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Applications of Artificial Intelligence in Agriculture

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Abstract
Farming is as ancient as the human species. It is arguably the cornerstone of human civilization. But in the last century, farming has faced a decline in both quality and manpower. This research paper aims to discuss the applications of computer science and coding in farming. This modern approach combining recent innovations such as the internet, drones and satellite imaging with the age-old practices of irrigation, cultivation and nurture may be the solution for food shortages seen across the globe. The data for this research project was gathered via journals, research papers, government resources and the internet. If the methods discussed here is implemented it would enable farmers to supply crops in a more efficient and effective manner, it will reduce the food shortages faced across the nation and pave the way for a more conscious approach towards our planet and its ecosystems.
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I. Introduction:

Artificial intelligence is a study of how to make computers do things which at the moment people do better. In general words, it refers to the application of human intelligence to machines. The field of coding and AI have seen an unprecedented boom since the early 1970s when the advent of missiles and space missions necessitated vast amounts of coding across the world. As this code developed, so too did the need for automated machines that performed human tasks with greater efficacy and lower cost. Hence was born the era of software and computers.

The father of AI was Alan Turing, who first proposed the idea of machines who were sentient enough to be able to communicate with humans seamlessly. This idea has evolved into modern day chatbots, virtual assistants, call bots and automated messages. This concept of precise coding from missiles and the human friendly interface of chatbots may be combined to create unique programs that can be applied towards many problems. AI has found varied applications across multiple fields such as medicine, manufacturing, defense, pharmaceuticals, research, entertainment and so on. But, in the field of agriculture, AI has not been utilized to its full capacity. Thus, this paper aims to analyze the most recent developments in computer science and AI and to contemplate on their applications across multiple domains of agriculture such as sowing, growth, harvest, pest control and so on. It aims to tackle common problems associated with agriculture and to enable the application of modern solutions which will reduce monetary costs and the overexploitation of available resources.

Objective:

- To discuss the various applications of AI in the field of agriculture.
- To discuss the scope of such methods in modern India.
- If possible, to detect the environmental implications of the same.

II. Methodology:

Procedure:

The required information was gathered from across the internet, books on agriculture and coding along with interviewing a few farmers of Kodagu district, Karnataka to identify common problems that they face in both cash and food crop cultivation.

Problems faced by farmers in the field of agriculture:

1. Detection of pests
2. Prevention of pest infestations
3. Detection of weeds
4. Removal of weeds without wastage of valuable crops
5. Detection of insects

Common crops affected by pests with their names:

PESTS	CROPS AFFECTED
Thrips	Groundnut, cotton, chillies, roses, grapes, citrus, pomegranate, tea, grapevine, castor, cotton
Mealybugs	Beans, cashew, cassava, coffee, cocoa, citrus, cotton, groundnut, guava, jute, sugarcane, sweet potato, tomato, apple, apricot
Berry Borer	Coffee
Aphids	Wheat, barley, oats, ladyfinger, brinjal, guava, chillies
Weevil	Coconut, jute, cotton, sorghum, pearl millet, maize
Rice skipper	Rice or paddy
Gall midge	Rice or paddy

Possible Solutions:

1. Detection of pests:

Usage of drones:

Drones are used across the rafters and on the rooftops of nearby buildings. This has been undertaken to find the location of the pest very quickly and effectively so as to plan accordingly to remove them.

Usage of Thermal imaging cameras:

This technology can detect insects on the walls, ceilings voids and other common spaces. It uses infrared radiation and is used to heat map the surface, and detects anomalies such as unusual regions of heat. Pests active in the night can be tracked by infrared cameras but the pests or the insects behind the wall cannot be tracked through this method. Wasp nests, beehives, and other clusters of social insects, can generate enough heat to be detected with a thermal imaging camera.

Usage of Internet of things:

Traps and devices with monitoring functionalities like automated insect monitoring devices, camera-enabled traps, and pheromone dispensers can connect to each other to collect and transmit data in a much more efficient way. The data that these devices gather can make it easier for homeowners and pest control services to find solutions in the management, prevention, and elimination of pests.

Heat detecting drones:

This device combines drones with thermal imaging technology. They can be beneficial for controlling pests in farmlands and large estates. By using drones to find pests instead of manually inspecting each area, pest control services can localize and detect infestations more efficiently and figure out the best course of action more quickly.

Electronic Pest Repeller:

The Electronic pest repeller uses a powerful combination of electromagnetic, ultrasonic, and ionic technologies to safely and ecologically keep pests away from farms. A range of different products are available including common roach killers, and others that cover a wide variety of pests including mice, spiders, ants, ticks, mosquitoes, even scorpions, bats and more. This may be modified to accommodate for wider areas and towards pests unique to a specific region. Therefore, such a device placed along regular intervals will assist immensely in covering huge areas of farmland and will be effective in pest control overall.

