NUTMEG PICKING ROVER

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Abstract

Nutmeg farming is one of the leading economies in Kerala. Harvesting nutmeg manually is tiresome and time-consuming process. Around 40 % of the labour goes into the collection of the nutmeg from the farms. The time and effort used for the harvesting of the nut can be greatly reduced by automating the process. Currently there are no device in the market to pick and harvest this kind of fruits and nuts. The use of automated machines is no longer limited to industrial environments. Also for the outdoor activities robotic systems are increasingly combined with new technologies to automate the labour intensive works. Our project concentrates on automating the entire harvesting process from collecting the nuts from the farm to keeping it in the storeroom. The machine collects the nuts and once the onboard container is full, the machine goes to the store to empty the container. The machine also charges voluntarily once the charge goes below a threshold by coming to the charging dock. All this is done by GPS mapping and image processing.

Key words: *Nutmeg, Rover, Collection, Automation process, Image processing, GPS mapping*

Introduction

The agriculture industry is demanding technological solutions focused on automating agriculture tasks so as to extend the assembly and benefits while reducing time and costs. These technological solutions are mostly supported the applying of sensor-based technologies. A comprehensive description is found in where the foremost recent research focused on solving agriculture and forestry tasks by using sensors is summarized.

Kerala could be a fast-developing state, most of the middle-class citizens rely upon their agriculture for his or her income and earnings. Most of them rely upon manual labour for harvesting their fruits. This process is labor intensive and also time consuming. Nutmeg farming is one amongst the leading economies in Kerala. Harvesting nutmeg manually is tiresome and time-consuming process. Around 40 you look after the labor goes into the gathering of the nutmeg fro the farms. The time and energy used for the harvesting of the nut is greatly reduced by automating the method. the utilization of automated machines isn't any longer limited to industrial environments. Also, for outdoor activities, robotic systems are increasingly combined with new technologies to automate labor intensive works. Our project concentrates on automating the complete harvesting process from

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collecting the nuts from the farm to keeping it within the storeroom. The machine collects the nuts and once the onboard container is full, the machine goes to the shop to empty the container. The machine also charges voluntarily once the charge goes below a threshold by coming to the charging dock. All this is often done by GPS mapping and image processing. These coordinates are given to the robotic arm to choose up the nut and place it within the container. Once the container is full the rover saves its current location and goes to the storeroom whose coordinates are saved within the rover. After emptying the container, the rover resumes the harvesting from the saved location. Similarly, when the battery goes below a intensity level, it goes to the charging dock and recharge.

LITERATURE REVIEW

Till now there's nothing called nutmeg picker invented to the present point. But related to fruit picking there are several proposals. Development of An “Autonomous Kiwifruit Picking Robot”, the robot that has an intelligent vision system which ensures only ‘good’ fruit is picked. The robot receives all instructions by link and operates autonomously because it navigates through the orchard, picking fruitss, unloading full bins of fruits, fetching empty bins and protecting the picked fruits from rain. The robot has four picking arms, each of which is ready to select one fruit per second. to extend the useful annual work period of the robot, it's envisaged that it will even beaccustomed pollinate kiwifruit flowers.

An apple picking robot which is developed in Belgium. Researchers has focused on Panasonic anthropomorphic robot with a soft silicone cup-shaped end effector with one camera at its center which could identify and pick apples using suction method. It detects and harvests about 80 percent of the apples (in non-windy conditions) with a pick rate of 8-10 seconds per apple. Currently the robot is mounted on a motortruck. somebody's operator drives it to the tree, stabilizes the robot platform, positions a shroud over the tree to manage the lighting and stores the picked fruit. It should be noted that, generally, it is not desirable to simply rip the apple off the plant because there's likely to be damage where the stem pulls out of the apple. In practice, the stems are bent as they're pulled so as that the break occurs within the stem.

An orange-picking robot developed in Catania, Italy. This device has two telescopic picking arms fitted with mechanical end effectors and one camera housed inside the pincers. The arms are mounted on wheeled vehicle which weighs over 2 tones and must be manually driven to the start point of the grove. It then navigates along the grove using GPS navigation and features a pick time (time to acknowledge fruit and pick it) of 8.7 seconds. the share of the complete crop picked isn't stated.

Next Generation Image Guided produce Pickers has developed an approach that mixes the economy of mass removal with the intelligence of robotics. It uses many low-cost mechanisms controlled through visual sensors and high-throughput computer processing. The fast-moving parts of the system are inexpensive and disposable, reducing maintenance costs. The system will harvest an estimated 32 pieces of fruit per second at peak performance. Energid’s approach applies 16 inexpensive, disposable mechanisms organized into a pneumatically actuated grid. Multiple grids are used simultaneously, allowing 64 or more picking mechanisms to be applied to a tree by one operator. The picking mechanisms have multiple picking modalities, including sharp end effectors that strike the stems of the fruit and remove the fruit from the tree. Each grid of picking mechanism integrates an array of sight cameras that are being used for visual guidance. the system are mounted on a goat truck with a modified boom arm and may house a central computing cluster with a high-throughput data capture interface, compressor with accumulator tank, and a gaggle of multiple Frog Tongue modules. It should be noted that the system is bulkier and takes many spaces.

