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Review Article

A Review on Real-Time Computer Vision Based Robotic Pesticide Sprayer for Multi-Crop

*Mr. Nagaraja Hebbar N[1], Dr. Sandeep Bhat[2]

[1]Research Scholoar,Srinivas University, Mangaluru,India
[2]Professor, CS &E, Srinivas Institute of Technology, Mangaluru,India.

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***Corresponding author: Mr. Nagaraja Hebbar N**
Research Scholoar,Srinivas University, Mangaluru,India

Abstract
For many Indians, agriculture serves as their primary source of income. Most family members rely on their income from agriculture. People are hesitant to become farmers because there are so many other options for making money. Despite the fact that many farmers want to grow different crops in different seasons. These include, among others, the leaves of Fenugreek (Methi), Tomatoes, Mirchi, Brinjal, and Chinese Spinach (Harive). Crop damage brought on by weed competition and other pests including bacteria, fungus, viruses, and insects severely reduces crop output and even kills it. Pests have an impact on a large number of crops. The unpredictable weather, high labor costs, and pest and bug attacks prevent farmers from increasing crop yields. Crop productivity can be increased with appropriate use of pesticides. The agricultural sector saw a variety of pesticide application methods, ranging from skilled labor to technical assistance. This report examined recent research on pesticide spraying devices based on computer vision. This study gives insight to computer vision approach for multi crop pesticide spray capabilities.

Keywords: Computer Vision, Robot, color model, Object sensor, Template matching, distance approximation.

I. INTRODUCTION
Pests negatively impact crops at many phases, including early growth, flowering, and ripening. Crop productivity would be considerably increased by early pest prevention. Herbal and chemical treatments are forms of protection. The development of technologies employed in the agriculture industry for crop production, crop management, and crop protection from weeds and pests has led to a notable improvement in crop yield in recent years. The field of precision agriculture is undergoing significant transformation due to the swift advancements in unmanned aerial vehicles (UAV) and vision sensors. The typical approach uses non-reusable test materials and is not adaptable to changes in the environment. Researchers contributed their ideas for developing intelligent techniques for diagnosing and controlling crop diseases that require little human interaction.

This study reviews several pest control and pesticide spraying methods for various crops. The methodology used for developing a robot based spraying system is also discussed. This study is concluded in the final section along with future scopes.

II. Literature Review
A microcontroller-based wheeled robot was developed to detect plants using a color sensor. This robot can move between planting rows to detect weeds based on the leaf color and spray chemicals on weeds. The master controller sends appropriate commands to the robot to activate the nozzle [1]. People can identify tomato diseases based on their own experiences, but find difficulties determining the underlying causes. Image processing technology [2] can quickly and accurately diagnose illnesses on crop leaves based on feature extraction. Using this approach disease prevention strategies may be applied quickly to overcome further illness. The suggested method [3] of pest detection and positioning is based centroid-matching technique, it uses a binocular stereo camera to obtain location information of the pests.

The researcher proposed [4] a smart spraying system based on computer vision that can be used as a field spraying operation to reduce the amount of spraying. When applying pesticides to crops, the system combines real-time image processing and feature recognition technology to identify plant leaves and the surrounding areas consumed by insect pests. It can also spray crops at varied heights independently. A novel vision-based spraying system was proposed [5], which can recognize vacant areas automatically while spraying a precise amount of pesticides on the target regions thereby reducing the wastage. This approach can provide a reference for future precision agriculture. With over 90% accuracy, the computer vision-based weed spot-sprayer system [6] was able to distinguish between maize and grass using image segmentation and feature extraction approaches. Since most crops are often planted in rows, an autonomous computer vision-based system developed [7] that gathers local information capable of detecting rows in plantations and controlling sprayer nozzles. The system was successfully implemented on smartphones and also easily fitted in tractor-mounted boom sprayers.

An appropriate navigation control algorithm for platform movement and a trajectory planning algorithm for shortest link travel are built in order to enable target spraying operation [8]. This technology will aid in reducing the overdose of toxic pesticides, hence reducing pesticide waste and regulating its hazardous effects on humans and the environment.
A multifunctional fuzzy logic-based robotic system [9] for spraying pesticides was able to identify unhealthy crops and apply pesticides. Pesticides are commonly used in crop protection, which raises production costs and affects the environment. Pesticide spraying robots have sparked a lot of attention from researchers. A cost-effective spraying robot [11] accomplishes more precise spraying with the use of several technologies approaches such as servo-controlled nozzles, flow control systems, and ultrasonic sensors etc. A semi-autonomous robot [12, 13] is can climb Arecanut trees and spray pesticides with servo-controlled nozzles. An autonomous pesticide sprayer [14] was implemented to spray pesticides precisely while incorporating ability to avoid obstacles. An ultrasonic sensing technology-based robotic [15] selective sprayer was used in orchards to spray exclusively toward the tree canopy, reducing pesticide usage by 26%. A robotic spraying system based on the SegNet model [16] was presented to spray pesticides in orchards. The X-Bot is considerably smaller than traditional pesticide-spraying robots, yet it saves a lot of energy and can spray pesticides [17].

A blue tooth-based pesticide-spraying robot was developed [21, 22] which can repel insects without any human intervention. The smart electric sprayer robot [23] has a crop perception system that calculates the leaf density based on an SVM classifier, and image histograms for local binary pattern, vegetation index, average, and hue. The leaf density is used as a reference value for the controller to determine sprayer parameters. In the work [24], image processing techniques were used to identify and remove the pests from the image acquired. This system automatically detects and extracts pest. A machine learning method predicts fruit maturity using RGB, HSL, HSV, and L * a * b * color characteristics. Based on the results of color acquisition by electronic sensors, a common color space named RGB (Red, Green, and Blue) was developed [25, 26]. This research proposes [29] an autonomous weed recognition system based on multi-image processing algorithm to lower agricultural product manufacturing costs and pesticide-related environmental damage. This work produced 18.18% of weed identified by the algorithm with accuracy of 81.82%. A fusion method that identifies five distinct groups of fruit datasets was proposed in the paper [30]. The proposed method uses image processing technique to guide the robot and position at suitable place for pesticide spraying process.

