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A Review on Developing Tech-Agriculture using Deep Learning Methods by Applying UAVs

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ABSTRACT

UAVs are replacing the manmade aircrafts or the satellites because of their peculiar feature of capturing high-resolution imagery below the cloud level. These drones are capable of collecting, mapping, processing and automation for computation using inexpensive open source tools. Now, invent of Deep Learning techniques took a great insights in handling the image datasets gathered by drones. Deep learning methods employed to experiment in finding the differences in the images and as well to improve the societal needs. Drones are boons for farmers in agriculture sector. Applying the Drone technology answers many issues in the field of agriculture. As agriculture is the major occupation of developing countries like India. Scarcity of food resources, reduction in land dimensions, high-end labour costs, uncertain weather and price of the crop yield are some of the factors prove to be peril profession. Technology supported agriculture is at present required to meet the needs. This can be achieved with invent of UAVs in agriculture for smart farming. This article briefs the application of drones in various aspects of agriculture. The methods applied assist in improving the farming practices. The main aim of this paper is to implement the drone technology for advancing the Indian agriculture.

Keywords : Deep Learning, Drones, UAVs, Agriculture, Artificial Intelligence, Neural Networks

I. INTRODUCTION

Size of the earth stays to be a constant but population spawns, increasing variably. From the intelligent systems, it is clear that the amount of crop yield prevailing in towards world will become scarce by 2050. The shortage of crop production can be due to various reasons such as water scarcity, weather conditions, urbanization and lack of humans working in agriculture sector [1,2]. Humanity has been dealing the scarcity of food since from all the past, but some solutions such as food preservation, invention of fertilization and mechanized farming to speed up the process. However, due to the exponential growth in the population globally, development of transport sector, urbanization and decrease of farming land are likely to decrease the quantity of crop production to diminish drastically. Pollution, soil-erosion and environment circumstances are added factors by degrading the quality of land. Now, it is high time to take some necessary action to protect the resources, which are very much essential for growing crops.

To address the prevailing problems advanced technologies are required to automate the things and take necessary actions timely. AI and DL are some of the technologies, which can be adapted to address these problems [3]. Many researchers and scientists are working towards these problems widespread across the agriculture sector. Prediction, weather forecasting, crop outcome, monitoring water levels, detecting crop diseases, type of soil and removal of

weeds are some of the major areas of research through deep learning methods [7].

Deep learning is a computing method, which is extremely powerful. It trains a computational model to understand and recognize complex patterns in data [9]. Pixel identification of an image allows the model to recognize the important features and as well, the difference between the images and their location are educated using a training dataset. Drones and satellites collect images for training data set in order to training the model to know the changes in the growth of a crop, to visualize the diseases and to control the weeds [4, 5].

In this paper, section 2 suggests the features for improving farming exercises. Section 3 describes the review of various drone application in the agriculture sector. Section 4 discusses the workflow of drones and the generation of mapping from images to process the computations. Finally, section 5 concludes by suggesting the government to implement the use of UAVs for Indian agriculture.

II. ADVANCEMENTS IN THE AGRICULTURE SECTOR USING DEEP LEARNING

Agriculture plays a vital role in Indian economy, as it is the main occupation for many states in India. Protecting and providing the necessary equipments and tools is the minimum need to accomplish. In this section, some issues to advance the farming in India using deep learning techniques and application of UAVs are addressed.

A. Effective Farming

Crop yield is affected with variety of reasons such as quality of soil, weather, superiority of seed, timely water supply and time of harvesting, fertilizers, pesticides, diseases and unwanted growth of weeds. These problems are solved by applying deep learning techniques. The deep learning models are trained with set of image collection by which the model automatically identifies the diseased crops and weeds. Blue River technology uses an automated mechanized tool, which detects the diseased crops and weeds, and passes a blue marks on those crops. These crops are supposed to be removed manually. Once the extent of problem is identified in the fields farmers are instructed to treat only those areas, which ultimately increase the production and crop yield [8, 9].

B. Diseases identification in plants

The dataset has 5000 images to distinguish healthy plants and infected plants for disease identification. The model developed train on these images and a test set is observed for high degree of accuracy. The infected crops affect the crop yield in a larger portion very rapidly. Detecting the early stages can wipe tears of many smallholder farmers. The recent advancement benefits the farmers in which plant diseases are examined by rapid identification by eradicating the devastating consequences such as famine in the area.

