Utilizing Python-Based Machine Learning for Discriminating Between Plants and Unwanted plant

Upputuri Swapna

Department of Computer Science Sri Venkateswara University, Tirupati

Abstract— *This study explores using support vector machines and random forest classifiers to classify paddy crops and weeds from digital images, aiding in weed management. By analyzing texture, color, and shape features extracted from the images, weeds can be accurately detected and classified. The proposed method achieved a high accuracy of 91.36%, outperforming single classifier systems.*

I. INTRODUCTION

Computer vision, or CV, is the automated analysis of images and videos, leveraging AI and machine learning to replicate human cognition. In agriculture, CV aids in tasks like crop and weed discrimination, disease identification, and yield prediction. Weeds, unwanted plants competing with crops for nutrients and water, pose a significant threat to agricultural yield. Despite this, weed management is often overlooked due to high costs. Weeds not only reduce crop yield but also serve as hosts for pests, leading to further crop damage. In rice fields, weeds are classified based on their life cycle and morphological features, with significant economic losses reported annually due to weed infestation.

II. LITERATURE REVIEW

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

Shyam Prasad Adhikari, Heechan Yang, Hyongsuk Kim

Weeds compete with crops for resources and reduce agricultural productivity. This study introduces a new neural network training method combining semantic graphics and an advanced encoder-decoder network to detect crop lines and weeds in paddy fields. Detected crop lines guide inter-row weeding robots, while weed detection enables intra-row weeding. The proposed method, leveraging semantic graphics, shows improved performance compared to traditional object detection approaches.

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

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

The navigation system is vital for paddy field weeding robots, especially in complex environments like South China. This paper proposes a navigation method based on SUSAN corner detection and an improved sequential clustering algorithm. By extracting gray features and SUSAN corners from paddy field images, the method detects seedling navigation lines using Hough Transform. Experimental results demonstrate the effectiveness of this approach in challenging environments.

2.3 Paddy Crop and Weed Discrimination: A Multiple Classifier System Approach

Radhika Kamath, Mamatha Balachandra ,1 And Srikanth Prabhu

Weeds among crops can drastically reduce yield and quality. Current weed management practices often lead to herbicide-resistant weeds and harm the environment. Computer vision-based weed detection offers a promising solution. This study explores multiple classifier systems using support vector machines and random forest classifiers to classify paddy crops and weeds from digital images. Texture, color, and shape features are extracted for classification, achieving an accuracy of 91.36%.

2.4 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,

Developing a stereo vision system for weed management in rice fields using artificial neural networks and metaheuristic algorithms. Stereo videos captured and processed to extract features for rice and weed discrimination. Results show ANN-BA classifier outperforms KNN, achieving accuracies up to 92.02%

2.5 Classification Of Paddy Weed Leaf Using Neuro-Fuzzy Methods

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

This paper proposes classification methods for paddy weeds using leaf shape extraction and neuro-fuzzy techniques. The developed methods achieve 83.78% accuracy in classifying weed types. Results aim to aid farmers and researchers in enhancing paddy yields and controlling weed growth, contributing to advancements in paddy production technology.

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 is a structured collection of data typically presented in tables. Each column represents a variable, while each row corresponds to a specific entry. Our chosen dataset, publicly available, is compact and designed for easy comprehension by agricultural professionals, facilitating the application of statistical and machine learning techniques.

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.

3.3 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.**

3.4 Feature Extraction

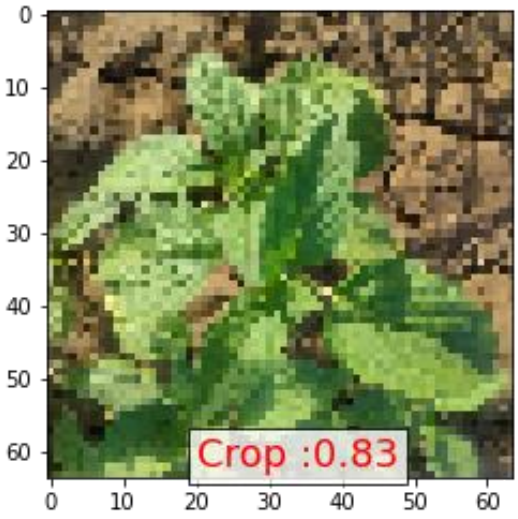
Soil and water background was removed to retain only green vegetation. Connected component algorithm and successive erosion and dilation were used to remove possible overlapping and to extract individual plants for feature extraction images with too heavy overlapping were not considered and left out 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).

