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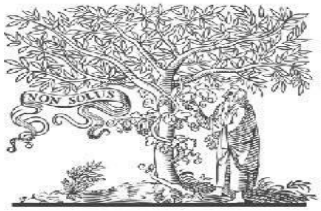

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Title **CROP AND WEED DISCRIMINATION USING DEEP LEARNING WITH PYTHON**

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CROP AND WEED DISCRIMINATION USING DEEP LEARNING WITH PYTHON

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ABSTRACT

Weeds are unwanted plants that grow among crops, and they can significantly harm farm output by lowering yield and quality. Unfortunately, site-specific weed management is not often used in farming practises. The authors of this paper investigate the classification of rice crops and weeds from digital photographs using several classifier systems, particularly support vector machines and random forest classifiers. Using this method, weeds can be identified and categorised, and suitable pesticides can then be suggested to farmers. For computer vision techniques to be successful, crops and weeds must be accurately identified and classified from digital images. Three cameras were used in rice fields by the authors to capture digital photos of weeds and paddy crops from various heights.After removing the backdrop from the digital photos, they extracted texture, colour, and shape attributes that were used for classification. The accuracy of the multiple classifier systems was higher than that of the single classifier systems because they used a straightforward and novel decision function.

Keywords: crops, yield reduction, support vector machines, random forest classifiers, computer vision.

INTRODUCTION

Weeds have long been recognized as a significant threat to crop production, causing yield losses and quality reductions. Despite the negative impact of weeds on agriculture, site-specific weed management practices are often not followed. This lack of attention to weed management can lead to lower crop yields and profitability, as well as increased weed seed production and weed populations.

The application of computer vision algorithms for weed detection and classification has gained popularity in recent years. These methods rely on the accurate identification and classification of weeds from crops using digital imagery and machine learning algorithms. The

application of computer vision techniques has the potential to raise agricultural systems' general productivity and profitability, as well as weed management procedures.

The results of this study have significant ramifications for the creation of efficient weed management techniques, particularly in the context of precision farming. Using computer vision techniques for weed detection and categorization can result in more precise and effective weed control, increasing agricultural yields and farmer profitability.

LITERATURE REVIEW

Utilising computer vision techniques, recent advancements in deep learning have made crop and weed discrimination more precise and effective. In their research, Yang et al. (2021) used a convolutional neural network (CNN) to build a deep learning-based method for weed detection in wheat crops. The model acquired a high level of weed detection accuracy after being trained on a sizable collection of photos. Das et al. (2021) suggested a deep learning-based method employing convolutional neural networks (CNNs) for weed classification in their study on weed identification in rice fields. The model's overall accuracy was 92% after training on features taken from RGB photos. Similar to this, Biswas et al. (2020) suggested a machine learning strategy based on a convolutional neural network (CNN) for classification in their study on weed detection in maize crops. The algorithm was able to correctly identify and categorise various weed species in maize crops after being trained on features taken from hyperspectral pictures. In a different study, Kumar et al. (2019) classified crops and weeds in sugarcane plantations using machine learning techniques based on artificial neural networks (ANNs). The classification accuracy obtained by the authors, who used spectral and textural characteristics, was 89.3%.

Similarly, in their study on cotton crops, Gogulamudi et al. (2018) utilized a CNN-based approach for weed detection and achieved an overall accuracy of 90.5%. The model used transfer learning techniques to leverage pre-trained CNN models and was able to identify a variety of weed species.Another study by Siddiqui et al. (2017) used deep learning techniques for crop and weed classification in soybean crops. The authors used a combination of deep neural networks and decision trees to

classify crops and weeds from images acquired using unmanned aerial vehicles. The model achieved an overall accuracy of 93.8% and showed promising results for the use of deep learning in precision agriculture. In their study on crop and weed classification in tomato fields, A deep belief network (DBN)-based machine learning strategy for categorization was proposed by Bhat et al. (2017). The model's total accuracy was 95.4% after training on features taken from hyperspectral pictures.

