Machine Learning Procedure for Plant and Weed Discrimination

Pottem Jaya Madhuri

Dept of Computer Science, SV University, Tirupati

Abstract— *Weeds are unwanted plants that grow among crops. These weeds can significantly reduce the yield and quality of the farm output. Unfortunately, site-specific weed management is not followed in most of the cases. This paper investigates the multiple classifier systems built using support vector machines and random forest classifiers for plant classification in classifying paddy crops and weeds from digital images. Using this technique, weeds can be detected and identified and a suitable herbicide can be recommended to the farmers. It is important for the computer vision technique to successfully identify and classify the crops and weeds from the digital images. Digital images of paddy crops and weeds from the paddy fields were acquired using three different cameras fixed at different heights from the ground. Texture, color, and shape features were extracted from the digital images after background subtraction and used for classification. A simple and new method was used as a decision function in the multiple classifier systems. An accuracy of 91.36% was obtained by the multiple classifier systems and was found to outperform single classifier systems.*

I. INTRODUCTION

Computer vision often abbreviated as CV is defined as the process of analyzing images and videos automatically to obtain meaningful inference or measurements without human intervention. It is a multidisciplinary field that involves artificial intelligence (AI) and machine learning concepts. Goal of computer vision is to understand the content of digital images and videos involves developing methods and techniques which attempt to repro-duce the human capability of cognition and recognition. Computer vision applications are being extensively used in the agricultural domain for the discrimination of crops and weeds, plant classification, crop disease identification, and so forth automatic weeding machine was proposed in, which was based on computer vision techniques. Automation of various agricultural tasks such as disease detection in crops, precise spraying of pesticides, prediction of crop yield, estimation of soil texture, automatic grading of fruits, estimation of crop biomass, management of water balance in the irrigation system, and monitoring plant growth has been done using computer vision techniques. In diseased plant leaves were identified using image processing and soft computing techniques. In discrimination of corn crop and weed species was done using the C5 algorithm based on textural and spectral features. Wireless sensor networks and wireless visual sensor networks are contributing to sending the sensed data of the field either in image or in text form to the remote machine where it will be processed and analyzed for some kind of decision-making. In a wireless sensor network was used to predict the occurrence of bud necrosis virus in groundnut crops. In a wireless sensor network was implemented to predict the water requirement in semi-arid regions. Soft computing techniques along with wireless sensor network technology are helping farmers and agronomists to make the right decision at the right time. A precision agriculture model resulted due to the advances in wireless sensor networks and computer vision techniques model can help to reorganize the entire farming system with low input, high efficiency and sustainable farming.

Weeds can be defined as undesirable plants growing with crops. Generally, they are referred to as plants out-of-space. compete with the crops for soil nutrients and water. Here, the term competition can be referred to as weed plants nourishing at the cost of rice competition usually does not result in the death of the rice crop but definitely leads to reduced yield problem caused by weeds and the importance of weed management is not recognized by the general population and sometimes even by agriculturists. One of the main reasons for agriculturists to ignore weeds is high cost involving manual weeding and expensive herbicides. Other than competing with rice plants for soil nutrients, water, and space, they also act as alternate hosts to various pests, which in turn attack crops and destroy them. Weeds are the main reason for heavy yield losses and sometimes are responsible for complete crop failure. It is reported that annually India is incurring a loss of INR 1050 million because of weeds in paddy field. Classification of weeds in rice fields is usually based on their life cycle, their habitat, and their gross morphological features are broadly categorized as sedges, grass, and broadleaved weed.

