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Applications of Artificial Intelligence in Agriculture

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Abstract: The applications of Artificial Intelligence have been very important in agriculture. This field faces various challenges to increasing its yield including wrong soil treatment, disease, and pest infestation, big data needs, low productivity, and knowledge break between farmers and technology. The vital concept of Artificial Intelligence in agriculture is its flexibility, high performance, accuracy, and cost-effectiveness. This paper presents an overall review of the applications of AI in soil management, crop management, and disease management. The main motive of this paper is to examine the various applications of Artificial intelligence in agriculture like irrigation, weeding, and spraying with the help of sensors and other methods embedded in robots and drones. These technologies help and save the excess use of water, pesticides, and herbicides and maintain the fertility of the soil, also help in the efficient use of manpower and increase the productivity and improve the quality. This paper reviews the work of many researchers to get a brief idea about the current implementation of artificial intelligence in agriculture.

Keywords: *Artificial Intelligence, Agriculture, Herbicide, Pesticide, Automation, Irrigation.*

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Introduction:

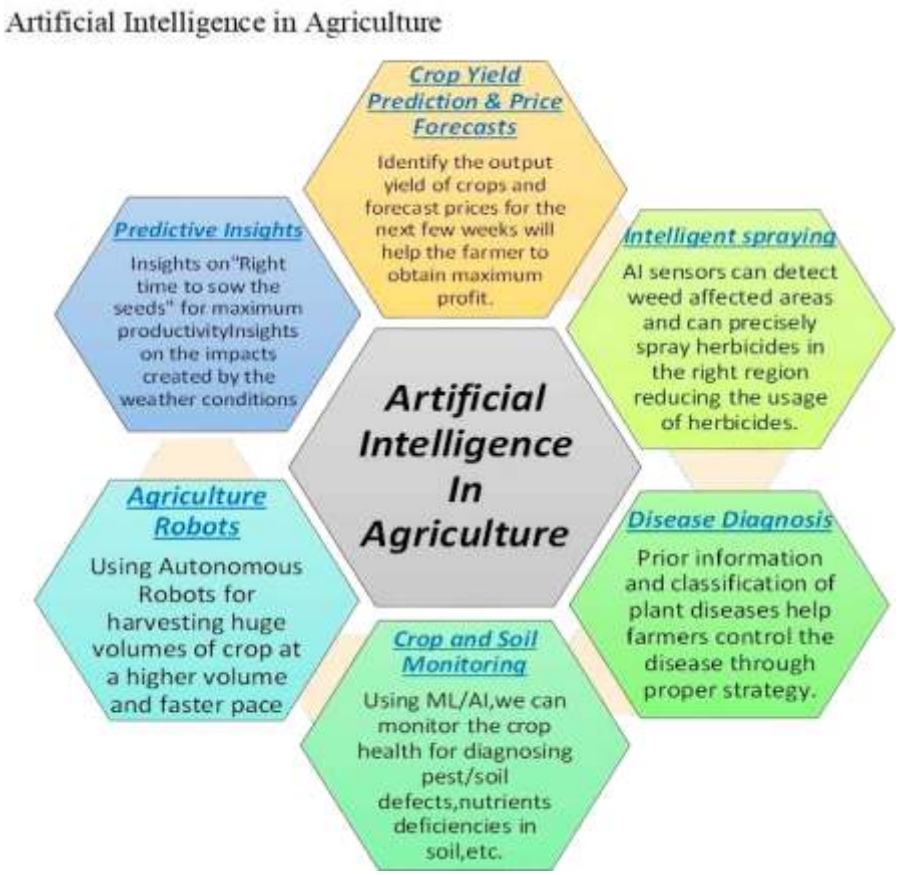
The Global population is anticipated to be approx. 10 billion through 2050, enhancing agricultural order in a scenario of humble monetary improvement through someplace with inside the variety of 50% contrasted with 2013 (FAO, 2017). Today, approximately 37.7% of the overall land floor is used for crop production. From the employment era to contribute to National Income, agriculture is essential. It is contributing an essential component to the regulatory prosperity of the evolved countries and is gambling an essential element withinside the financial system of the growing nations as well. The augmentation of agriculture has led to a substantial boom withinside the per-capita earnings of the agricultural community. Thus, putting an extra emphasis on the agricultural quarter might be rational

and apposite. In the nations, like India, the rural quarter holds for 18% of GDP and affords employment to 50% of the country's people. Development withinside the agricultural quarter will improve the agricultural improvement, similarly main closer to rural increase and ultimately ensuing withinside the structural transformation (Mogili and Deepak, 2018; Shah et al., 2019). With the development of the era, there was discovered a dramatic transformation in some of the industries throughout the globe (Kakkad et al., 2019). Surprisingly, agriculture, though being the least digitized, has visible momentum for the improvement and commercialization of agricultural technology.

