Review on Drones for Crop and Vegetation Monitoring

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Abstract: In recent times the use of UAV or drone has increased by a significant amount. Present monitoring techniques has some limitations including range, resolution, proximity etc. With use of drones for monitoring some of these limitations can be eliminated. This paper is a review on crop and vegetation monitoring techniques with UAVs or drones in focus. This paper includes the review of literature in context of using drone and capturing image in order to achieve monitoring of certain area. This paper tries to find out the various applications as well as advantages in particular. Also, the paper attempts to find out the issues related to with the techniques.

Index Terms **-UAV, Drone, Crop, Vegetation, Monitoring.**

INTRODUCTION

The crop and vegetation monitoring system has always been a crucial part of estimation and conservation aspects of any economy. The forest is a resource of not only the natural consumables (wood, food, oxygen etc.) but also it protects the diversity by protecting the wild species. On the other hand, crops provide food to the human kind in turn keeping them alive. According to world population prospects 2019 published by United Nations projections the trends of population growth will follow 8.548 billion in 2030 to 9.735 billion in 2050. [1] To take care of this growing population a sustainable ecological system is important and hence comes a responsibility of monitoring them.

1.1 Necessity Crop and Vegetation Monitoring:

1.1.1 Crops:

1. The crop monitoring can benefit the farmers in many areas including monitoring crop health, density, colour and spread of crop, height of canopy without actually being near them. [7]
2. The problems of water and fertilizer distribution including the effect of pesticides and herbicides can also be monitored using the crop monitoring technology. [10]
3. It can also find applications in government or private crop survey in the cases of insurance and assessing the damage to the crops in order to analyse the damage and calculating the return or help package required.

1.1.2 Forest and Vegetation:

1. The depleting forest cover can be analysed using UAV's since it provides closer assessment.
2. The distribution of flora and fauna can also be assessed using UAV.
3. It can also help ensure the work flow and nature of restoration activities.

The paper attempts to find out existing literature in the aspects related to crop and vegetation monitoring and tries to find out different methods used for crop and vegetation monitoring and their relative efficiency.

LITERATURE REVIEW:

Zhang J. et al (2016) [2] This Paper evaluates the value of drones in long term ecological studies. Data from 20-ha Dynamic plot was analyzed using drone derived canopy variables ground based mapping and topographic and edaphic variables. The key findings were 1. The drone derived canopy variable contributes in supporting gap dynamics hypothesis of structuring observed forest diversity. 2. The substantial evidence is found that drones can prove to be a major asset in long term ecological monitoring by providing low cost and high-resolution data.

Almeida D. R. A. et al (2019) [3] Author used UAV-borne lidar system used for monitoring the forest. The experiment was conducted in brazil's Atlantic forest with 20 native tree species were analyzed three structural variables from lidar data (canopy height, gap fraction and leaf area index) and field inventory data. The paper points out enormous potential of forest monitoring using UAV. Also, the author suggests using UAV in forest restoration project and forest landscape restoration.

Kavoosi Z. et al (2018) [4] this paper describes monitoring crop residue cover (CVC) using remote sensing technology. For the following purpose author used Landsat 8 OLI data and images capture by drone. A total of 23 indices where used to remote sense CRC. The author found out that drone capture images can estimate amount of CRC but the images captured by Landsat 8 OLI were slightly more accurate than that of drone. the author also points out that the drone imagery has lower expenses easy access and more spatial and temporal resolutions with control over desired data range.

Murugan D. et al (2016) [5] In this paper the precision agriculture monitoring is done using freely available satellite data and drone imagery.it was proposed to classify the vegetation into sparse and dense vegetation. The Landsat images were classified and has been verified visually by overlaying drone imagery. The proposed method can successfully do the classification and it has been validated by comparing both Landsat and drone images

Park S. et al (2018) [6] The author has used a small drone that can collect sensor information with the help of gateway mounted on fuselage. In this tests were carried out and data was collected by a hovering drone. The objective is to collect data from large farm or forest fields. The experiments were conducted and certain issues were identified that the battery and gateways sensitivity and humidity proved to be a small hurdles. It is also stated that LoRa and drone can be applied to monitor the vegetation.

Duffy J. P. et al (2018) [7] This paper uses a technique using lightweight drone with very high spatial resolution camera. The author state that the satellite and airborne platform like airplanes can suffer from temporal and spatial inconsistencies. The drone imagery was used to detect threats such as scarcity of water, quality and wasting disease and declining in meadow quality. The author predict that the lightweight drone and future developments can carry out the operation more successfully and will soon surpass the existing quality.

Assmann, J. J et al (2018) [8] In this paper the author attempts to discuss the challenges, technical aspects and practical considerations of vegetation monitoring using multispectral drone sensor. The author also proposes a workflow based environment on remote sensing using drone. The challenges enlisted by the author largely covers the sensors led aspects and relevant errors while it can be understood that the optimum working of sensors requires drone stability and hence a stable drone design is necessary.

Reinecke M. et al (2017) [9] The paper sheds light on benefits of drones in agriculture and drone assisted farming. The emphasis is laid on the drone camera technology to detect pests and water shortages. The author enlists several benefits including farm monitoring, digital maps, crop health detection and detection of size and scope of an outbreak. The author infers that using monitoring application of drone in early warning system of an agricultural field can be a huge help for the farmers.

Murugan D. et al (2017) [10] The author attempts to cover the challenging task of monitoring agriculture over a large scale. A combination of drone and satellite is proposed for agricultural monitoring. The author also attempts to minimize the repetitive use of drones by developing an adaptive approach. The approach adapts image statistics and finding threshold to maximize OA and minimize FAR. The author suggests that this approach of monitoring can be used by government agricultural agencies, policy makers, farmers and also insurance agencies for Fasal Bima Yojna, India.

Malik Basso et al (2019) [11] The author told that UAVs activities reduce soil compaction as compared to heavy machinery as well as reduce waste of artificial substances through punctual and self-regulating application. Main intention of wok is to design and develop of entire system composed of hardware and software architectures. From observation author told in this paper i.e. proposed system has better performance than work found in article. Further, the main intention is to develop the system A.I artificial intelligence of conducting UAVs more accurately into plantation area.

J.M. Guerrero et al (2013) [12] in this paper author suggested about techniques first one is separating green plants(weeds) from soil and second one is system geometry where expected crop lined in image. The paper generates a crop row detection model with satisfying quality. While the future estimation suggests the use of similar technology in detecting weed.

CONCLUSION

This paper compares different technologies of crop and vegetation monitoring along with its advantages and applications. Various entities such as water scarcity, canopy heights, weed and pest's detection, crop diseases etc. can be monitored and observed using drones or UAVs. The comparison between satellites and drones in the existing literature proves to be an essential analysis in identifying the proper application of these technologies. The satellites might have the high-resolution imagery equipment but the distance proves to be the hurdle which requires high end image processing which requires substantial cost. Hence using drones with low capital cost over smaller areas will prove to be revolutionary in areas like insurance claim. In some literatures use of UAV's with satellites in combination or as a validation for each other is proposed. The drone is found to be useful as well as efficient in crop and vegetation monitoring and hence a design approach should be suggested for the same.

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