II. LITERATURE REVIEW

Learning Semantic Graphics Using Convolutional Encoder Decoder Network For Autonomous Weeding In Paddy

Shyam Prasad Adhikari, Heechan Yang, Hyongsuk Kim

Weeds in agricultural farms are aggressive growers which compete for nutrition and other resources with the crop and reduce production. The increasing use of chemicals to control them has inadvertent consequences to the human health and the environment. In this work, a novel neural network training method combining semantic graphics for data annotation and an advanced encoder–decoder network for (a) automatic crop line detection and (b) weed (wild millet) detection in paddy fields is proposed. The detected crop lines act as a guiding line for an autonomous weeding robot for inter-row weeding, whereas the detection of weeds enables autonomous intra-row weeding. The proposed data annotation method, semantic graphics, is intuitive, and the desired targets can be annotated easily with minimal labour. Also, the proposed "extended skip network" is an improved deep convolutional encoder–decoder neural network for efficient learning of semantic graphics. Quantitative evaluations of the proposed method demonstrated an increment of 6.29% and 6.14% in mean intersection over union (mIoU), over the baseline network on the task of paddy line detection and wild millet detection, respectively. The proposed method also leads to a 3.56% increment in mIoU and a significantly higher recall compared to a popular bounding box-based object detection approach on the task of wild–millet detection.

A Visual Navigation Algorithm For Paddy Field Weeding Robot Based On Image Understanding

Qin Zhang, M.E. Shaojie Chen, Bin Li

Navigation system and its navigation algorithm are the crucial parts for intelligent paddy field weeding robot. The environments of paddy fields are complicated in South China. The colours of weed, duckweed and cyanobacteria, which grow in paddy fields, are very similar with rice seedlings. Moreover, the rice seedlings present various morphological features during the growth progress. Therefore, how to extract the guidance lines for navigation system and weeding robot presents various challenges. In order to deal with the above-mentioned problems, a navigation method for weeding robot based on SUSAN (smallest unvalued segment assimilating nucleus) corner and improved sequential clustering algorithm is proposed in this paper. Firstly, Gray feature in paddy field image is extracted by using the adaptive greying algorithm. Secondly, the SUSAN corners are extracted as characteristic points. Thirdly, the seedling navigation line is detected by applying the improved sequential clustering algorithm and Hough Transform. Finally, the position error and angle error are calculated, and a fuzzy controller is designed to control the robot. Experimental results show desirable performances of the proposed method. The proposed segmentation method is effective in complicated environment.

Paddy Crop and Weed Discrimination: A Multiple Classifier System Approach

Radhika Kamath, Mamatha Balachandra ,1 And Srikanth Prabhu

Weeds are unwanted plants that grow among crops. These weeds can significantly reduce the yield and quality of the farm output. Unfortunately, site-specific weed management is not followed in most of the cases. That is, instead of treating a field with a specific type of herbicide, the field is treated with a broadcast herbicide application. This broadcast application of the herbicide has resulted in herbicide-resistant weeds and has many ill effects on the natural environment. This has prompted many research studies to seek the most effective weed management techniques. One such technique is computer vision-based automatic weed detection and identification. Using this technique, weeds can be detected and identified and a suitable herbicide can be recommended to the farmers. Therefore, it is important for the computer vision technique to successfully identify and classify the crops and weeds from the digital images. This paper investigates the multiple classifier systems built using support vector machines and random forest classifiers for plant classification in classifying paddy crops and weeds from digital images. Digital images of paddy crops and weeds from the paddy fields were acquired using three different cameras fixed at different heights from the ground. Texture, color, and shape features were extracted from the digital images after background subtraction and used for classification. A simple and new method was used as a decision function in the multiple classifier systems. An accuracy of 91.36% was obtained by the multiple classifier systems and was found to outperform single classifier systems.

Weed Classification for Site-Specific Weed Management Using an Automated Stereo Computer-Vision Machine-Learning System in Rice Fields

Mojtaba Dadashzadeh ,Yousef Abbaspour-Gilandeh ,Tarahom Mesri-Gundoshmian, Sajad Sabzi ,José Luis Hernández-Hernández ,Mario Hernández-Hernánde, Andjuan Ignacio Arribas,

