

International Journal Research Publication Analysis

Page: 01-07

WEED IDENTIFICATION USING DEEP LEARNING AND IMAGE PROCESSING IN VEGETABLE PLANTATION

^{*1}Prof. Rashmi S., ²Manju K., ³Santosh, ⁴Sathwik Ural, ⁵Bharath Kumar

¹Professor ECE department, Amruta Institute of Engineering and Management Sciences,
Bidadi, Bangalore.

^{2,3,4,5}Student ECE department, Amruta Institute of Engineering and Management Sciences,
Bidadi, Bangalore.

Article Received: 09 September 2026

*Corresponding Author: Prof. Rashmi S.

Article Revised: 29 September 2026

Professor ECE department, Amruta Institute of Engineering and Management
Sciences, Bidadi, Bangalore.

Published on: 19 October 2026

DOI: <https://doi-doi.org/101555/ijrpa.7132>

ABSTRACT

The Weed Identification Using Deep Learning and Image Processing in Vegetable Plantation is an intelligent embedded system designed to automatically identify weeds present among vegetable crops. The system uses a Raspberry Pi as the main controller and a USB web camera to continuously capture plant images in real time. The captured images are processed directly on the Raspberry Pi using a pre-trained YOLO deep learning model. The model is trained with predefined images of different types of weeds to detect and classify them accurately. When a weed is detected, the system identifies the type of weed and activates a buzzer to provide an immediate alert. An LCD display shows “Weed Detected” along with the detected weed name. If no weed is detected, the LCD displays “Healthy Crop – No Weed Detected.” The complete image processing and weed identification process is performed locally on the Raspberry Pi without requiring an internet connection. The system provides real-time monitoring of weeds in vegetable plantations and helps reduce the need for manual inspection. It supports efficient crop monitoring and improved crop management. The proposed system is simple, low-cost, and efficient for real-time weed identification. It can help farmers monitor weeds more easily and take timely action. Overall, the system provides an automated and intelligent solution for weed detection in vegetable plantations.

I. INTRODUCTION

Agriculture plays an important role in providing food and supporting the economic

development of many countries. Weed growth is one of the major problems affecting the productivity and quality of vegetable crops. Weeds compete with crops for essential resources such as water, nutrients, sunlight, and space. Traditional weed identification mainly depends on manual inspection, which requires considerable time, effort, and labor. Therefore, automated weed detection can help farmers monitor plantations more efficiently. Recent developments in artificial intelligence and image processing have made automatic plant identification possible. Deep learning techniques can analyze plant images and distinguish weeds from healthy crops. In this project, a Raspberry Pi is used as the main processing and control unit. A USB web camera captures real-time images of plants in the vegetable plantation. The captured images are processed using a pre-trained YOLO deep learning model. The model detects and identifies weeds from the captured images based on their learned features. When a weed is detected, a buzzer provides an alert to the user. An LCD display shows the weed detection status and the identified weed name. The system performs image processing locally on the Raspberry Pi without requiring an internet connection. This provides a simple, low-cost, and efficient solution for real-time weed monitoring and supports better crop management. The system helps farmers detect weeds quickly and reduce manual monitoring efforts. It provides a simple, low-cost, and automated solution for efficient vegetable crop management.

II. LITERATURE REVIEW & RESEARCH GAP

Agriculture plays an important role in food production, but weed growth affects crop growth and productivity by competing for water, nutrients, sunlight, and space. Traditional weed identification mainly depends on manual inspection, which requires considerable time and labour. To overcome these limitations, researchers have developed automated weed identification techniques using image processing, machine learning, and deep learning.

Ahmed et al. (2012) proposed a Support Vector Machine (SVM)-based approach to classify crops and weeds using digital images and extracted image features. Milioto et al. (2017) developed a convolutional neural network (CNN)-based method for real-time semantic segmentation of crops, weeds, and background. Potena et al. (2017) investigated deep learning techniques for fast and accurate crop and weed identification in precision agriculture.