Acoustic Sensors:

Acoustic sensors can be augmented in the drone and can be used to detect pest at the early stage rather than spoiling the crops when the yield is ready this method can be undertaken if implemented. Drones can use these sensors and detect the pests so as to improve the yield at the further stage. This sensor works by monitoring the noise level of the insect pests. When the noise level of the pest crosses the threshold, a sensor transmits that information to the control room computer, which then accurately identifies the infestation area. These sensors help detect an infestation at a very early stage, thus greatly reducing crop damage. This is a great tool for the monitoring of large field areas with very low energy consumption.

2. Detection of weeds:

Weeds are the unwanted plants that are present in between the crops. An important one is functional: they interfere with food and fiber production in agriculture, wherein they must be controlled to prevent lost or diminished crop yields. Other important reasons are that they interfere with other cosmetic, decorative, or recreational goals, such as in lawns, landscape architecture, playing fields, and golf courses. Similarly, they can be of concern for environmental reasons whereby introduced species out-compete for resources or space with desired endemic plants.

Based on Deep Learning:
Deep learning has a unique network feature structure, and features extracted using various deep learning methods are more effective than manually extracted features. In the field of weed detection, deep learning methods use spatial and semantic feature differences to realize the identification and detection of crops and weeds and effectively improve the accuracy of weed identification and detection. In recent years, commonly used deep learning networks to solve the problem of weed detection include CNNs and fully convolutional networks (FCNs). Various methods in semi- and unsupervised fields have also emerged to reduce the labelling cost. In many cases, classification results obtained using these deep learning algorithms are better than those generated using traditional algorithms. The use of traditional algorithms to classify different types of crops with high accuracy is still difficult. Deep learning methods need to rely on a large number of datasets for training, and the difficulty of collecting crop and weed images also demonstrates the disadvantages of deep learning methods for weed identification.

3. Weed Detection:
Detection of weeds can be done without pulling or removing them manually by hands or using weedicides. Some apps coded with pictures to detect them can help farmers prevent the loss of yield. This method can be undertaken at the early stage of growth. Artificial intelligence can be used to create a database of pictures of the weeds, its respective species, the area where its prevalent and the crop most affected. This database can be fed to the app such that it can detect the weeds using computer imaging technology. The app must be connected to drones with sensors so that it can detect weeds across the farmland or acreage. This requires lots of research and procedures to be implemented before full-fledged production can commence. The app will be able to identify the weeds and then it should be able to send a message to the drone which can be further implemented by using SSSA automated drone such that it can pull the weeds precisely without manual interference. The farmer should easily be able to install the drone apparatus and the requisite app.

4. Detection of insects:
Automatic Monitoring of Lepidoptera Pest Species:
A wide range of moth and butterfly species, such as Gypsy moths, Codling moths and Diamondback moths are known to cause significant yield losses in many crops worldwide. These insects are able to lay a large number of eggs, and the larval stages feed voraciously, causing direct defoliation, thus leading to huge losses when populations are well developed. Currently, the usual surveillance method is based on delta traps with pheromone lures. However, due to the multiple poses that these insects can display when attached to sticky traps, the development of automatic detection and identification models is quite challenging. Silveira and Monteiro developed a tool to automatically identify eyespot patterns of the Nymphalid butterfly, using a machine learning algorithm with features based on circularity and symmetry to detect eyespots on the images. The software was also able to successfully recognize patterns of other butterfly species.
Automatic Monitoring of Sucking Insects:
Sucking pests are among the critical factors causing losses in greenhouse environments. Thrips, aphids, and whiteflies are recognized as some of the most problematic pests when crops are cultivated in congested conditions in closed areas. Usually in greenhouses, sticky traps are placed in order to monitor the populations of these pests. This method can be considered a difficult task for not specialized professionals. Using threshold algorithms, Bodhe and Mukherji developed a system to detect and count whiteflies using image analysis. Applying texture and shape analysis, Ghods and Shojaeddini created an algorithm that could identify whiteflies in plant leaves with 85% accuracy. Blasco et al. developed a prototype to monitor insect traps placed in the field by capturing and sending images of the trapped insects to a remote server. The device was created on the basis of a Raspberry Pi platform and incorporates a camera to capture the images, a control board to program the image capture intervals and a modem to send the images and additional information to a remote media server.

III. Conclusion:

If the methods discussed here is implemented it would help the farmers in a higher rate. These methods can be used so as to increase conscious farming. Farming in these methods can help farmers to reduces their labour wages while also being mindful of our planet. This way of farming can reduce food shortages across the nation and can reduce the nation’s suffering of scarcity. We may also be able to help farmers supply crops to the markets at a faster rate.

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