Artificial Intelligence (AI) has begun to play an essential function in everyday lives, extending our perceptions and capacity to alter the surroundings around us (Kundalia et al., 2020; Gandhi et al., 2020; Ahir et al., 2020). Plessen (2019) gave a technique for harvest making plans primarily based totally on the coupling of crop tasks with automobile routing is presented. With those growing technology, the team of workers which had been confined to handiest the minimum commercial sector at the moment is contributing to several sectors. AI is primarily based totally on sizeable domain names like Biology, Linguistics, Computer Science, Mathematics, Psychology, and engineering. Jha et al. (2019) a short assessment of the modern implementation of agricultural automation. The primary idea of AI is to increase an era that features a human mind (Parekh et al., 2020; Jani et al., 2019) This era is perpetrated by analyzing how human.

The mind thinks, about how human beings examine, make decisions, and paint at the same time as fixing a hassle, and on this floor wise software programs and systems are evolved. This software is fed with education records and similarly, those wise gadgets offer us favored output for each legitimate input, similar to the human mind.

Materials and Methods :



- **Intelligent spraying of chemical compounds using AI:** Every day, farmers have one-of-a-kind troubles accompanying temperature, soil, utilization of water, climate condition, etc. With the support of artificial intelligence and machine learning models, those troubles supply energy to behave correctly in actual time for attaining valuable insights like deciding on the appropriate time to sow seeds, figuring out the crop varieties, and hybrid seed choices to generate more yields and the like.

  The typical harvest first-class and precision are progressed with the contribution of AI Systems - discussed as precision agriculture. AI era allows for detecting ailments in plants, pests, and terrible nutrients of farms. Using AI sensors, we will discover and goal weeds after which determine which herbicide to use in the area. It reduces the use of herbicides and costs savings. Many technological organizations advanced robots, which use computer vision and artificial intelligence, and synthetic intelligence to reveal and exactly spray on weeds. These robots deliver down the expenditure of herbicide via way of means of 90% and do away with 80% of the amount of the chemical compounds normally sprayed at the plants. These sensible AI sprayers can significantly reduce the variety of chemical compounds used inside the fields and consequently enhance the best of agricultural produce, and convey cost-efficiency.

- **AI for predictive analytics:**

- It predicts the finest time to sow. The distinction between a valuable 12 months and a failed harvest is simply the well-timed data on an easy statistics factor of the timing of sowing the seed. To match this, scientists of ICRISAT used a predictive analytics device to spread at a specific date for sowing the seeds to achieve the most yield. It even offers visions of soil health and fertilizer hints similarly to a 7-day climate forecast.

- Crop yield forecasts and Price predictions -

  The biggest anxiety is the cost fluctuation of the crop for plenty of farmers. Due to unhinged prices, farmers are by no means cap in a position to devise a specific manufacturing pattern. This trouble is notably commonplace in plants like tomatoes which have very restrained shelf time. Companies use climate statistics to evaluate the acreage and reveal crop fitness on an actual-time basis. With the assistance of technology like large statistics, AI, and gadgets gaining knowledge of organizations can discover pest and ailment infestations, estimate the tomato output and yield, and forecast prices. They can manual the farmers and governments at the destiny fee patterns, call for level, sort of crop to sow for maximum benefit, pesticide utilization, etc.

  Innovative start-ups are the use of AI in the subject of agriculture. A Berlin-primarily based agricultural tech startup3 developed a multi-lingual plant ailment and pest diagnostic app, which makes use of several images of the plant to determine illnesses; a smartphone collects the photograph this is matched with a server photograph after which an analysis of that unique ailment is supplied and carried out to the crop the use of sensible spraying technique. In this way, the utility makes use of AI and ML to remedy plant illnesses. Over seven million farmers have downloaded this app and it has helped remark over 385 crop illnesses between subject plants, fruits, and vegetables. To recapitulate, AI solves the shortage of resources and hard work to a big volume and it will likely be an effective device that could support corporations deal with the mounting quantity of complexity in current-day agriculture. It is an excessive time that large organizations spend money on this space.