Lottes et al. (2018) introduced fully convolutional networks that use sequential image information to improve crop and weed detection. Partel et al. (2019) developed a low-cost artificial intelligence-based system for precision weed management. Olsen et al. (2019) introduced the Deep Weeds dataset, which supports the development and evaluation of deep

learning models for identifying different weed species.

Gao et al. (2020) investigated a deep learning-based approach using a YOLO-based network to detect *Convolvulus sepium* weeds in sugar beet fields. Wang et al. (2022) proposed TIA-YOLOv5 to improve real-time crop and weed detection. Sportelli et al. (2023) evaluated YOLO object detectors for weed detection under different turfgrass conditions.

These studies demonstrate the potential of artificial intelligence and image processing for automated weed identification. Based on these developments, the proposed project uses a Raspberry Pi, USB web camera, and YOLO-based deep learning model to identify predefined weed classes in vegetable plantations. An LCD display and buzzer provide immediate information about weed detection, while local processing enables operation without continuous internet connectivity.

Research Gap

Although existing studies demonstrate effective approaches to crop and weed identification, there is a need for a simple, low-cost, and practical weed identification system suitable for vegetable plantations. Traditional methods require manual effort, while some advanced detection approaches may require specialised equipment or greater computational resources.

The proposed project addresses this need by integrating a Raspberry Pi with a USB web camera and a YOLO-based deep learning model for real-time weed identification. The system performs image processing locally without requiring continuous internet access. It also uses an LCD display to show the detected weed name and a buzzer to alert the user when weeds are identified. Therefore, the project focuses on developing an affordable, embedded, and user-friendly solution for automated weed monitoring in vegetable plantations.

III. PROBLEM STATEMENT & OBJECTIVES

Weed growth in vegetable plantations reduces crop productivity by competing with crops for essential resources such as water, nutrients, sunlight, and space. Traditional weed identification methods rely on manual inspection, which is time-consuming, labour-intensive, and prone to human error. Therefore, an automated system is required to identify weeds accurately and efficiently. This project proposes a deep learning-based weed identification system using a Raspberry Pi, USB web camera, and YOLO model to detect predefined weed classes in real time. An LCD display and buzzer provide immediate alerts, while offline processing enables weed monitoring without continuous internet connectivity.

Objectives

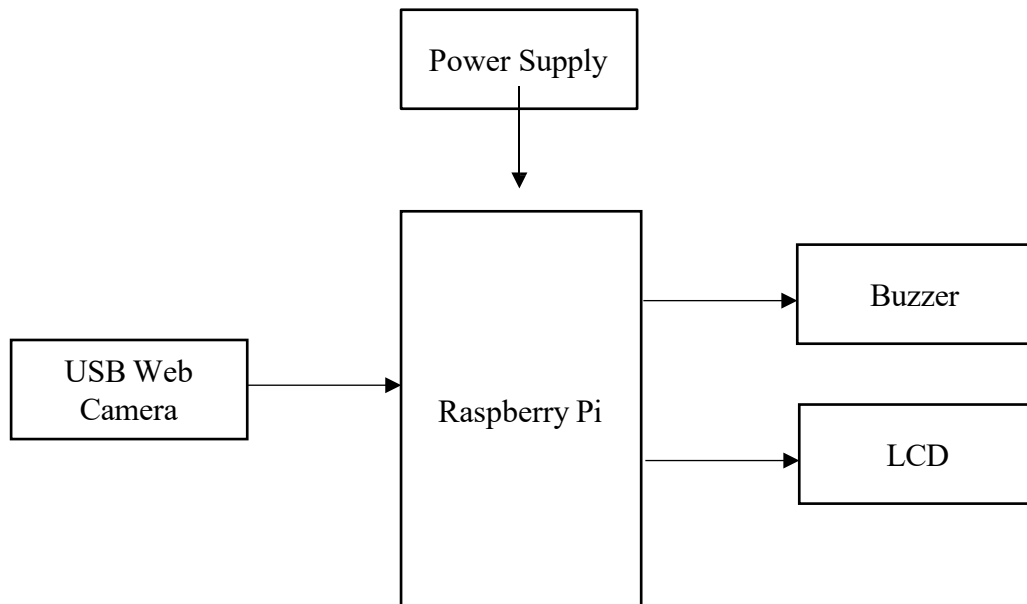
- 1.To identify weeds using deep learning.
- 2.To capture plant images using a USB camera.
- 3.To process images using a Raspberry Pi.
- 4.To detect weeds using a YOLO model.
- 5.To provide alerts using a buzzer and LCD.
- 6.To develop a low-cost and offline system.