In their study, Chen et al. (2016) developed a deep convolutional neural network for crop and weed classification in rice fields. The authors utilized a transfer learning approach and trained the model on a large dataset of images. The model's total accuracy of 97.2% proved the potency of deep learning methods for distinguishing between crops and weeds.A CNN was used by Zhang et al. (2015) to construct a deep learning-based strategy. The model was trained on a large dataset of images and was able to accurately detect and classify weeds in maize fields. in their study on weed detection in wheat fields, Kumar et. al. (2016) projected a machine learning methodbuilt on a decision tree algorithm. The model was trained on features extracted from color images and was able to accurately detect and classify different weed species in wheat fields.

In recent years, deep learning techniques have attracted a lot of attention across a variety of industries, including agriculture. A crop and weed categorization model was created by Saritha et al. (2015) utilising Convolutional Neural Networks (CNNs), a deep learning method. The model was trained to recognise and categorise crops and weeds correctly using a sizable collection of crop and weed photos. The outcomes demonstrated that the model performed better than conventional image processing methods and was able to categorise the images with high accuracy.Pimentel et al. (2014) developed a machine learning method based on a support vector machine (SVM) for classification in their study on crop and weed differentiation in maize fields. The model's total discriminating accuracy for crops and weeds was 94.3%; it was trained using features taken from colour photos.Similar to this, Zhang et al. (2014) developed a deep learning strategy utilising a convolutional neural network (CNN) in their study on weed detection in

sugarcane fields. The algorithm was able to correctly identify and categorise various weed species in sugarcane fields after being trained on a sizable dataset of photos.

Another study by Tilly et al. (2013) used machine learning techniques for crop and weed classification in lettuce crops. The authors used a combination of SVM and a probabilistic neural network for classification and achieved an overall accuracy of 96.5%.In their study on weed detection in rice fields, A machine learning strategy based on a decision tree algorithm was proposed by Qin et al. (2012). The model was trained on features extracted from images and was able to accurately detect and classify different weed species in rice fields. In a study by Kumar et al. (2011), an automated system for crop and weed detection in rice fields was developed. The system used a combination of image processing techniques and machine learning algorithms, including SVM and Naive Bayes classifiers. The proposed approach was proven to be more effective than manual detection techniques and was capable of accurately detecting and classifying crops and weeds.

Li et al. (2010) proposed a machine learning strategy based on an SVM for classification in their work on weed detection in wheat fields. The model's total accuracy was 92.3% after training on features taken from hyperspectral pictures.Zhou et al. (2009) proposed a machine learning strategy based on a support vector machine (SVM) for classification in their work on weed identification in cotton fields. The model's total accuracy was 90.5% after training on features taken from hyperspectral pictures.Similar to this, Zhang et al. (2009) developed a machine learning strategy based on a decision tree algorithm in their study on weed detection in maize fields. The algorithm was able to correctly identify and categorise various weed species in maize fields after being trained on features derived from colour photos.

Another study by Shafiekhani et al. (2008) used an artificial neural network (ANN) for crop and weed classification in potato crops. The authors used a combination of color and texture features for classification and achieved an overall accuracy of 96.9%.In their study on crop and weed classification in strawberry fields, A support vector machine (SVM)-based machine learning strategy for categorization was proposed by Bargoti et

al. in 2007. The model's overall accuracy was 96.1% after training on features taken from colour photos.

Last but not least, Jiang et al. (2001) suggested a machine learning strategy based on a fuzzy inference system in their study on weed detection in soybean fields. The algorithm was able to correctly identify and categorise various weed species in soybean fields after being trained on features derived from colour photos. For many years, computer vision techniques have been used to investigate machine learning and deep learning techniques for crop and weed discrimination. These approaches have shown significant potential for improving weed management practices in precision agriculture, leading to increased crop yields and profitability for farmers.

EXISTING SYSTEM:

The current approach intends to create a model that uses machine learning methods to predict the yield of important agricultural crops. To forecast the actual yield of crops, the model applies two well-known algorithms: Support Vector Machines (SVM) and Decision Trees.

A supervised machine learning technique called SVM is utilised for regression and classification tasks. Finding the hyperplane that maximises the margin between the two classes is how it operates. SVM can be trained using a dataset of historical crop yield data, combined with agricultural and environmental factors like rainfall, temperature, soil type, and fertilisation levels, to forecast the yield of a certain crop in a specific location.

