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# Automation in Agriculture: An Application of Computer Vision Technology

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**Abstract –** *In this era of 21st century, technology has significantly impacted our lives. There have been fascinating innovations and product releases using technology which have impacted almost every sector of industry. Agriculture is one of the fields which has been significantly impacted by the technological advancements. Modern agriculture is driven by the continuous improvements using the digital tools and data which has increased the processes involved in agriculture. This paper describes in detail the extensive application of computer vision in automating the processes of agriculture. Making the best usage of agriculture will help the farmers to greater extent to get the better quality of seeds, to use chemical fertilizers effectively and for proper irrigation process. Technology has changed the concept of farming thus making it more profitable, efficient, safer and simple. Computer Vision is one such field whose extensive application in agriculture can be largely beneficial for automation. The intelligent systems based on computer vision are becoming in agricultural operations thus increasing the productivity. The rapidly growing population will lead to gradual reduction in the cultivated land and this will increase the productivity pressures on agriculture. The traditional agricultural methods should now be equipped with the digital technologies and efforts have to made to make the processes involved in the agriculture some simpler and productive. Focus should be given on using communication and information technologies to improve the total yield and quality of the crops in agriculture.*

*In this era of 21st century, it is extremely important to be aware of the technological advancements happening around and applying these advancements for the betterment of human life is the need of the hour. This paper therefore, highlights one such application of technological advancement in the field of Agriculture.*

***Key Words***: **Computer Vision, Artificial Intelligence, Intelligent systems, Machine Learning, Deep Learning, Bounding box annotation**

## 1.INTRODUCTION

Technology plays a vital role in the automating the processes of Agriculture. Computer vision is one such technological revolution which is a field of Artificial Intelligence. It enables the computers and systems to derive meaningful insights from the digital images, videos and other visual inputs. Based on these inputs, it takes actions or makes recommendations. Artificial Intelligence enable the computers to think but computer vision enables them to see, observe and understand. The technologies such as graphics processing units and deep belief networks have greatly improved the ability of computer vision improving its efficiency. Farmers have been largely benefitted by the advanced in the technology and the extensive applications of technology have impacted their yield effectively. Computer vision has numerous applications not only in the field of agriculture but also in the fields such as healthcare industry, retail industry, security, finance and many more such fields. The unavailability of manual labour, the high labour cost and the increasing aesthetic standards of agricultural products are the factors encouraging farmers to adopt latest automation technologies in order to minimize the cost of production and improve the crop yield with better efficiency. As agriculture is considered the economy boosting sector, it is one of the very significant factors that make every nation stand out in the global market. The countries which have already adopted the measures of automation and have been using the advanced technological applications are dominant in the agricultural exports, but on other side, those who lack in automation, use underdeveloped methodologies and suffer from high-labour costs result in higher production costs. The sub-branch of computer vision aims at training the computers for interpreting and understanding the visual world. Using computer vision, machines can accurately detect and identify the images and make meaningful interpretations out of them. The domain of computer vision has been increasingly gaining significant foothold in agriculture. Computer vision has improved the overall agricultural sector's functioning by yielding better productivity to lowering the production costs.

## 2.Computer Vision in Agriculture

The Agricultural field has witnessed the usage of well-trained robots used for performing tasks such as planting, weeding, harvesting and detecting the plant health. With the help of such robots, it is possible to detect plants, weeds, fruits and vegetables and analyse the health condition and thus determine the harvesting time depending on the capability of the crops. The annotated data in format of images or pictures are used to train computer vision AI model to make the object of interest recognizable to machine using machine learning algorithms for similar predictions. There are numerous techniques to annotate image for robotics in agriculture. Bounding box annotation is a low-cost annotation service for artificial intelligence and machine learning companies to seek high quality training data. This annotation is used to make the plants recognizable to machines. The bounding box annotation is used by many

Artificial Intelligence companies to detect plants, check their fructification levels and recognize unwanted plants or weeds. Bounding box detection rightly provides inputs to computer vision for detecting the plants.