C. Prediction of market requirement

This methods aim is to observe the present requirement of the commodity by using deep learning technology to analyse the images faster and forecast the needed requirement. This model builds patterns to predict the commodity requirements over time. As the need increases necessary arrangements are recognized to improve the productivity.

D. Pesticides reduction

Weeds are becoming more challenging to grow herbs where as chemical treatments are becoming mandatory to avoid diseases for trees and plants. These pesticides usage should be reduced initially and in due course their usage should be avoided. LettuceBot, a product of Blue River Technology uses the deep learning methods to identify sprout as a lettuce or a weed. They implement the algorithms for detecting using machine vision. This automatically pins the weeds and unfledged the weeds. This technique improves the crop yield as well as provide healthy crop.

E. Crop Selection

The type of soil, climate, fertility, and region are some of the features that definitely affect the crop yield. Machine learning methods provide deep insights in determining the relationship crop selection and yield prediction. Many factors affect the crop yield. To better analyse the effect of natural calamities on the crop production and choose the best crop based on the soil and climate meets the improved crop yield.

F. Weather Forecasting

Indian Agriculture mainly relies on seasonal rains for proper irrigation. Prediction of weather plays an important role in crop yield and harvesting. Plenty of water supplies are needed for some crops like rice, sugar cane, plantations etc. Accurate weather information does not reach farmers and which cannot take necessary precautions priorly. Some applications are recent developments for providing the dynamic updates of weather over time. These weather forecasting applications are showing best results in prediction analysis.

G. Minimum Support Price for Crop

Government decides Minimum Support Price (MSP) basing on some factors such as cost of production, fluctuation in input costs, demand, price trends, crop variety, quality and supply. Machine learning algorithms are appropriate to understand the best price for the product after proper and through training on the factors relating the dataset. They provide a comprehensive analysis on the data set in order to give best price for the crop. Still government has to recommend best minimum support price for the welfare of farmers. It has to take necessary action that the price of crop should not fall down and creates a loss for the poor smallholder farmers [8].

III. REVIEW ON UAV APPLICATION FOR AGRICULTURE

The above advancements in agriculture can be developed by using smart sensor suites and also autonomous called Unmanned Aerial Vehicles (UAVs) for best outcomes. Recent improvements in inertial measurement units (IMUs), cameras and flight control systems led to rapid application of UAVs for remote sensing methods. These UAVs capture the information of a single object with various dimensions and angles which can be grouped as data or as multi-spectral images. Let us interpret these automated machines A scale-invariant feature transform (SIFT) and a supervised extreme learning machine classifier are used for autocorrelation and matrix representation of image as a shape feature.

Recently Colombo based international water management institute used UAVs to supervise the paddy crops in and around the water scarce area of Anuradhapura. The sensors captured images of paddy fields to detect the low laying areas prone to pooling. These methods improved the cropping patterns, shifting of water resources and extent of environmental disasters to monitor the crops. This has become a conventional machinery to sow and harvest as well [10].

Water was the deciding factor for a poor irrigation in Nigeria on rice plants. Due to poor irrigation infrastructure the rice cultivation is rain fed in Africa. As a UAV technology project implemented in Africa boomed the planning this resulted in accurate productions. UAVs used for estimating the required amount of fertilizer and planting material needed for that growing season. This advanced the precision agriculture in Africa [11].

High resolution imagery of green vegetated areas was collected to identify locust affected regions in Ethiopia. The teams are able to use the data collected by UAVs to find suspicious locations. A separate control UAV is to administer pesticides directly onto locust concentrations. Human operators no longer need to expose for potentially dangerous pesticides. Pest control operations also become effective as UAVs regulate the accurate dose of pesticides and methods [12].

Spectral signature assists in revealing the inner facts whether individual plants are thriving or whether they are stressed by any other factors. The other factors can be drought, deficit of nutrients or attack of insects or a virus. The signatures are analysed by determining the measurable differences in the wavelength of light, which reflects the exposed sunlight, and density of air for a proper growth in a crop in Tanzania [13].