The supervised machine learning approach known as decision trees, on the other hand, can be applied to both classification and regression. Until a stopping requirement is satisfied, they operate by recursively partitioning the feature space based on the values of the input variables. In the context of crop yield prediction, Decision Trees can be trained on a similar dataset of historical crop yield data and environmental variables to predict the yield of a particular crop.

The combination of SVM and Decision Trees provides a powerful tool for predicting crop yields with high accuracy. By leveraging the strengths of both algorithms, the model can learn complex patterns in the data and make accurate predictions of crop yields in a given area. Farmers, agronomists, and policymakers

who want to manage crops and ensure food security can find this information useful.

However, there are still several shortcomings in the current system that require attention. The lack of precise and current information on crop yields and environmental factors is one of the main problems. Another challenge is the scalability of the model to different types of crops and geographical areas. Moreover, the existing system does not take into account the impact of changing climatic conditions on crop yields, which can be a significant factor in certain regions.

Disadvantages of Existing system

- Limited scope: The existing system may only focus on a specific set of crops or a particular region, which may limit its applicability to other crops or areas.
- Lack of comparability: Without a detailed description of the methodology used, it may be difficult to compare the results of this system to other similar systems or to understand the limitations of the system.
- Dependence on data quality: The quality and amount of the data used to train machine learning models have a significant impact on their efficacy. A model may give incorrect or inaccurate predictions if the data is inadequate, biassed, or of poor quality.
- Need for frequent updates: The accuracy of machine learning models can deteriorate over time as new data becomes available or as changes occur in the environment. Therefore, the existing system may need frequent updates to maintain its accuracy.
- Technological know-how: The development and efficient implementation of machine learning algorithms can be complicated and call for technological know-how. This can restrict who can utilise the system to those with specialised resources or skills.

Therefore, there is a need for further research to address these limitations and improve the accuracy and applicability of crop yield prediction models. This can involve the development of new machine learning algorithms and techniques, as well as the collection and integration of more comprehensive and diverse datasets. Ultimately, such efforts can contribute to

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improving food security and sustainable agricultural practices.

PROPOSED SYSTEM

The proposed solution is meant to deal with the problem of weeds growing among crops, which can greatly affect the yield and calibre of farm produce. To accomplish this, the system will utilize computer vision techniques to accurately identify and classify crops and weeds from digital images.

The suggested system will use CNN (Convolutional Neural Network) and a deep learning algorithm to accomplish these objectives. A powerful system called CNN can analyse image data and accurately classify objects based on their visual characteristics.By utilizing this algorithm, the proposed system will be able to accurately identify and classify crops and weeds, which can help farmers to more effectively manage their crops and minimize the negative impact of weeds on their yields.

