Ergonomic heavy-lift pesticide dispeller drone instilled with an intelligent atomizer to achieve optimal spray and improved pest control

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Abstract—The traditional method of farming can be replaced by bringing the UAV technology into play. The main idea of this paper is to project a new idea to control the pest rate with the help of Unmanned Aerial Vehicle (UAV). The drone carries a multispectral high-resolution camera which captures the image which serves as the base data for the learning. The existing data sets are used to train the models. Then patterns are analysed to identify the disease in the captured images. Using this strategy, we can get the possible results in which the healthy crop can be differentiated from the infected ones. The drone will be designed to have different compartments to store a variety of pesticides based upon need. A particular compartment selection and the quantity of a pesticide to be applied will be programmed and controlled effectively using micro-controller. If an infected crop or crop area is detected the processor not only triggers the sprayer present in the drone to spray the pesticides only to the affected area but also, controls the amount of pesticide to be sprayed. This in turn saves lot of time and improves the economic and health condition of farmers.

Keywords—Multispectral Imaging Camera; Unmanned Aerial Vehicle; Raspberry Pi processor

1. Introduction

In and around the globe the major factor which affects the farm products and in turn the farmer economically is the pests and insects. The only way to overcome this issue is by using pesticides. But the major problems in using the pesticides are health of the farmer affected by pesticide spraying, in-adequate or excess spraying of pesticides, illiteracy in monitoring the spray and many more aspects.

In general, the farmers are continuously exposed to pesticides during instant spray, spray from neighboring fields, or by contact with pesticide remains on the crop or soil. This nature exposure is underestimated most of the times. The absorption by skin and inhalation through nose are typically the most common routes of farmers' exposure to pesticides. Dermal exposure during raw handling of pesticides handling takes place in body areas that remain uncovered by protective clothing. Excessive use of pesticides may lead to the destruction of biodiversity. Many flora and fauna are under threat because of harmful pesticides. The best solution for the above problem is to keep farmer away from pesticide and to spray controlled amount of pesticide to tackle the disease.

2. Disease Detection Survey

Disease detection is the most significant concern in agriculture in arable farming and greenhouse scenarios. The most extensively used practice in pest and disease control is to homogeneously spray pesticides over the cropping area. This practice, even though effective, has a high financial and significant environmental price tag. Environmental impact can be residues in crop produce, side effects such as ground water contamination, destruction of local wildlife and eco-systems, and so on. Machine Learning is an incorporated part of agriculture management, where agro-chemicals input is embattled in terms of time and place.

In the literature, Pantazi et al [1], a tool is introduced for the detection and identification of fit Silybum marianum plants and those contaminated by smut fungus Microbotyum silybum during vegetative growth.

In [2] Ebrahimi et al, proposed a novel method based on image processing algorithms for the classification of parasites and the automated detection of thrips in strawberry greenhouse environment.

Chung et al, in [3] presented a method for identification and screening of Bakanae disease in paddy seedlings. More explicitly, the plan of the study was the perfect detection of pathogen Fusarium fujikuroi for two paddy cultivars. The automated screening of affected plants increases the grain yield and time efficient compared with naked eye examination. One of the economically significant crops worldwide is wheat. The previous five studies presented in this sub-category are devoted to the detection and bias between diseased and healthy wheat crops.

Pantazi et al [4] developed a novel system for the detection of nitrogen hassled, and yellow rust infected and fit winter wheat canopies based on self-organizing classifier and hyperspectral reflectance imaging statistics This study aims at the exact detection of these category for a more efficient usage of fungicides and fertilizers according to the plant's requirements

In the next study, Moshou et al, [5], the development of a structure was offered that automatically discriminates between water stressed Septoria tritici affected and healthy winter wheat canopies. The approach uses least squares (LS)-SVM classifier with optical multisensor fusion.

Moshou et al, [6] presented a method to detect either yellow rust infected or healthy wheat, based on Artificial Neural Network models and spectral reflectance characteristics. The exact detection of either affected or healthy plants enables the accurate targeting of pesticides on the field.

In [7] Moshou et al, presented a practical remote sensing system for the identification of yellow rust infected and fit wheat. The technique is based on a self-organising map (SOM) neural network and data fusion of hyper-spectral reflection and multi-spectral fluorescence imaging. The intentiona of the study was the exact detection, before it can visibly identify the yellow rust infected winter wheat cultivar "Madrigal".

Moshou et al, [8] proposed a method for the simultaneous detection and intolerance of yellow rust infected, and nitrogen stressed and healthy wheat plants of cultivar "Madrigal". The technique is based on an SOM neural network and hyperspectral reflectance imaging. The aim of the study was the accurate discrimination between the plant death, which is caused by disease and nutrient deficiency under farm conditions.