Drone used for farming Source: [6]

Crop damage assessment and accurate estimated yields are major challenges for farmers in India. These devices collected data that assist the agricultural analysts, farmers and insurance companies to improve crop insurance system to assess the damage caused due to natural disasters. This loss resulted in killing of farmers themselves every year. The other reason could be the crop insurance and climatic flippancy [14, 16].

The plan to use UAVs in this research is to identify maize plants from confounding vegetation such as inter-copped beans, weeds or small bushes. The model is tested for high quality images which do not deviate due to the environmental conditions. Reflectance values relating the object automate it to standardize the image that has been used for the flight. Finally time series crop yield are used to understand fields and crops to improve farming practices [15, 17].

Coconut's of Samoa are renewable resources and produces various export products like oil, cream, fibre and shell products to other countries. The research was conducted to find the virgin coconuts in Somoa. The best solution was to use the UAVs to identify the virgin coconuts in the region. These drones were used to capture images of those farms which are not easily accessible. It gives the flexibility to fly until the weather permits supporting the digitization project [18].

Laurel is a fungal disease found in trees caused by Beetles. The disease has a particular devastating effect on commercial avocado grooves in US. Detecting the laurel wilt was a major challenge. Disease spread rapidly to other trees via root grafting. The UAV technology alone was not just enough to identify the cause. That is where the role of dogs comes in. Dogs have up to fifty times olfactory receptors to sense the odour efficiently than human. Dogs are trained to detect the odours and UAVs are used for searching the affected areas. The combination of technology, research and assistance of dogs could be the solution to fight against the farmful fungus [21].

A pipeline counting technique is used to estimate the fruit count of two different datasets of oranges in daylight and green apples at night. A deep learning convolutional network algorithm is adapted to estimate yield and manage orchards in regards to many factors such as labor allotment, storage, packing, transportation and management. Smart sensors UAVs will benefit the growers to forecast the accurate yield. The method performs well on highly occluded fruits that are challenge human to annotate [23].

Scale-space filtering (SSF) algorithm is applied to detect trees of different crown sizes. To implement the model UAVs are applied for detecting the forest inventories by reducing cost. These UAVs capture information of single papaya tree in China to determine the plantation improvement and yield

prediction. The applied methodology focuses on image quality and color transformation for improving computational efficiency [24].

The use of palm oil is extensive in tropical regions like Malaysia. Supervising the growth and maximizing the productivity is increasing challenge in these regions. The trees considered under study are mostly grooved and has crowns overlapped. Remote sensing techniques are used for automatic tree crown detection by filtering and image binarization. Model used polar shaped matrix representation of an image and standardized the dimensions of features [25].

IV. GENERATING MAPS FROM SMALL DRONES

The following are steps, which illustrate small drone mapping workflow, are divided as follows:

A. Map Design and Flight planning

Identify the required sensor like visible light, infrared, multispectral and hyper spectral basing on the dataset. In regards to the sensor chosen proper GSD-Ground Sampling Distance is to be computed for a suitable resolution of the map.

B. Image Acquisition

Ground Control Points are to be determined for positive identifiable aerial images. Safe operation of flight and landing should be monitored once the flight plan is executed for operation.

C. Image processing

Mapping the needed resolution is aligned by setting the workflow using Structure from Motion technique. This process can be accelerated for accurate positions of flight controller, camera and subsequent products.

D. Preparation and Visualization of geo-spatial products

3D visualization is used to track various factors for improving the vegetation health, building detections, terrain evaluations with regard to drainage and irrigation, volume calculation and crop heights.

E. Extracting essential information

CAD or GIS systems extract mass data in huge volumes. It is essential to perform analysis on huge data which assist the surveyor navigates over virtual terrains to map and reduce the fieldwork [19, 20].

V. CONCLUSION

Agriculture is a field that has been lacking the mass adoption of technology and its advancements. Indian farmers need to be up to the mark with the international techniques. Deep learning is a naïve approach to understand the peculiarity, development and faults by image processing techniques. It has already established its prowess over conventional algorithms of computer science and statistics. Deep learning algorithms have enhanced the accuracy of artificial intelligence machines including sensor based systems used in precision farming. This paper has reviewed the various applications of Deep learning by application of UAVs in the farming sector. It also provides an insight into the troubles faced by Indian farmers and how they can be resolved using these techniques.

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