  Can AI update the knowledge that farmers have usually had? The answer might be no for now- however, truly inside the near to destiny, AI will increase and undertake the way selections are made and improve farming practices. Such technological interventions are likely to result in higher agricultural practices, and yields, and qualitatively enhance the lives of farmers.

- **AI-based robots for farm harvesting:** It isn't the conventional farm employee nevertheless robot machines that might be able to do bulk harvesting with greater accuracy and pace which might be responsible for getting the product for your kitchen table. These machines assist increase the dimensions of the yield and decreasing waste from plants being left inside the subject. These machines use sensor fusion, gadgets imaginative and prescient, and synthetic intelligence ways to perceive the vicinity of the harvestable produce and assist to select the proper fruits. Agriculture is the second biggest enterprise after Defence in which provider robot's marketplace was deployed for expert use. The International Federation of Robotics estimates that as many as 25,000 agricultural robots were sold —like the variety used for navy purposes.

- **Models for Farmers Services:**

  There are several beneficiary models provided by AI which can be helpful for farmers, such models are (a) Chatbot (b) Agri-E-calculator for appropriate crop choice together with useful resource estimation (c) Crop care provider. (d) Price prediction and marketplace guidance (e) Crop loan and insurance provider.

- **Chatbot:** AI-powered chatbots (digital assistants) are now being used in the retail, travel, media, and coverage industries. However, agriculture may benefit from this period by providing farmers with solutions and advice for specific concerns. This carrier will allow farmers to have their questions answered via interactive voice chat in their language. For uninterrupted and context-sensitive learning, the chatbot engine is pushed with each supervised and reinforced machine learning technique. As a result, the chatbot will respond to the majority of frequently asked questions before requiring human operator assistance for more specific requests.

- **Agri-E-Calculator:** The Agri-e-calculator, as intelligent software, assists the astute farmer in selecting the most suited crop and affordability based on a variety of dependencies. The farmer can utilize the sophisticated calculator to select the preferred crop to be grown over his preferred insurance farm location. Then, based on various dependency factors, all other required inputs are mechanically diagnosed and delivered through the e-calculator, which provides the estimation results. This output result provides useful statistics on fertilizer price/quantity estimation, water, seeds, cultivation system price, and Labour Day efforts/price with Labor Day effort distribution on a calendar chart of the crop life cycle, crop yield, and extrapolated marketplace charge on harvest time and profitability. All of the specified inputs, both linear and non-linear, are obtained through the farmer's statistics base and the previously mentioned outside data assets. The inputs are processed using machine learning techniques, which give estimates with a feasibility analysis so that the farmer may choose the best crop to cultivate.

- **Crop care service:** Crop care covers everything from seed sowing to harvesting. Artificial Intelligence approaches are used to analyze the complex dependent records sampled from IoT sensors in the field, along with records gathered from assets of statistics websites, as well as field professional inputs when desired. The overall corrective motion object is obtained from the PID (Proportional Integral and Differential) controller mechanism after the evaluation of all records. As a result, the farmer receives an alert on their smartphone, prompting them to prioritize their actions based on the severity and urgency of the situation.

- **Price prediction and market guidance:** This service allows farmers to be protected against market fluctuations and reduces the risk of rate loss. A forecast rate and call for data are shared with the farmers for the duration of the crop lifetime, based on statistical facts gathered from several assets. As a result, farmers may make better plans for getting their products to market.

- **Crop loan and insurance service:** This service assists farmers in determining the viability of obtaining a crop loan, processing assistance, eligibility conditions, and loan limit based on the clever estimation performed for the suggested crop. It also makes it easier to get the crop insured as a precaution against crop failure due to unforeseen events or disasters.

Currently used AI technologies in Agriculture:

- **Blue River Technology:** Founded in 2011. This California primarily-based start-up combines artificial intelligence, computer vision, and robotics to construct next-technology agriculture device that reduces chemical substances and saves costs. Computer vision identifies every man or woman plant, decides on the way to deal with every man or woman plant and robotics allows the clever machines to take action. The use of sensors that locate weeds, the kind of weeds, and the proper herbicides to use in the proper buffer across the plant. The cameras and sensors use system mastering wherein the photographs are captured and the machines may be taught in distinctive weeds. Then moreover the proper herbicides are sprayed exactly according to the encroachment area. Blue River Technology has evolved a robotic referred to as See & Spray which reportedly leverages pc imagination and prescient to display and exactly spray weeds on cotton plants. Precision spraying can assist save you herbicide resistance.