3.5 Evaluation

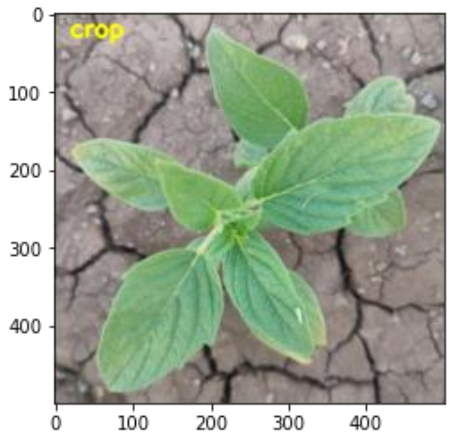
To Evaluate the classification of plant and weed using confusion matrix matrices. In confusion matrix having the recall, precision, support, F1 Score and accuracy score will be calculated. We implemented the system accuracy score is 98%. The system predicts the plant and weed discrimination.

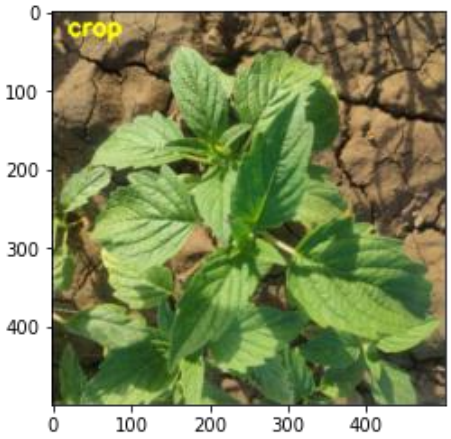
IV. IMPLEMENTATION

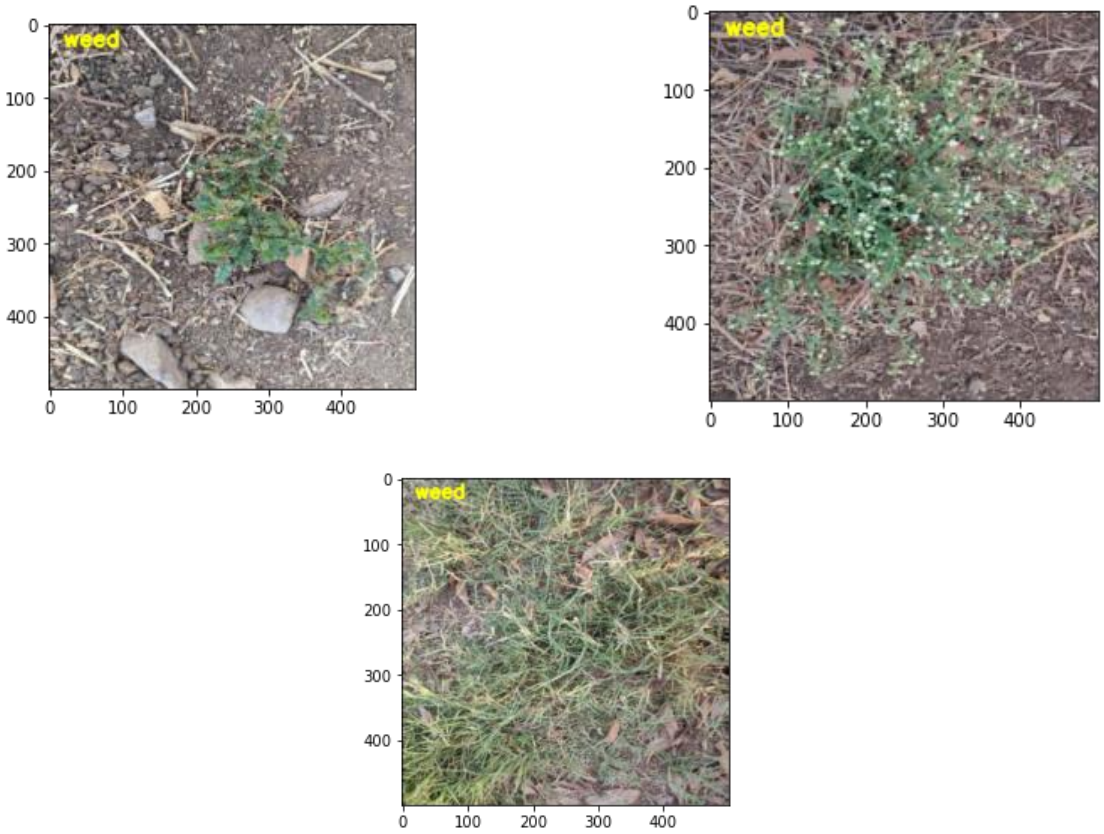
Crop :0.83



<Figure size 432x288 with 0 Axes>







V. CONCLUSION AND FUTURE WORK

In this study, two multiple classifier systems (MCSs) were developed and evaluated for classifying paddy crops and weeds from digital images. The approach involved creating digital images of paddy fields using various cameras, removing soil and water backgrounds, and extracting texture, color, and shape features. MCS-1 and MCS-2, utilizing calibrated and uncalibrated classifiers respectively, outperformed single classifier systems. The study demonstrated promising results, indicating the potential for recommending suitable herbicides based on classification outcomes and reducing broadcast herbicide application.

REFERENCES

[1] Adhikari, Shyam Prasad, Heechan Yang, and Hyongsuk Kim. "Learning semantic graphics using convolutional encoder–decoder network for autonomous weeding in paddy." Frontiers in plant science 10 (2019): 1404.

[2] Liu, Fuchun, Yang Yang, Yiming Zeng, and Zeyong Liu. "Bending diagnosis of rice seedling lines and guidance line extraction of automatic weeding equipment in paddy field." Mechanical Systems and Signal Processing 142 (2020): 106791.

[3] Ma, Xu, Xiangwu Deng, Long Qi, Yu Jiang, Hongwei Li, Yuwei Wang, and Xupo Xing. "Fully convolutional network for rice seedling and weed image segmentation at the seedling stage in paddy fields." PloS one 14, no. 4 (2019): e0215676.

[4] Zhang, Qin, ME Shaojie Chen, and Bin Li. "A visual navigation algorithm for paddy field weeding robot based on image understanding." Computers and Electronics in Agriculture 143 (2017): 66-78.

