources such as temperature, precipitation, wind speed, and solar radiation, along with comparisons to historic values for anywhere on the agricultural earth, Although Artificial intelligence won't eliminate the jobs of human farmers, it will improve their processes and provide them with more efficient ways to produce, harvest and sell essential crops. Government has constituted a committee for see the role of Digital Technology, which can play a transformational role in modernizing and organizing how rural India performs its agricultural activities.

The technologies include Artificial Intelligence, Big Data Analytics, Block chain Technology, etc. By use of the advance technologies and Artificial Intelligence (AI) and we can give accurate and timely information regarding crops, weather and insects etc. to the farmers y which they can improve the crop productivity, reduce the risk and improve the income of the farmers. (Anonymous)

Concept

Artificial Intelligence (AI): Artificial intelligence is defined as the principle and development of computer systems able to execute tasks normally requiring human intelligence such as visual perception, speech recognition, decision-making, and translation between languages (Russel, 2016) [23]. It covers computer vision, data mining, deep learning, image processing and neural networks (Kale, 2019) [11] In the field of agriculture industries factors such as climate change, population growth and food security concerns have propelled the industry into seeking more innovative approaches to protecting and improving crop yield. As a result, AI is steadily emerging as part of the industry's technological evolution. Hence "Artificial Intelligence is a program that can adapt itself to execute tasks in real time situations using cognitive processing as the human mind. Interestingly, it does not require constant supervision". (Maher, 2018) [15]. In India, In February 2016, Prime Minister Narendra Modi's government has started the use of Artificial Intelligence on pilot basis for crop cutting and yield estimation under its flagship scheme Pradhan Mantri Fasal Bima Yoajana. The main aim is cutting down the expenditure of farming while accelerating productivity per unit area According to government this modern technology can be helpful in giving information and advice to farmers which will help in increasing productivity Under Pradhan Mantri Fasal Bima Yojana, the government has carried out many pilot studies for standardized of crop cutting experiments, in which AI was used to optimization and yield estimation," said the minister. (Tripathi, 2019) [31] Many technology companies and start-ups have emerged in the past few years with targeted agri-based solutions that benefit the farmer in which the most popular applications of AI in Indian agriculture appear to fall into three major categories, which are,

Predictive analytics

aWhere: Satellites for Weather Prediction and Crop Sustainability aWhere, a Colorado based company uses machine learning algorithms in connection with satellites to predict weather, analyze crop sustainability and evaluate farms for the presence of diseases and pests. (Ananomys, 2019) [3].

Farm shots: Satellites for Monitoring Crop Health and Sustainability Based in Raleigh, North Carolina, Farm Shots is another startup focused on analyzing agricultural data derived from images captured by satellites and drones. Specifically, the company aims to "detect diseases, pests, and poor plant nutrition on farms." (Ananomys, 2019) [3]

Crop and soil health monitoring

PEAT: (Machine Vision for Diagnosing Pests / Soil Defects) Deforestation and degradation of soil quality remain significant threats to food security and have a negative impact on the economy. Berlin-based agricultural tech start-up PEAT, has developed a deep learning application called Plantix that reportedly identifies potential defects and nutrient deficiencies in soil. Analysis is conducted by software algorithms which correlate particular foliage patterns with certain soil defects, plant pests and diseases. The image recognition app identifies possible defects through images captured by the user's Smartphone camera. Users are then provided with soil restoration techniques, tips and other possible solutions as explained in the short video below: (Anonymous, 2019) [3]

Trace genomics: Machine Learning for Diagnosing Soil Defects Similar to the Plantix app, California-based Trace Genomics, provides soil analysis services to farmers. Lead investor Illumina helped develop the system which uses machine learning to provide clients with a sense of their soil's strengths and weaknesses. The emphasis is on preventing defective crops and optimizing the potential for healthy crop production. (Rosen, 2017) [22]

Plantix: A machine-based tool which help in detecting crop disease and cultivation of valuavble crops and manage agriculture. Plantix.

Crop In: Using AI to Maximize per-Acre Value With CropIn's 'smartfarm' solution, all the plots were geo-tagged to find the actual plot area. The solution helped in remote sensing and weather advisory, scheduling and monitoring farm activities for complete traceability, educating and learning farmers on adoption of right package of practices and inputs, monitoring crop health and harvest estimation, and alerts on pest, diseases etc. Essentially, CropIn uses technologies such as AI to help clients analyze and interpret data to derive real-time actionable insights on standing crop and projects spanning geographies. Its agri-business intelligence solution called Smart Risk "leverages agri-alternate data and provides risk mitigation and forecasting for effective credit risk assessment and loan recovery assistance.