- **Farm Bot:** Founded in 2011. The mission goal is to "Create an open and handy era helping everybody to develop meals and to develop meals for everybody." Farm Bot is an open-source supply mission permitting hardware, software program, and documentation changes and adds from users. The product, Farm Bot comes at a charge of $4000 and allows the proprietor to give up farming all via way of means himself. Ranging from seed plantation to weed detection and soil checking out to watering of plants, the whole lot is looked after via way of means of this bodily bot the use of an open supply software program system.

- **Harvest CROO Robotics – Crop Harvesting:** Harvest CROO Robotics has advanced a robotic to assist strawberry farmers to select and pack their crops. Lack of labourers has reportedly caused hundreds of thousands of greenbacks of sales losses in key farming areas inclusive of California and Arizona. The robotic choices up strawberries, assisting farmers to lessen the value of harvest labour.

  Strawberries want to be picked in a positive term and consequently certified pickers are needed. Harvests CROO Robotics believes that their invention will shop money, grow yields, lessen electricity utilization, and enhance quality. Watch this quick imaginative and prescient and study more.

- **Plant diseases diagnosis app – Plantix:** It is a cellular crop advisory app for farmers, extension people, and gardeners. Plantix turned into evolved via way of means of PEAT GmbH, a Berlin primarily-based AI start-up. The app claims to diagnose pest damages, plant illnesses, and nutrient deficiencies affecting plants and gives corresponding remedy measures. Users can take part withinside the online network in which they discover scientists, farmers, and plant professionals to talk about plant fitness issues. Farmers can get entry to nearby weather, get proper agricultural recommendations at some point of the season and acquire ailment signals as soon as an ailment is spreading in their surroundings. In this manner, the utility makes use of AI and devices getting to know to resolve the plant illnesses.

- **Prospera:** Founded in 2014. This Israeli start-up has revolutionized the manner farming is done. It increases computer imaginative and prescient technology that constantly screens and examines plant health, improvement, and stress. Their era captures weather and visible facts from the field and affords actionable insights to growers through cell and web. Their crew is constructed of computer scientists, physicists and agronomists blended with skilled Agri-commercial enterprise leaders

that together, are revolutionizing the gear with which they develop their foods. It has evolved into a cloud-primarily based answer that aggregates all current facts that farmers have like soil/water sensors, aerial snapshots, and so on. It then combines it with an in-subject tool that makes the experience of it all. The *Prospera* tool which may be utilized in inexperienced homes or withinside the subject is powered with the aid of using several sensors and technology like computer imaginative and prescient. The inputs from those sensors are used to discover a correlation among one-of-a-kind facts labels and make predictions.

Challenges with AI in Agriculture:

Though AI provides considerable potentialities for utility in agriculture, there still exists a loss of familiarity with excessive technical school devices gaining data of answers in farms throughout most components of the planet. Exposure of farming to outside components like climate things, soil things, and the presence of pests is pretty heaps. AI structures in an accumulation desire a mass of records to teach machines and to create explicit predictions. just in case of sizeable agricultural land, alevin although special records are also accumulated simply, temporal records are hard to induce. for instance, most of the crop-precise records are also received handiest as presently as in a very period whereas the vegetation area unit growing. Since the records infrastructure takes time to mature, it needs a considerable amount of your time to construct a robust device gaining data from the model. this is often one motive why AI sees an entire heap of use in scientific discipline merchandise comprehensive of seeds, fertilizer, pesticides, and then forth in preference to in-area exactitude answers.

Conclusion:

AI technology assists farmers to look at land/soil/fitness of crop and then forth and keep time and allow farmers to develop correct crop in each season that has satisfactory yield. Vertical cropping will reduce water usage, create inexperienced land usage, and is also cultivated in town regions in buildings. It will reduce the problems with labour inconvenience. permits prediction of ensuant twelve months crop seasons/weather/climate/rainfall and then forth. AI-based} predictions permit suggesting appropriate pesticides/crops/location at the correct time before Brobdingnagian scale prevalence of unwellness. With an oversized space withal untouched in agriculture for the intrusion of computerized reaction systems, there is also a sizeable chance for the agriculture enterprise to leverage the rising era of catboats for serving farmers with the solutions to any or all their queries and giving applicable recommendations and tips to their explicit farm associated problems. This in flip propels the boom of the AI marketplace in agriculture.

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