[5] Kamath, Radhika, Mamatha Balachandra, and Srikanth Prabhu. "Paddy Crop and Weed Discrimination: A Multiple Classifier System Approach." International Journal of Agronomy 2020 (2020).

[6] Yan, Xue, Xiangwu Deng, and Jing Jin. "Classification of weed species in the paddy field with DCNN-Learned features." In 2020 IEEE 5th Information Technology and Mechatronics Engineering Conference (ITOEC), pp. 336-340. IEEE, 2020.

[7] Ab Jamil, Mohd Zulhilmi, Sofianita Mutalib, and Zalilah Abd Aziz. "Classification of Paddy Weed Leaf Using Neuro-Fuzzy Methods." Malaysian Journal of Computing 3, no. 1 (2018): 54-66.

[8] Dadashzadeh, Mojtaba, Yousef Abbaspour-Gilandeh, Tarahom Mesri-Gundoshmian, Sajad Sabzi, José Luis Hernández-Hernández, Mario Hernández-Hernández, and Juan Ignacio Arribas. "Weed Classification for Site-Specific Weed Management Using an Automated Stereo Computer-Vision Machine-Learning System in Rice Fields." Plants 9, no. 5 (2020): 559.

[9] Chlingaryan, Anna, Salah Sukkarieh, and Brett Whelan. "Machine learning approaches for crop yield prediction and nitrogen status estimation in precision agriculture: A review." Computers and electronics in agriculture 151 (2018): 61-69.

[10] Wan, Shiuan, and Yi-Ping Wang. "The Comparison of Density-Based Clustering Approach among Different Machine Learning Models on Paddy Rice Image Classification of Multispectral and Hyperspectral Image Data." Agriculture 10, no. 10 (2020): 465.

[11] Kamath, Radhika, Mamatha Balachanra, and Srikanth Prabhu. "Paddy crop and weed classification using color features for computer vision based precision agriculture." International Journal of Engineering and Technology (UAE) 7, no. 4 (2018): 2909-2916.S

[12] Nagoda, Nadeesha, and Lochandaka Ranathunga. "Rice Sample Segmentation and Classification Using Image Processing and Support Vector Machine." In 2018 IEEE 13th International Conference on Industrial and Information Systems (ICIIS), pp. 179-184. IEEE, 2018.