Agriculture machine and drones

Sky Squirrel Technologies. is one of the technology which have to bring for vineyards which help to s improve crop yield and to reduce costs. SkySquirrel uses algorithms to integrate and analyze the captured images and data to provide a detailed report on the health of the vineyard, specifically the condition of grapevine leaves. Since grapevine leaves are often telltales for grapevine diseases (such as molds and bacteria), reading the "health" of the leaves is often a good proxy for understanding the health of the plants and their fruit as a whole. (Sennar, 2019) [25]

See and spray: It monitor precisely spray of herbicide to weeds and infected crops and in this way it helpful in weeds management and protecting crops. S. Spray.

Harvest CROO robotics: Harvest CROO Robotics has developed a robot to help strawberry farmers pick and pack their crops. Lack of labourers has reportedly led to millions of dollars of revenue losses in key farming regions such as California and Arizona. In the Hillsborough County, Florida region which has been described as the "nation's winter strawberry capital," between 10,000 and 11,000 acres of strawberries are typically harvested in a season. Harvest CROO Robotics claims that its robot can harvest 8 acres in a single day and replace 30 human laborers. In the short video below, the Harvest CROO team provides a demonstration of the robot: (Sennar, 2019) [25]

Blue river technology: The ability to control weeds is a top challenge for farmers and an ongoing challenge as herbicide resistance becomes more common. Automation and robotics can help farmers find more efficient and accurate ways to protect their crops from abiotic stresses especially from wed. Blue River Technology has developed a robot called *See & Spray* which reportedly leverages computer vision to monitor and precisely spray weeds on cotton plants, it can help prevent herbicide resistance. (Osterman, 2010) [18]

AI and Robots from picking fruits to harvesting plants: Various developed countries in all over the world have developed machines or robots that can work at the same accuracy and care as a human, help in harvesting apples, tomatoes and other crops and increasing the harvest between 3-4%. It also interprets sudden death syndrome for the soy fungal disease and prompts for the location and severity of the observation.

Companies that helps to advance agriculture for improving standard of small farmers and agriculture in Indian atmosphere (Baruha, 2019) [6].

1. Intello Labs: Using Deep Learning for Image Analysis and give advanced image identification or recognition technology that can easily observe objects, faces, flora fauna and tag them in any image. Smal "Our Image based solutions provide insights on the crops' health during the growing period and its final harvested quality by click of photograph," the company states on its website which will be helpful to small farmers in scientific understanding of crop and its life cycle.

- **It helpful in agricultural product grading:** As it is a automated quality analysis of images of food products and it is a accurate method for classification of fresh products (fruits, grains, vegetables etc.) designated by color, size and shape. Their solution reads the image that a farmer has taken on his phone and prescribes the product quality in real time, without any manual intervention.

- **Alerts on crop infestation:** By clicking an image of crop farmer can understand the problems and use their solution detect pests, diseases, and weeds present in their fields. The solution uses deep learning and image processing models to recognize any crop diseases or pest infestation in the crops. Along with the parameters, it gives recommendations on how that disease can be cured or treated and prevented from expanding further.

2. Microsoft India: AI-based Sowing App Which helps in deciding the correct time to plant crops to avoid negative consequences of drought and unpredictable rainfall can. Microsoft in collaboration with ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), developed an AI Sowing App that uses machine learning and business intelligence from the Microsoft Cortana Intelligence Suite. The app giving information to participating farmers about optimal date to sow. Its gives benefit of reduce capital expenditure by eliminating installation of sensor in farmer's field. They only need a feature that phone capable of receiving text messages. Microsoft in collaboration with United Phosphorous (UPL), India's largest producer of agrochemicals, to create the Pest Risk Prediction App that again leverages AI and machine learning to indicate in advance the risk of pest attack. Because of AI today, these farmers across the Indian states of Andhra Pradesh and Karnataka wait to get a text message before sowing the seeds. As per the report cited above, in a few dozen villages in Telangana, Maharashtra, and Madhya Pradesh, farmers receive automated voice calls alerting them whether their crops are at risk of a pest attack based on weather conditions and stage of the crop.

Gobasco: The Intelligent Agri Supply Chain. Based in the North Indian state of Uttar Pradesh, Gobasco has the advantage of a high-tech team. This company is helpful to farmer as by performing following works.

- **Quality Maintenance:** Computer vision and AI-based automatic grading and sorting is done for vegetables and fruits for creating an international Agri-commodity standard for reliable trading across country boundaries.

- **Credit Risk Management:** Crowd-sourced data, algorithms and analytics overcome the credit default problem, the most challenging problem of current supply-chain, to ensure a very low risk operation.

- **Agri-Mapping:** Deep-learning based satellite image analysis and crowd-sourced information fusion obtains a real-time Agri map of commodities at a resolution of 1 Sq-km

Gramophone: Recognition of image for Soil Science. Based in the Indian state of Madhya Pradesh, Gramophone claims to leverage the power of image recognition and soil science to help farmers with timely information, technology, and right kind of inputs to achieve better yields.