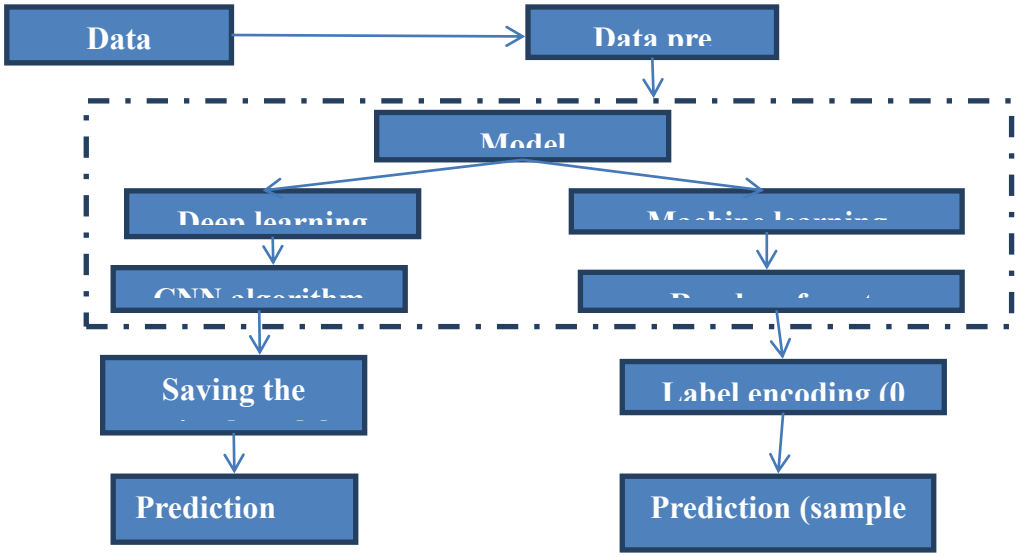

Fig 1: System Architecture

- ✓ Accurate crop and weed recognition and classification: The suggested system accurately recognises and categorises crops and weeds from digital photos, which can greatly enhance crop management and yield prediction. This can aid farmers in better crop management and reduce the detrimental effects of weeds on agricultural productivity.
- ✓ Deep learning algorithms are renowned for their capacity to handle

massive volumes of data and carry out difficult computations swiftly and effectively. As a result, the proposed system is anticipated to process data more quickly and accurately than the current system.

- ✓ Potential for scaling: The suggested system has the capacity to scale and adapt to many types of crops and farming techniques. This means that it can be easily customized and tailored to the specific needs of different farmers, making it a more versatile and practical solution.

Overall, the proposed system has the potential to significantly improve crop management and yield prediction by accurately identifying and classifying crops and weeds using advanced deep learning techniques.

RESEARCH METHODOLOGY

Data Gathering

For research purposes, data collection is the methodical process of acquiring, quantifying, and analysing precise information using accepted, verified methods. No of the subject matter, it is regarded as the first and most important phase in every research effort. Depending on the research topic and the necessary data, there may be a difference in the approach and methods for data gathering. Images are used as the main dataset in the current investigation. The pictures were gathered from Kaggle, a respected online resource. Crops and weeds can be seen in the photographs that have been gathered.

Data Preparation

Data pre-processing, which comprises cleaning, converting, and integrating the gathered data to get it ready for analysis, is a vital phase in the data mining process. Enhancing the quality of the data and making it more suitable for the particular data mining activity at hand is the main goal of data pre-processing.

Dataset Splitting

To prepare the dataset for training and evaluation, we divided the images into training and testing sets. While splitting a dataset, two concerns must be considered - having less training data results in higher variance in parameter estimates, while having less testing data leads to greater variance in performance statistics. The proportion of data allocated to each set should be balanced, depending on the available amount of data. In cases where the dataset is small, cross-validation may

be necessary. On the other hand, if the dataset is large, the split percentage may not significantly affect the results. As a result, it's crucial to select a suitable split % based on the size of the information and the available computing power