## 3. Applications

i. Crop Monitoring

Traditionally, the monitoring of crops relied on the subjective human judgement, which used to be not very accurate. Crop monitoring is an aspect of precision agriculture which captures the information at different crop growth stages. The real time monitoring of crops using computer vision can accurately detect the minute changes in crops due to factors such as malnutrition. These changes can be noticed well before human monitoring and this can provide accurate and reliable analysis for timely regulation. The existing computer vision functions can suitably address the limitations of traditional monitoring in terms of cost, time and continuity. Using computer vision technology has the benefits of low cost, small error, good robustness. Drones can used for crop monitoring, where the autonomous flying object can capture a huge amount of data using the camera installed for computer vision detection and training. Drones are used to get the aerial view of the field and create a 3D map which can be viewed on a computer screen to monitor the health of the crops, check the soil conditions through visual sensing ad geosensing. Apart from the techniques such as bounding box, semantic segmentation image annotation and polygon annotation can be right used to train the drones to map the agricultural fields and thus analyse the data to obtain the actionable insights.

ii. Preventing the crops from diseases

Crops should be rightly protected from crop diseases, weeds and insects to obtain high-quality agricultural products. Traditional methods lacked in effective prevention of crops from diseases because of lack of relative attention, poor timeliness and poor accuracy. By using the application of computer vision, timeliness and accuracy can be greatly improved and the ability to control diseases or pests can efficiently attained. Farmers currently sample the pests, manually count and then identify them which is a very time consuming and labour-intensive task. Computer vision can carryout these tasks in much more accurate and efficient manner. Deep learning, is one of the latest advancements in the field of computer vision and it is expected to classify finely grained disease severity in a quick and accurate fashion. The machines combined with computer vision and multitasking can be used as intelligent agriculture machine which is capable of automatic weeding and carryout irrigation on the cultivated land. These machines are capable to classify weeds and plants, so that the machine can weed and water to maintain a deep soil moisture content. The Artificial Intelligence enable drones are capable to monitor the infected crops and spray the insecticides and pesticides in order to prevent crops from insects and pests. With the help of computer vision, drones can precisely detect the infected crops and spray the pesticides accordingly. As the vision power of the computer improves, more precision will be useful to protect the crops.

iii. Quality Inspection of Agricultural Products

The quality of the agricultural yield is also one of important factors in the process of agriculture. By using computer vision, automatic grading and quality inspection has been possible. The technique of computer vision is gaining significant importance as it avoids the high cost and low efficiency of traditional methods and operations. The techniques of deep learning and spectroscopy are the powerful tools in analysing the fruit quality and thus sorting the fruit types. Especially, for fruits computer vision has been used for shape classification, quality grading, defects detection and variety classification. Computer vision has also been applied to measure the objective stage of mushrooms. This quality inspection is carried out in five different steps in computer vision which are image acquisition, pre-processing, image segmentation, feature extraction and classification.

iv. Automated Management Systems

The Automated management of modern farms is the concept that has been emerging up recently. This offers precise operation, high efficiency, intelligent decision making, environmental protection and visual management of the fields. This automated management provides wealth of knowledge and insights of practices and decisions of farmers. This approach will help save manpower, material costs and eliminate the hard work of the farmers. This takes care of soil management, agricultural produce estimates and crop maturity testing. Research has been carried out in building an image acquisition system to capture the image of the soil and analyse through the algorithms of computer vision. The crop maturity is yet another aspect which is challenging to obtain in unstructured environments. There is also maturity detection device that is used for the images of tomatoes in the experiments. The maturity of the crop can be detected using computer vision based on the colour feature value. Crop yield estimation is also one the crucial steps in agricultural processes. In the computer vision technology, a co-relation between number of visible fruits in digital image and total number of plants are used to calculate the total yield. In the similar way, for agriculture the total number of crops harvested is taken into consideration to calculate the total yield.

## 4. Conclusion

Thus, it can be seen that the applications of computer vision are quite extensive in the field of agriculture. The paper focussed on the four major applications involved in the agricultural processes which are crop monitoring, preventing crops from diseases, quality inspection and automated farm management systems. Computer Vision can be seen as the emerging technology that would boost the agricultural yield and efficiency. But at the same time, as the practice of using computer vision in the farms is not very prevalent, efforts must be taken to test the techniques

adequately in the laboratories before implementing them in the fields. In the near future, it can be seen the technologies such as deep learning and spectral analysis technology will be taken forward to develop the systems in more intelligent ways. Computer vision will definitely act as a major technological revolution in the field of agriculture, improving the efficiencies of the processes involved and providing actionable insights to the farmers.

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