Major schemes of AI for agriculture include

- Development of Kisan Suvidha mobile application to facilitate spread of information to farmers on the critical parameters *viz*., Weather; Market Prices; Plant Protection; input Dealers (Seed, Pesticide, Fertilizer) Farm Machinery; extreme weather alerts; Soil Health Card; Cold Storages & Godowns; Veterinary Centres. With market information, farmers are better informed about markets to sell produce, about prevailing market prices and what quantity demanded in the market. Thus, they can make informed decisions to sell produce at the right price and right time. (Anonymous, 2019) [3].

- Development of 'Farm Machinery package for Different Agro-Climatic Zones in India' mobile application, which gives information on farm machinery package available for state-wise, agro-climatic zone wise, district-wise, cropping pattern wise and power source wise.

- Development of 'My Ciphet' mobile application to help farmers to get accurate information related to the Indian Council of Agriculture Research (ICAR) developed post-harvest technologies, products and machineries. (Anonymous, 2019) [3].

- ICAR has also compiled more than 100 mobile apps developed by ICAR, State Agricultural Universities and Krishi Vigyan Kendras in the field of crops, horticulture, veterinary, dairy, poultry, fisheries, natural resources management and integrated subjects, offer valuable information to the farmers, including package of practices, market prices of various commodities, weather related information, advisory services, etc. (Anonymous, 2019) [3].

- Development of mKisan Portal (www.mkisan.gov.in) for sending advisories on various crop related matter to the registered farmers through SMSs.

- Launching of e-National Agriculture Market initiative to provide farmers an electronic online trading platform.

(https://www.enam.gov.in/web/)

- Introduction of Soil Health Card Scheme to assist State Governments in providing Soil Health Cards to all farmers across the country once in a cycle of 2 years. Soil health card provides information to the farmers on nutrient status of their soil along with recommendations on appropriate dosage of nutrients to be applied for improving crop productivity and soil fertility. (Anonymous, 2019) [3].
- Using machine learning process along with different computer algorithm for crop classification and area estimation. rop management, including applications on yield prediction, disease detection, weed detection crop quality, and species recognition; (b) livestock management, including applications on animal welfare and livestock production; (c) water management; and (d) soil management. The filtering and classification of the presented articles demonstrate how agriculture will benefit from machine learning technologies. By applying machine learning to sensor data, farm management systems are evolving into real time artificial intelligence enabled programs that provide rich recommendations and insights for farmer decision support and action. (Konstantinos *et al.*, 2018) [13].

Application of AI in agriculture
1. Same-day aerial maps and 3-D field models
DroneDeploy: Software from the San Francisco–based startup DroneDeploy makes it possible for anyone to operate a small drone and analyze the captured mapping images using a computer or smartphone. The company focuses on industries such as agriculture, construction, inspection, and insurance. With one click, users can launch almost any commercially available drone on an automated path to get same-day aerial maps and 3-D field models. The technology can help them see where their crops need attention, estimate yields, and store accurate data for comparison over time. (https://www.dronedeploy.com/blog/#agriculture)

SenseFly's eBee: The tiny SenseFly eBee drone is designed to eliminate human error from crop scouting. The fixed-wing UAV allows farmers to inspect more acres faster, as well as capture near-infrared band data for vegetation evaluations. Plus, it's almost entirely autonomous. Toss it into the air and it will fly, acquire images, and then land itself. After flying, it can quickly generate maps of crops, identify problem areas, customize agricultural application maps, and create drone-to-tractor work flows for crop treatments, all on the same day. (https://www.sensefly.com/2016/08/30/sensefly-ups-agricultural-ante-launch-high-precision-large-coverage-ebee-sq-drone/)

2. Precision agriculture
"Nowadays, a continuing decrease in remote sensor costs and advances in advance technology, tablets, and smart devices have made precision agriculture fair many farmers." These new technologies-which carry everything from GPS services, sensors, and big data calculation + will make it so easy for farmers. (Kamilaris, 2017) [12] Hence, they can make decisions based on detailed information about water, climate changes, and soil quality, the health of their crops and livestock, and the conditions of their machinery. Precision Farming refers to a method of regulating farms and maintains of resources through the use of IoT and Information and Communication Technologies (ICT). It obtains real-time information related to the condition of farm elements, (i.e. crops, soil and air) to protect the environment while ensuring profits and sustainability [Crossen, 2016]. Smart Irrigation is a method of fixing the potency of irrigation processes and reducing losses of water (Mohanraj, 2016) [17]. Drones are employed in many agricultural applications, including monitoring field crops and livestock, and scanning large areas, while sensors on the ground collect a huge range of information (Ptricio, 2018) [19].