Finally, Ferentinos et al, [9] presented a CNN-based method for the disease identification diagnosis based on leaves pictures with sufficient accuracy to classify between healthy and diseased leaves in various plants.

3. ERGONOMIC PESTICIDE DISPELLER METHOD

In traditional methods, the disease in a particular plant in a farm was identified by a farmer and based on his perception, he will apply pesticide not only to the disease affected plant, but to all the same variety plants in that farm, assuming disease is endemic. Applying a wrong pesticide might result in phytotoxicity. In this method, the disease identification is done plant wise and controlled amount of pesticide will be discharged on the affected area, thereby increasing the yield and ensuring quality. The best results are possible using this strategy. It also saves time and pesticides which in turn benefits the farmer.

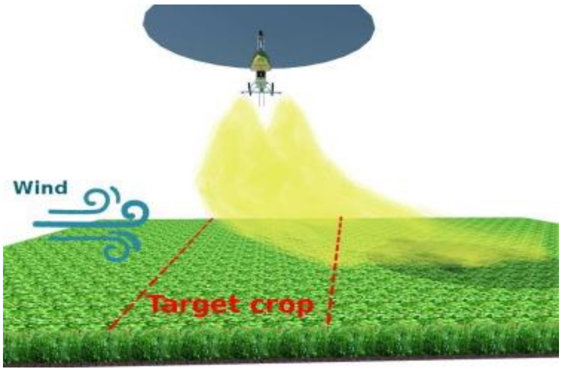

Fig.1. Schematic of proposed system

The traditional method of farming can be replaced by bringing the UAV technology into play. The prime idea of our project proposal is to control the pest rate with the help of UAV. The drone carries the multispectral camera which captures the image which serves as the base data for the learning. The existing data sets are used to train the models. Then patterns are analysed to identify the disease in the captured images. Using this strategy, we can get the possible results in which the healthy crop can be differentiated from the infected ones. The drone will have different compartments to store different pesticides. A particular compartment selection and the quantity of a pesticide to be applied will be programmed using micro-controller. The microcontroller in the drone also keeps in the direction of wind blowing and also controls the trajectory of the pesticide sprayed.

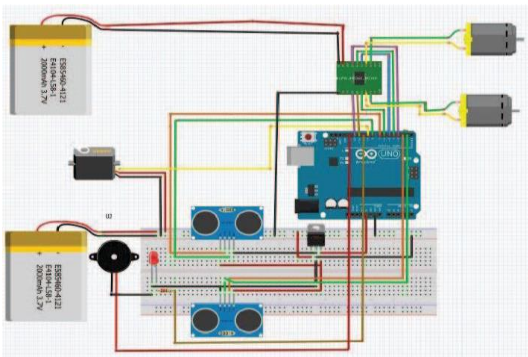

Fig.2. Implementation of prototype using Arduino

If an infected crop or crop area is detected the processor not only triggers the sprayer present in the drone to spray the pesticides only to the affected area but also, controls the amount of pesticide to be sprayed. This in turn saves lot of time and improves the economic and health condition of farmer.

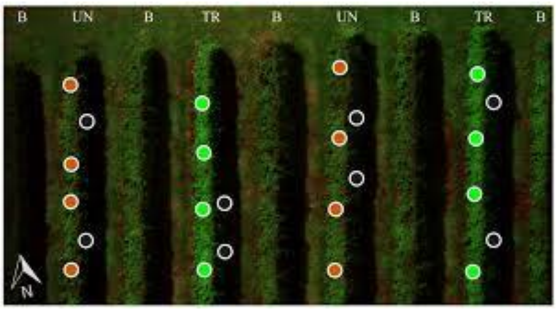

Fig.3. Disease identification spectra

The aerial Images of the Plants are to be captured using Drones. From the images, analysis of leaves has to be done to check for any diseases by comparing with the available database. The diseases present in leaves are studied and a ML model is trained to identify these diseases. Multi Spectral camera attached to the drone captures the images and identifies the diseases. From the diagram illustrated above it is evident that after processing, the red spots indicate the diseased plants, while the green spots indicate the healthy ones. Based on the analysis results, the drones are commanded to spray sufficient type and quantity of pesticides and maximum protection to crops, which can ultimately lead to better crop management and production.