Site-specific weed management and selective application of herbicides as eco-friendly techniques are still challenging tasks to perform, especially for densely cultivated crops, such as rice. This study is aimed at developing a stereo vision system for distinguishing between rice plants and weeds and further discriminating two types of weeds in a rice field by using artificial neural networks (ANNs) and two metaheuristic algorithms. For this purpose, stereo videos were recorded across the rice field and different channels were extracted and decomposed into the constituent frames. Next, upon pre-processing and segmentation of the frames, green plants were extracted out of the background. For accurate discrimination of the rice and weeds, a total of 302 color, shape, and texture features were identified. Two metaheuristic algorithms, namely particle swarm optimization (PSO) and the bee algorithm (BA), were used to optimize the neural network for selecting the most effective features and classifying different types of weeds, respectively. Comparing the proposed classification method with the K-nearest neighbors (KNN) classifier, it was found that the proposed ANN-BA classifier reached accuracies of 88.74% and 87.96% for right and left channels, respectively, over the test set. Taking into account either the arithmetic or the geometric means as the basis, the accuracies were increased up to 92.02% and 90.7%, respectively, over the test set. On the other hand, the KNN suffered from more cases of misclassification, as compared to the proposed ANN-BA classifier, generating an overall accuracy of 76.62% and 85.59% for the classification of the right and left channel data, respectively, and 85.84% and 84.07% for the arithmetic and geometric mean values, respectively.

Classification Of Paddy Weed Leaf Using Neuro-Fuzzy Methods

Mohd Zulhilmi Ab Jamil, Sofianita Mutalib, Shuzlina Abdul Rahman, Zalilah Abd Aziz

Paddy weed appears to be one of the many visible threats to paddy crop production and subsequently farmers' income. It is for this reason that the growth of paddy weeds in paddy fields should be controlled as it results in a significant decrease of paddy yields. However, farmers might have limited knowledge on weed types, and are thus unable to identify and determine the right prevention methods. This paper presents classification methods for paddy weeds through the leaf shape extraction and applies neuro-fuzzy methods for recognizing the types of weeds. The types being focussed are the Sphenoclea zeylanica, Ludwigia hyssopifolia and Echinochloa crus-galli. The developed e-prototype methods would be able to classify paddy weeds with 83.78% accuracy. Hopefully, the findings in this study would assist farmers and researchers in increasing their paddy yields and eliminating weed growth respectively. The production of paddy in Malaysia would eventually be improved with the proposed methods, which can be considered as a technology advancement in the field of paddy production.

Problem Statement

Our existing system is to build the model that estimation of Major Agricultural Crop with Effective Yield Prediction

1. Techniques: Machine learning
2. Algorithm used: SVM, Decision Tree

Disadvantages

1. Only to predict crop yield production
2. No longer identify of weeds in between of plant or crop
3. Less accuracy

III. PROPOSED WORK

- Weeds are unwanted plants that grow among crops. These weeds can significantly reduce the yield and quality of the farm output.

- It is important for the computer vision technique to successfully identify and classify the crops and weeds from the digital images.
- A simple and new method was used as a decision function in the multiple classifier systems.
- An accuracy of 91.36% was obtained by the multiple classifier systems and was found to outperform single classifier systems.

Advantages

- To predict the unwanted weeds in between plant or crop
- Easily handled feature extraction are used in this model.
- It gives High accuracy than the previous model.
- Time consuming.

3.1 Dataset Collection

A dataset (or data set) is a collection of data, usually presented in tabular form. Each column represents a particular variable. Each row corresponds to a given member of the dataset in question. It lists values for each of the variables, such as height and weight of an object. Each value is known as a datum.

We have chosen to use a publicly-available field dataset which contains a relatively small number of inputs and cases. The data is arranged in such a way that will allow those trained in agricultural disciplines to easily draw parallels between familiar statistical and novel ML techniques. Additionally, the compact dataset enables short computational times on almost all modern computers.

3.2 Pre-processing

The sklearn. pre-processing package provides several common utility functions and transformer classes to change raw feature vectors into a representation that is more suitable for the downstream estimators.

In general, learning algorithms benefit from standardization of the data set. If some outliers are present in the set, robust scalers or transformers are more appropriate. The behaviours of the different scalers , transformers, and normalizers on a dataset containing marginal outliers is highlighted in .