3. Water conservation and irrigation
Real-time technologies that can supervise soil moisture and water availability, and thereby manage water costs, are critical. This type of precision farming can minimize waste and produce valuable crops, high productivity, and increased advantage.

4. Keeping track of livestock
Collars placed on grazing animals and cameras in the fields help farmers keep track of their herds from their phones or home computers. Tags placed on livestock can send data on everything from the animals' health to their mating patterns. (Crossen, 2016)

5. Sensors on crops and farm machinery
Sensors can connected with various agricultural machinery like combine harvesters, tractors, and other devices and it will permit farmers for gathering of new of information about their crops and soil. Sensing technology makes farms more creative and more linked through precision agriculture. This is just one way to increase the quality and quantity of agricultural production. The information collected from sensors not only directly helps the farmers but also the agriculture business overall. (Mekala and Viswanathan, 2017) [17].

6. Environmentally safe pesticides
The food and agriculture industries are focused on finding efficient and cheap option to chemical pesticides. Natural pheromones-some chemicals produced by animals that affect the natural behavior of another animal of the same species-are now being used to disrupt the mating patterns of pests that eat fruit.

7. The Connected tractor and future of Ag Bots
On board telemetric software that monitors farm machinery's hours of use and maintenance needs also helps improve farming productivity. Farmers can gather data that are analyzed by software and provide feedback that will suggest exactly what should be planted and where, how much fertilizer to add, and when harvesting should begin.

Advantage of AI
Agriculture is becoming digital and smarter, AI in agriculture is appearing in three major categories which are agricultural robotics, soil & crop monitoring, and predictive analytics, Farmers are using sensors and soil sampling to collect data and this data is stored on-farm management systems that allow for better processing & analysis.
Agricultural provide information of soil's strengths and weaknesses, the emphasis is on standardized the potential for healthy crop yield production and preventing defective weak crops, the growth in AI technology has enable agro-based businesses to run more efficiently.

Artificial intelligence helps farmers get more produce from the land in limited resources, the farmer can protect corn from grasshoppers by using AI to detect a swarm in an undetermined parcel of his field, Images of the plant flow into an artificial intelligence algorithm that foreshow how long it will take for the blossom to become a ripe tomato ready for picking & packing.

Machine learning helps to recommend seeds, the technology is also being applied in another applications such as Automated machine adjustments (combine, planter down force, etc.), Weather forecasting, Disease or pest identification, image recognition, Disease and pest movement, Machine maintenance and break-down prediction, Field accessibility or harvest advisory type estimations, Irrigation and water management, Nutrient use and fertility recommendations, Autonomous machines or robots.

AI systems have the ability to solve some of the most challenges or problems of farmers are grappling with such as climate change, infestation of insect and weeds and reduced yields.

The collars are embed with transponders that can tell when a cow is ready for milking and connects with machines for the automatically milking, intelligence can improve plant breeding and crop management practices, many tech companies invest in algorithms that are becoming useful in agriculture, They use natural language toolkit for field notes, and yield prediction algorithms based on satellite imagery.

A robot called See & Spray reportedly leverages computer vision to control and precisely spray weeds on cotton plants, Precision spraying can help prevent herbicide resistance, The cameras & sensors use machine learning where them images are captured and the machines can be taught in different weeds, Then the right herbicides are sprayed precisely as per encroachment area.

Disadvantages of AI in agriculture

Although Artificial intelligence advances the agriculture industry in many ways, there are many worry relating to the forthcoming of AI on employment and the manpower of the agricultural sectors, Agriculture is a $3 trillion industry that employs over 1.5 billion people, which is a massive 20% of the world's population, There are predictions of there being millions of unemployed field workers in the next decades primarily due to the effect of AI in the agriculture industry.

Field tasks which are monotonous can be easily automated this can gradually make certain roles obsolete, Humans will be replaced by smart robots that can safely navigate the space, find and move agricultural products as well as perform simple and complex field operations.

The cost of technology such as drones has made it unavailable outside of the government and research bodies, it is costly to buy the drones, the biggest challenge will be funding internally from the government efforts and research institutions.

Conclusion

Agriculture is the central element to the survival of human beings. Recent IoT/AI technologies with current practices of traditional agriculture can improve the performance, quality amount and volume of production. This study has reviewed the existing software's, machines, apps and IoT/AI technologies discussed within the main research journals newspapers and official sites of specific software in the area

of agricultural. It explains that how AI main is important in sustainable agriculture, i.e. human resources, crops; weather, soil, pests, fertilization, farming products, irrigation/water, livestock, machines, and fields. AI can be appropriate and powerful in agriculture sector as it optimizes the resource use and efficiency of resources. Adoption of AI is quite useful in agriculture or it can bring technological revolution and explosion in agriculture to feed the day by day developing human population of world. This will identify the suited strengthens and weaknesses for further improvement and enrichment.

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