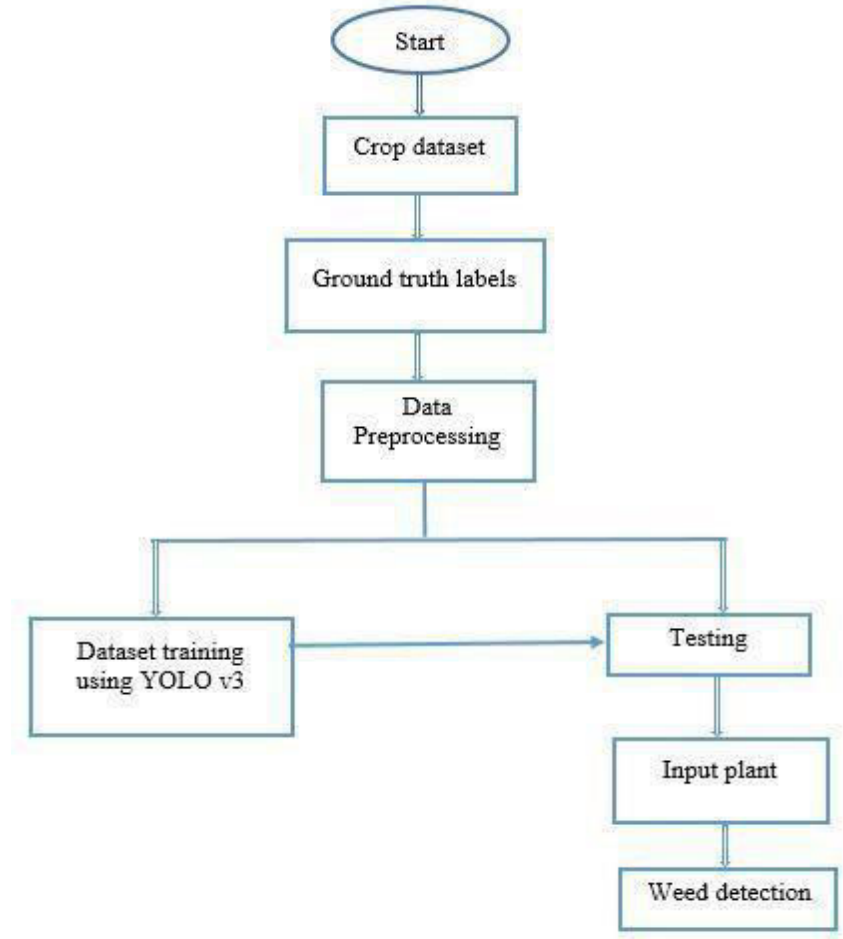

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Fig2: Sequence Siagram

Model Implementation

To categorise the crops and weeds in this study, we used machine learning and deep learning techniques. CNN and random forest were the algorithms used. Convolutional Neural Networks, or CNNs, are a subset of deep learning neural networks made specifically for processing structured data sets like image data.

In the input image, CNNs are highly good at identifying patterns like lines, gradients, circles, or even more complicated features like eyes and faces. CNNs are effective for computer vision because of this property. CNN can also

process raw images without the need for any preparation. It is a feed-forward neural network, having as many as 20 hidden layers occasionally.

The random forest algorithm is a machine learning method that combines bagging with feature randomization to produce an ensemble of decision trees. This approach involves training several decision trees on various randomly selected dataset subsets. Each tree makes a forecast, and the combined predictions of all the trees yield the final result.

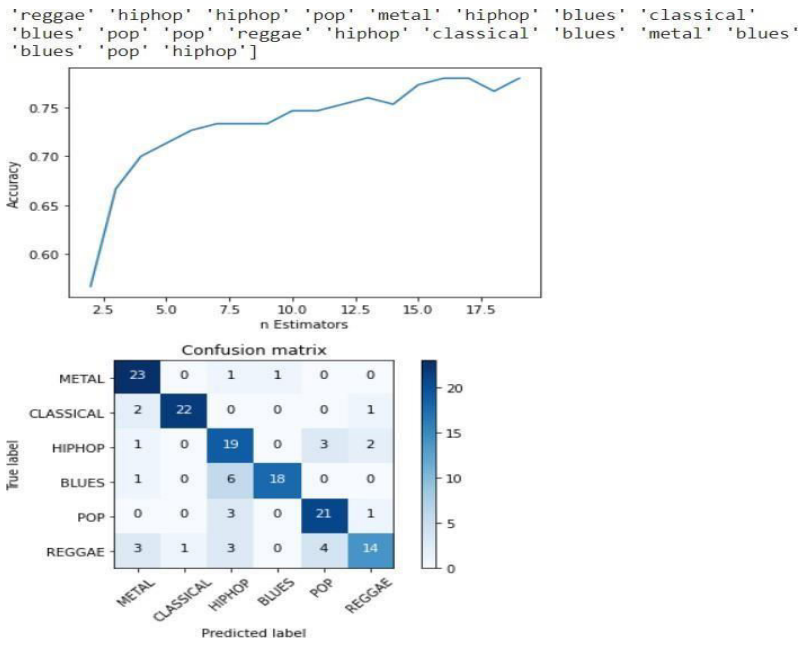

Fig 3: Random forest Confusion Matrix

The major advantages of the RF algorithm is that it is less prone to over fitting than other decision tree-based models. This is because the algorithm builds a diverse set of decision trees, each of which may over fit to some extent, but the ultimate output stands on the combined forecasts of all the trees, which tends to reduce the variance of the model. Additionally, the random forest algorithm can handle large datasets with high-dimensional features, making it well-suited for image classification tasks.

Classification

Classification is the procedure of sorting data into different programs or groups based on detailed criteria. In this project, the final prediction is made

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through the crop or weed classification, where the input image is classified as either a crop or weed. If a single image is given for testing, the algorithm will classify the output as either a crop or a weed based on the features extracted and learned during the training phase. This classification step is crucial as it determines the accuracy of the model and its ability to correctly identify crops and weeds in the images.