IV. METHODOLOGY

The proposed system uses deep learning and image processing to automatically identify weeds in vegetable plantations. The system consists of a Raspberry Pi, USB web camera, LCD display, buzzer, and a trained YOLO model. The USB camera is connected to the Raspberry Pi to capture real-time images of the plantation. The captured images are continuously provided to the Raspberry Pi for processing. The input images are pre-processed to obtain suitable frames for detection. The pre-trained YOLO model is loaded into the Raspberry Pi for weed identification. The model is trained using a dataset containing images of different predefined weed classes. During operation, the YOLO model analyzes each captured frame and identifies objects present in the image. The detected objects are compared with the trained weed classes. If the detected object matches a weed class, the system identifies the corresponding weed name. The detection result is then processed by the Raspberry Pi. When a weed is detected, the Raspberry Pi activates the buzzer to provide an alert. At the same time, the LCD displays the message “Weed Detected” along with the identified weed name. If no weed is detected, the system displays “Healthy Crop – No Weed Detected” on the LCD. The system performs the complete detection process locally on the Raspberry Pi. No continuous internet connection is required for image processing or weed identification. The system continuously monitors the camera input to detect weeds in real time. The YOLO model provides bounding boxes around detected weeds and identifies their classes. The Raspberry Pi acts as both the processing unit and control unit for the connected output devices. The buzzer provides an immediate indication whenever a weed is identified. The LCD provides clear information about the current detection status. The proposed method reduces the need for continuous manual inspection of the plantation. It also provides a simple and low-cost approach for automated weed monitoring. The combination of image processing, deep learning, and embedded hardware makes the system suitable for real-time agricultural applications. Overall, the methodology provides an automated process from

image capture to weed detection and user notification.

Block diagram



V. HARDWARE & SOFTWARE COMPONENTS

A. Hardware Components

1. Raspberry Pi – 1
2. Memory Card – 1
3. USB Web Camera – 1
4. LCD Display – 1
5. Buzzer – 1
6. Connectors – 20

B. Software Components

1. Raspberry Pi OS
2. Python IDLE 3.10

VI. RESULTS & DISCUSSIONS

The proposed system integrates a Raspberry Pi, USB web camera, and YOLO-based deep learning model for weed identification in vegetable plantations. Real-time plant images are captured and processed locally by the Raspberry Pi. The YOLO model identifies predefined weed classes using bounding boxes and class labels. A buzzer alert is triggered when a weed is detected. The LCD displays the detected weed name and status. When no weed is detected,

the LCD displays “Healthy Crop – No Weed Detected.” Local processing enables operation without continuous internet connectivity. The system aims to reduce manual inspection and support efficient weed monitoring. Performance depends on lighting, image quality, weed characteristics, and processing capability. Further testing is required to measure detection accuracy, precision, recall, and processing time.

VII. CONCLUSION

The proposed Weed Identification System provides an automated and efficient solution for detecting weeds in vegetable plantations. The system combines a Raspberry Pi, USB web camera, image processing, and deep learning technology. Real-time images of the plantation are captured using the USB camera. The captured images are processed locally by the Raspberry Pi using a YOLO-based deep learning model. The model identifies predefined weed classes from the captured images. When a weed is detected, the system identifies the weed name and provides an immediate alert. The buzzer alerts the user about the presence of a weed. The LCD display shows the detection status and identified weed name. When no weed is detected, the system displays a healthy-crop message. The offline processing feature allows the system to work without continuous internet connectivity. The proposed system reduces the effort and time required for manual weed inspection. It provides a simple and low-cost method for real-time weed monitoring. The system can support better crop management and timely weed identification. Overall, the project demonstrates the effective use of deep learning and embedded technology for smart agricultural applications.