Standardization, or Mean removal and Variance Scaling

Standardization of datasets is a **common requirement for many machine learning estimators** implemented in scikit-learn; they might behave badly if the individual features do not more or less look like standard normally distributed data: Gaussian with **zero mean and unit variance.**

3.3 Feature Extraction

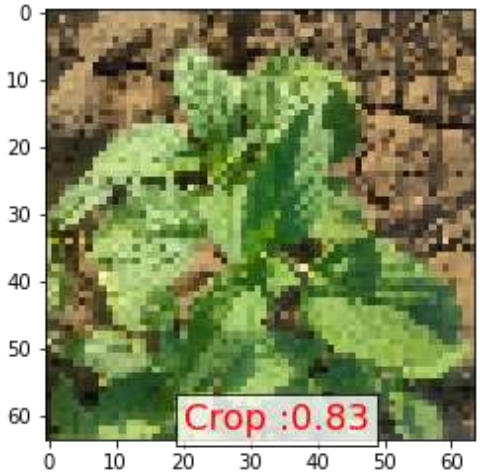
Soil and water background was removed to retain only green vegetation. Connected component algorithm and successive erosion and dilation were used to remove possible overlapping and to extract individual plants for feature extraction images with too heavy overlapping were not considered and left out from classification. Colour features were extracted using the methods explained in two different types of shape features were extracted, namely, size independent features and Hu's moments using the method as explained. Texture features were extracted using the Laws' texture masks using the method explained. Ninety-three features were extracted. From these, seventy-one best performing features were selected using the feature selection method based on analysis of variance (ANOVA).

3.4 Evaluation

To Evaluate the classification of plant and weed using confusion matrix matrices. In confusion matrix having the recall, precision, support, F1 Score and accuracy score will be calculated. We implemented the system accuracy score is 98%. The system predicts the plant and weed discrimination.

IV. IMPLEMENTATION

Crop :0.83



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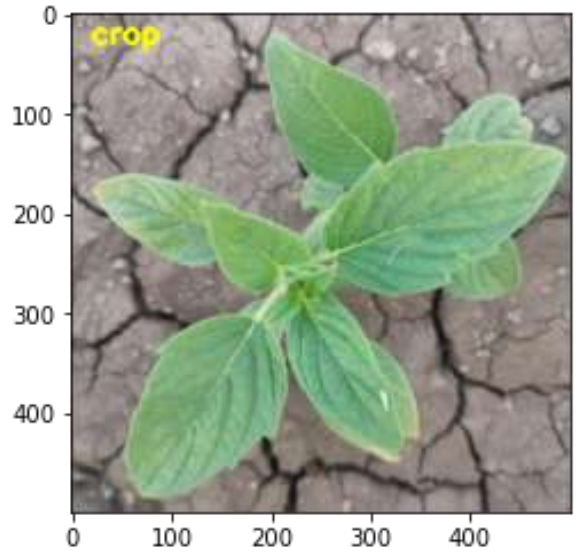

