Title: “Advancing Tomato Harvesting: An Automation with Machine Learning Approach"

On this paper author focuses on the design and development of an autonomous tomato harvesting robot, which aims to address labor shortages and boost crop productivity in agriculture. The robot's key elements include harvesting, recognition, and movement. It utilizes a plucking mechanism with a rotational gripper for efficient tomato harvesting and integrates a color camera for fruit recognition. The review highlights the importance of improving recognition methods to increase the harvesting rate and discusses challenges, such as grasp state estimation and simultaneous recognition of fruit and stem positions. The robot's evaluation through extensive harvesting experiments in diverse environments is also explored.[1]

This research article introduces a method for detecting mature tomatoes using computer vision techniques, with a particular focus on applying machine learning and color analysis to achieve precise tomato detection. The authors utilize Histograms of Oriented Gradients (HOG) features and a Support Vector Machine (SVM) classifier for the detection process. The article provides an in-depth description of the HOG feature extraction process, SVM classifier training, and the adoption of a sliding window approach to identify tomatoes.[2]

In this document the author focus on design and testing of a tomato harvesting robot equipped with a vision positioning system and a picking gripper for efficient tomato harvesting. The robot's control system comprises an information acquisition unit, IPC operation control unit, and motion execution unit. Tested in a greenhouse, the robot achieved a successful tomato harvesting rate of 83.9%. Its primary goal is to enhance efficiency and reduce labor in tomato harvesting processes.[3]

This document focuses on the design and research of the end actuator of a tomato picking robot The end effector, comprising hardware components such as fingers, vacuum corrugated suckers, bidirectional screws, DC servo motors, and more, plays a vital role in achieving successful fruit and vegetable picking. [4]

The paper focuses on the design of a chassis system for a tomato picking robot in a greenhouse. It provides detailed information on the mechanical structure design, girder assembly, and drive line, as well as the overall layout of the chassis. Additionally, it discusses the components' functions, such as the mounting frame for the picking system and the control system installation area. The paper also covers the design of the power supply circuit and control program. [5]

Introduction:

Backgroun theory

The agricultural industry is continually seeking innovative solutions to address labor shortages, enhance productivity, and improve harvesting efficiency. In recent years, autonomous harvesting robots have emerged as a promising technology to revolutionize the way crops are harvested. This report presents the design and implementation of an autonomous tomato harvesting robot equipped with a 6 Degrees of Freedom (6DOF) robotic hand and a machine learning-based recognition system. The primary objectives of this research are to optimize the Harvesting Mechanism, develop an efficient Recognition System for ripe tomato identification, and design robust and precise movement capabilities for the robot.

Harvesting Mechanism:

The Harvesting Mechanism is a crucial component of the autonomous tomato harvesting robot. The primary goal is to ensure a gentle yet efficient method of detaching ripe tomatoes from the plant to minimize damage and preserve the crop's quality. In this report, we explore various harvesting mechanisms, with a particular focus on the use of a 6DOF robotic hand. This advanced robotic hand offers greater dexterity and versatility, allowing the robot to handle delicate tomatoes with precision and efficiency.

Recognition System:

Accurate recognition of ripe tomatoes is essential for the efficient operation of the harvesting robot. To achieve this, we implement a machine learning-based Recognition System using advanced computer vision techniques. The system employs Histograms of Oriented Gradients (HOG) features and a Support Vector Machine (SVM) classifier to identify and locate ripe fruits accurately. By training the machine learning model on a vast dataset of tomato images, the robot can intelligently differentiate between ripe and unripe tomatoes, enhancing its harvesting capabilities.

Problem Statement:

The traditional manual harvesting of tomatoes in agricultural practices is labor-intensive and time-consuming, leading to increased production costs and inefficiencies in crop harvesting. The lack of an automated and efficient harvesting solution poses a significant challenge to the agricultural industry. Moreover, accurately identifying ripe tomatoes amidst foliage can be challenging, resulting in potential crop damage and wastage. To address these issues, there is a pressing need for the design and implementation of an autonomous tomato harvesting robot with advanced recognition capabilities and precise harvesting mechanisms to improve productivity, reduce labor dependence, and ensure optimal crop quality.

Objective:

1. Develop an autonomous tomato harvesting robot with a 6DOF robotic hand and optimized movement capabilities for precise and gentle fruit detachment from the plant, efficient navigation through tomato plants, and avoidance of obstacles.

2. To Implement a machine learning-based Recognition System using HOG features and SVM classifier to accurately identify and locate ripe tomatoes.

Scope and application

* Revolutionizing agricultural practices by enhancing harvesting efficiency and reducing manual labor dependency.
* Improving crop productivity and quality by minimizing crop damage and wastage during harvesting.
* Adapting the autonomous harvesting robot for various greenhouse and field cultivation setups.
* Enhancing sustainability in agriculture through the efficient use of resources and reduced environmental impact.
* Potential application in other fruit and vegetable harvesting tasks to address labor shortages and improve production efficiency in the agricultural industry.