REFERENCES

1. F. Ahmed, H. A. Al-Mamun, A. S. M. Hossain Bari, E. Hossain, and P. H. Kwan, "Classification of Crops and Weeds from Digital Images: A Support Vector Machine Approach," *Crop Protection*, 2012.
2. A. Milioto, P. Lottes, and C. Stachniss, "Real-Time Semantic Segmentation of Crop and Weed for Precision Agriculture Robots Leveraging Background Knowledge in CNNs," in *Proc. IEEE International Conference on Robotics and Automation (ICRA)*, 2017.
3. P. Lottes, R. Khanna, J. Pfeifer, R. Siegwart, and C. Stachniss, "UAV-Based Crop and Weed Classification for Smart Farming," in *Proc. IEEE International Conference on Robotics and Automation (ICRA)*, 2017.
4. C. Potena, D. Nardi, and A. Pretto, "Fast and Accurate Crop and Weed Identification with Summarized Train Sets for Precision Agriculture," in *Proc. IEEE International Conference on Robotics and Automation (ICRA)*, 2017.

5. P. Lottes, J. Behley, A. Milioto, and C. Stachniss, "Fully Convolutional Networks with Sequential Information for Robust Crop and Weed Detection in Precision Farming," *IEEE Robotics and Automation Letters*, 2018.
6. V. Partel, S. C. Kakarla, and Y. Ampatzidis, "Development and Evaluation of a Low-Cost and Smart Technology for Precision Weed Management Utilizing Artificial Intelligence," *Computers and Electronics in Agriculture*, vol. 157, pp. 339–350, 2019.
7. J. Yu, S. M. Sharpe, A. W. Schumann, and N. S. Boyd, "Deep Learning for Image-Based Weed Detection in Turfgrass," *European Journal of Agronomy*, vol. 104, pp. 78–84, 2019.
8. A. Olsen, D. A. Konovalov, B. Philippa, P. Ridd, J. C. Wood, J. Johns, W. Banks, B. Girgenti, O. Kenny, J. Whinney, B. Calvert, M. R. Azghadi, and R. D. White, "DeepWeeds: A Multiclass Weed Species Image Dataset for Deep Learning," *Scientific Reports*, vol. 9, 2019.
9. M. H. Asad *et al.*, "Weed Detection in Canola Fields Using Maximum Likelihood Classification and Deep Convolutional Neural Network," *Computers and Electronics in Agriculture*, 2020.
10. J. Gao, A. P. French, M. P. Pound, Y. He, T. P. Pridmore, and J. G. Pieters, "Deep Convolutional Neural Networks for Image-Based Convolvulus sepium Detection in Sugar Beet Fields," *Plant Methods*, vol. 16, 2020.
11. K. Sudars, J. Jasko, I. Namatevs, L. Ozola, and N. Badaukis, "Dataset of Annotated Food Crops and Weed Images for Robotic Computer Vision Control," *Data in Brief*, vol. 31, 2020.
12. X. Jin, J. Che, and Y. Chen, "Weed Identification Using Deep Learning and Image Processing in Vegetable Plantation," *IEEE Access*, 2021.
13. A. Ahmad, D. Saraswat, V. Aggarwal, A. Etienne, and B. Hancock, "Performance of Deep Learning Models for Classifying and Detecting Common Weeds in Corn and Soybean Production Systems," *Computers and Electronics in Agriculture*, vol. 184, 2021.
14. A. Wang, T. Peng, H. Cao, Y. Xu, X. Wei, and B. Cui, "TIA-YOLOv5: An Improved YOLOv5 Network for Real-Time Detection of Crop and Weed in the Field," *Frontiers in Plant Science*, 2022.
15. M. Sportelli, O. E. Apolo-Apolo, M. Fontanelli, C. Frascioni, M. Raffaelli, A. Peruzzi, and M. Perez-Ruiz, "Evaluation of YOLO Object Detectors for Weed Detection in Different Turfgrass Scenarios," *Applied Sciences*, vol. 13, no. 14, 2023.