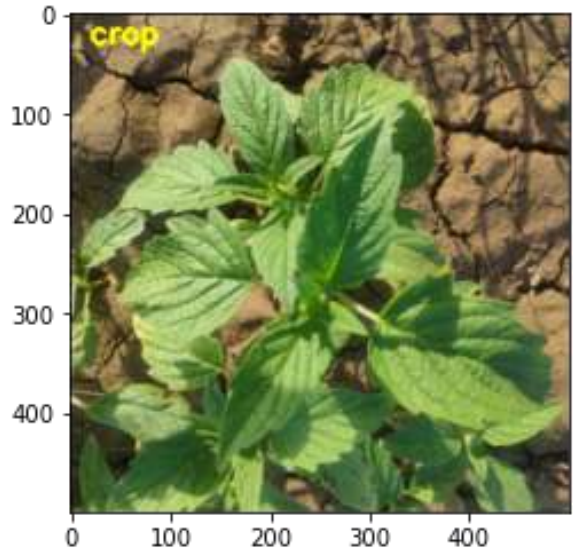

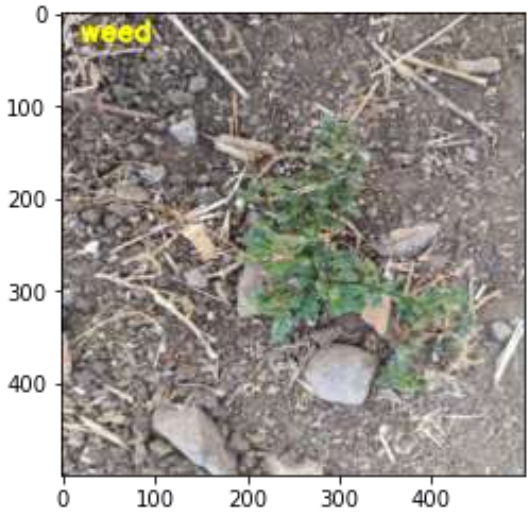

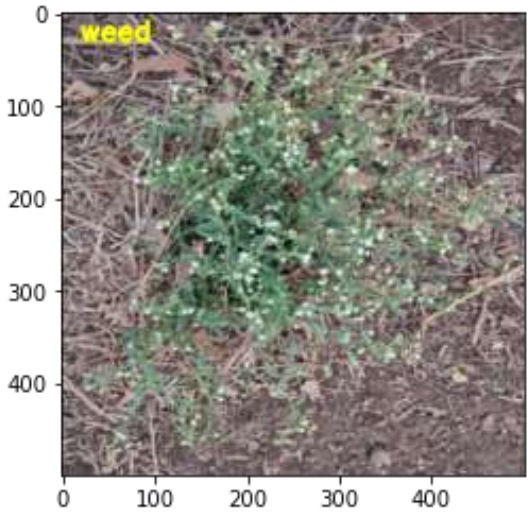

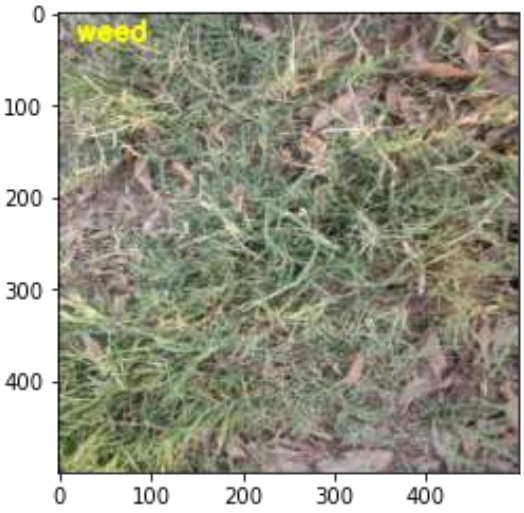

V. CONCLUSION AND FUTURE WORK

In this study, two MCSs were designed and assessed for the classification of paddy crops and weeds from the digital images approach was first to create digital images of paddy crops and weeds from paddy fields using digital cameras, and the Raspberry Pi camera was fixed at different heights from the ground to make the method device independent soil and water background was removed. Texture, color, and shape features were extracted. Two se-lection-based MCSs were designed, one with calibrated random forest and calibrated SVM classifiers called as MCS-1 and another MCS with uncalibrated random forest classifier and uncalibrated SVM classifier called as MCS-2. MCS-1 and MCS-2 outperformed the single classifier systems. In addition, it was found that the MCS designed with calibrated classifiers performed slightly better than the MCS designed with uncalibrated classifiers features extraction and classification process proposed in this research work were applied on a publicly available paddy crop and weed dataset and results obtained are very promising. study showed that the extracted features are good enough to classify paddy crops and weeds. work could be used to recommend suitable herbicide for a particular type of weed based on the classification results to avoid broadcast application of the herbicides could lead to the reduction design different types of MCSs for the classification of paddy crops and weeds and analyze the performance. In addition, we intend to carry out extended research to develop a general crop and weed discrimination model using a selection base MCS.

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