III. Proposed System

The system consists following modules: central processing module, Wireless camera, object sensor, nozzle sprayer module, and herbal liquid (non- chemical and non-toxic) tray module. The block diagram is shown in the figure 1. The wireless camera is mounted on pesticide carrying robotic module. Initially it is enabled for its operation. The camera module captures continuous image frames and sends to central processing module. The central processing module applies image pre-processing techniques.

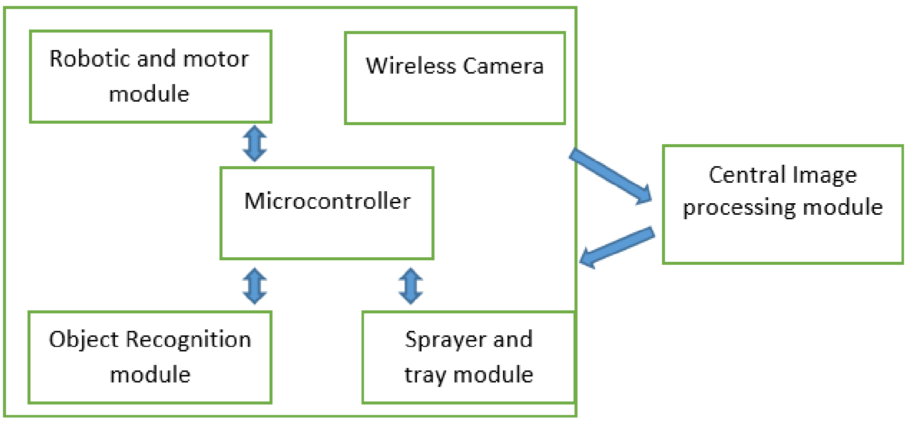

Figure 1: Broad view of proposed system

The Image processing module is implemented in personal computer. Following steps are essential in order to control the spraying operation

Image acquisition: Wireless camera mounted on robotic module captures video. It sends video stream to central Image Processing module. Medium resolution wireless camera is essential. Usually, the wireless camera has a clear line of sight of up to 450ft.

Image Pre-processing: This step involves image resizing, contrast adjustment, color correction, gray scale conversion. This step is essential to enhance the image quality and to reduce clutter.

Decision making to control the robot: Various techniques are used based on type of crop. In case of crop is a tree like Arecanut, HSV estimation, green pixel estimation method shall be employed which gives promising result. In case of ground level growing crop like Mirchi, Methe, Brinjal leaf pattern recognition algorithm is used.

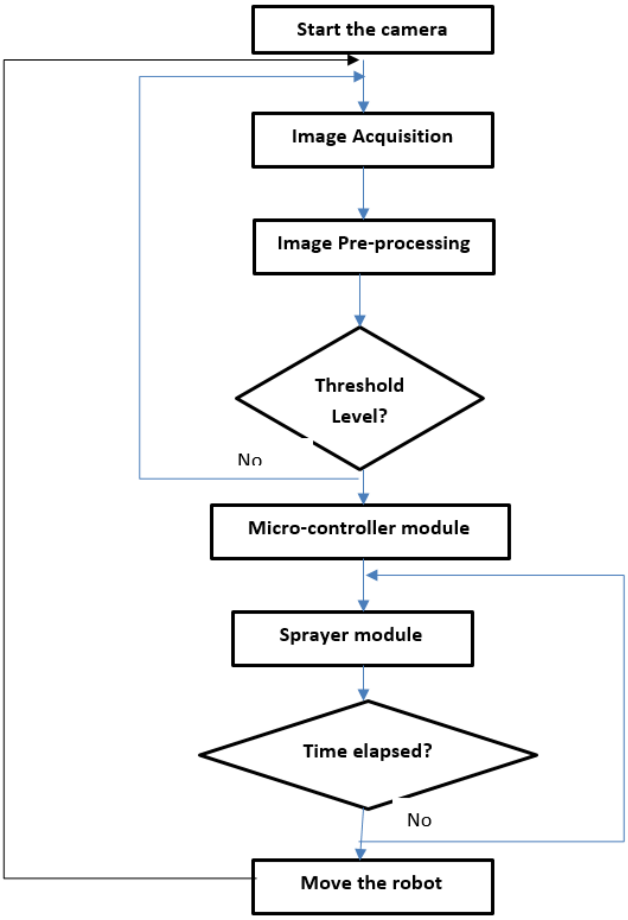

Figure 2: Flow diagram of proposed system

Based on the threshold value, suitable command is sent to microcontroller in serial mode. On receiving a data byte from central system, microcontroller module stops robot movement and enables sprayer by sucking suitable chemical or herbal mixture from tray module. The nozzle will continue to spray for a specified time duration then its value is automatically shut off. This process is depicted in the flow chart figure 2.

IV. Conclusion and Future Scope

Most of the researchers addressed the issues using machine learning and deep learning algorithms, a pesticide spraying robot to reduce labor and effectively control the spray process. The key strength and highlight of the idea is the autonomous spraying of pesticides, which is done automatically by the robot and may be regulated by a controlling module. This robot is real time, cost efficient, effective, easy to operate with minimum resources. The sophisticated proposed system can be used for multi crop. The aid of computer vision technology in robotic reduces the requirement of huge data set, computing resources.

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