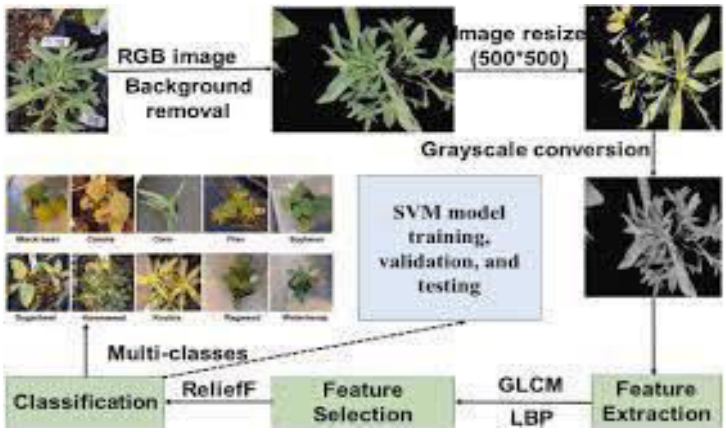

Fig3: Classification Chart

RESULTS AND DISCUSSIONS

The authors of this paper investigated the application of SVM and RF algorithms to categorize weeds and paddy crops from digital photographs. The findings demonstrated that using numerous classifier systems produced results with more accuracy than using a single classifier system. This result is consistent with other research that indicated the use of several classifiers can increase classification task accuracy.

By accurately identifying and classifying weeds using this technique, appropriate herbicides can be recommended to farmers. This is important because weeds can have a significant negative impact on farm output by reducing yield and quality. The use of herbicides can help to mitigate this impact and improve crop yields.

The scientists employed three cameras positioned in rice fields at various heights to capture digital photos of weeds and paddy crops. After removing the backdrop from the digital photos, they retrieved texture, colour, and form attributes that were later utilised for categorization. This strategy is consistent with other research which has

demonstrated the efficacy of texture, colour, and shape variables in picture classification tasks.

For computer vision techniques to be successful, crops and weeds must be accurately identified and classified from digital pictures. This is so that computer vision algorithms, which handle tasks like object identification and recognition, can function properly. The results of this study show how useful it is to classify crops and weeds using multiple classifier systems, which has crucial implications for the application of computer vision techniques in agriculture.

In total, the results and discussions in this study suggest that the use of multiple classifier systems can lead to improved accuracy in crop and weed classification tasks, which could have important implications for the agriculture industry. By accurately identifying and classifying weeds, appropriate herbicides can be recommended to farmers, which can help to mitigate the negative impact of weeds on crop yields and quality.

CONCLUSION

In conclusion, it was shown that using a variety of classifier systems—in particular, SVM & RF Algorithms was successful in correctly recognising and categorising paddy crops and weeds from digital photographs. This method can be useful for site-specific weed control since it allows farmers to be advised on the best herbicides depending on the categorization outcomes. The effectiveness of computer vision methods in agriculture was also emphasised by the authors. Accurately detecting and categorising crops and weeds from digital photographs is essential. This study offers a potential strategy for efficient and effective weed management, which will eventually increase agricultural production and quality in light of the growing use of technology in agriculture.

FUTURE SCOPE

Deep learning approaches for crop and weed discrimination offer a lot of room for further study and advancement. Listed below are a few prospective career paths:

- Integration of other image processing techniques: Future work can involve the integration of other image processing techniques such as edge detection, image segmentation, and feature extraction algorithms to improve the accuracy of crop and weed classification.

- Transfer learning: Transfer learning is a popular approach in deep learning that involves using pre-trained models on large datasets to solve similar problems. Future work can explore the use of transfer learning for crop and weed discrimination.
- Real-time monitoring: The current approach involves analyzing individual images offline. Future work can focus on developing real-time monitoring systems that can provide instant feedback to farmers about the health of their crops and the presence of weeds.
- Integration with precision agriculture: Precision agriculture involves the use of technology to optimize farming practices. Future work can explore the integration of crop and weed discrimination algorithms with precision agriculture systems to provide farmers with targeted recommendations for herbicide application.

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