4. Design flow

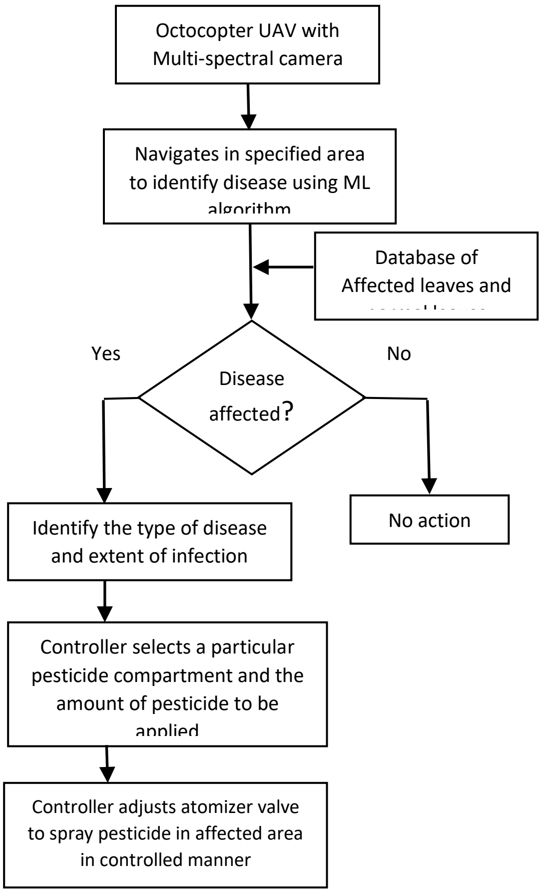

Fig. 4. Flow Chart

5. Leaf Disease Study Procedure

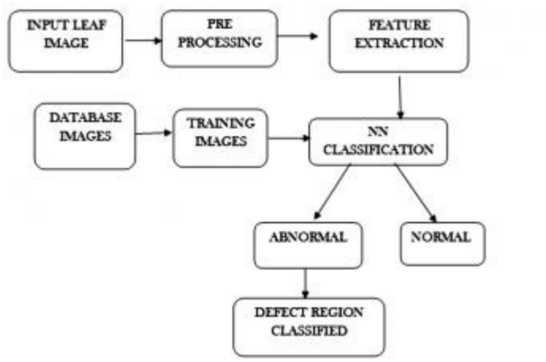

Fig.5. Disease detection flow diagram

The above flow diagram gives us an insight as to how the proposed system efficiently detects diseases in any individual plant. The multispectral camera installed upon the drone initially captures the image of a leaf. Next initial or pre-processing is performed and through programmed algorithms, feature extraction technique is applied and certain regions of the leaves are separated. Based upon the images already present in the database of the controller viz. the trained images, comparative study of the obtained image is performed. Any match with any one of the trained images intimates the output as abnormal.

Once the abnormality is detected, the defected regions are identified and once again drawing information from the database, the type of disease and region where it is affected will be exposed by the system. If no abnormality is observed, the region is understood as healthy and has no defects.

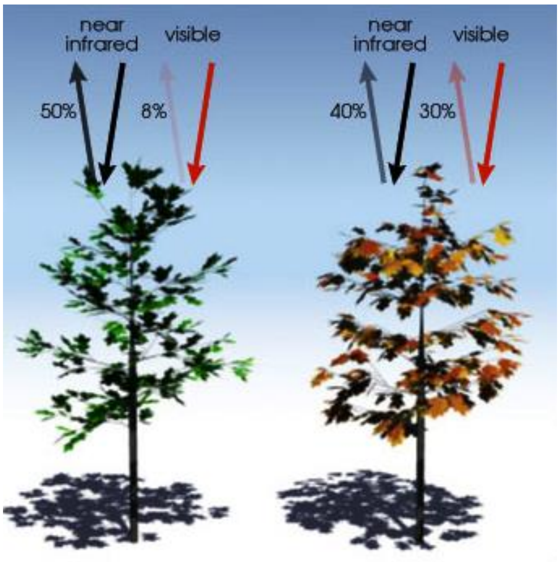

Fig.6. Comparative Analysis of disease detection

The above Fig. 6 defines clearly the difference obtained in he results using traditional disease detection techniques and those detected using our pesticide drone. The diseased area is clearly marked using the lateral technique, which makes the product stand-out from all others.

6. Conclusion

Thus incorporating the system and design if brought into agro sector will result in an Octacopter design UAV for application of precision variable rate application of liquid pesticides, fertilizers and herbicides. The product introduced would definitely turn a stone in the field of agriculture and introduce one of the most intelligent ways of applying pesticides in a much-focused manner to crop. The product combines the advantages of being extremely efficient and simple to use by a lame man. It offers complete protection to the farmer whose is the sole beneficiary of this product and would be free from adverse effects of pesticides on his health. The amount of pesticide sprayed will also be only the required amount thereby saving plants and humans who are consuming it. Also, if the product design can be developed into a corporate, drone flying will give rise to many employment opportunities.

Apart from farmers, the end product can also be useful for Agricultural Research Institutions and Agricultural Universities wherein unscalable area can be reached out through the drone and new diseases can be investigated.

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