Object Identification and placement utilized by the Fruit and Vegetable Picking Robot supported Human higher mental process, this paper presents a semi-automatic identification and placement method, which is Human-Computer-Interaction way and supported human-decision making. And this method can recognize fruits, vegetables and picking points in an exceedingly faster and more convenient way. This method may improve the picking robot's reliability to complete the work to pick selected fruits and vegetables. First, the vision system is applied to urge close range pictures of the fruit-vegetable-picking site; second, the picker will determine the condition of target fruits and vegetables through the pc screen and ascertain the case of the picking points; then, the corresponding points of the picking points are clicked on the screen supported peripolar constraint; final step is to calculate the spatial value of picking points.

An Underactuated End-effector Design for fruit picking is to grasp the shape adaptability and stable grasping for fruit mechanical picking, a design scheme of end effector with tendon-driving is proposed supported the underactuated principle. statics analysis of finger and also the look rules for improving grasp stability is researched, likewise because the most structure parameters of the end-effector are determined. Analysis and calculation results show that the tip effector meets all the look requirements and might achieve the upper adaptability to fruit shape, nondestructive grasping, and has such features as simple structure, low cost, convenient operation and maintenance. End-effector is that the key actuator in picking robot. Considering the irregular shape and vulnerability of the grasped objects, and also the wants of operation simplicity and price for users, the simplest end-effector should have the following characteristics the upper adaptability to fruit shape, wide versatility, certain flexibility, nondestructive grasping for fruits, simple system structure, low cost, convenient operation and maintenance.

TOP LEVEL DESIGN CONSIDERATIONS

Design of the product

The machine we propose is using the image processing and GPS locating to identify and locate the rover in the farm map. The rover moves with a belt system to make the movement easier on uneven lands. There is a small container attached to the back of the rover to store the harvest on the go.A camera on the front takes the surrounding image and feed it to the processor and it locates the nuts and gets the coordinates of the nuts or fruits. This coordinate is given to the robotic arm to pick up the nut and place it in the container. Once the container is full the rover saves its current location and goes to the storeroom whose coordinates are saved in the rover. After emptying the container, the rover resumes the harvesting from the saved location. Similarly, when the battery goes below a threshold level, it goes to the charging dock and recharge.

Block diagram

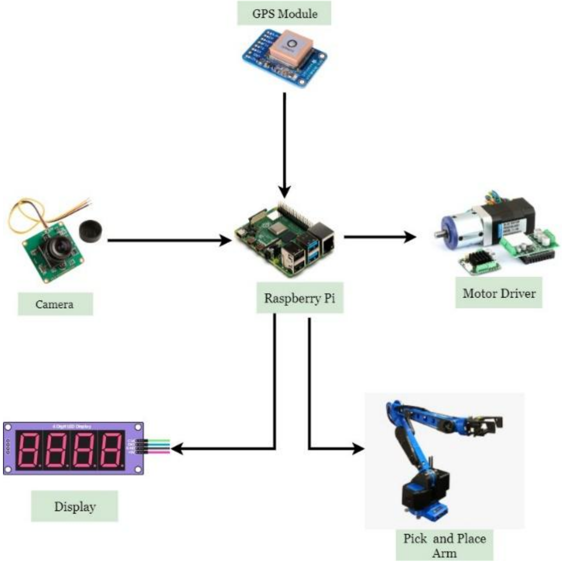

Fig. 1 Block Diagram

The main processor that we are using is raspberry pi, in order to incorporate image processing. The location to the trees is given by the GPS module. The motor drives the rover to the given location. At the location, the camera detects the nuts and gives the relative coordinates to the robotic arm. The arm then picks the nuts and puts it in a container.

Circuit Diagram

The entire circuit is powered by a 3 cell 11.1V LiPo battery. There are four sections to the circuit. They are Raspberry Pi, GPS, Motor Driver and Power supply. The Raspberry Pi has all the programs to control the GPS, Motor Driver, and servos.

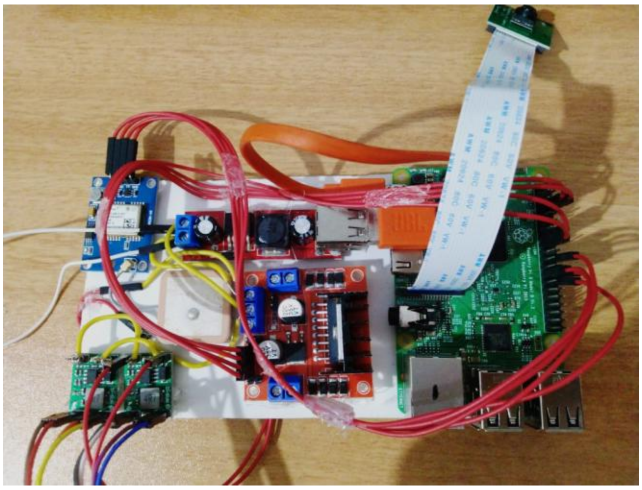

Fig.2 Circuit Diagram

The Gps module is powered by the 5V from the Raspberry Pi. The main 11.1V is converted to 5V for the Raspberry Pi by using a voltage regulator (LM2596) which has USB output ports. The rover uses DC motors for movement, and it is 12V motors, hence the motor driver. The motor driver takes voltage from the LiPo battery and the signals from the raspberry pi to make a PWM voltage that is given to the DC motors hence controlling the movement by with the raspberry pi. A program takes the inputs from the GPS module and decides where to go. There are four servo motors in the rover, these servos are powered by another 5V voltage regulator (LM2596). The signal to the servo is given from the raspberry pi, these signals are calculated using a program. This program takes the location coordinates from the object detection program to translate it into the angle that is required for the servo.

The Raspberry Pi is given power form a standard Micro USB power supply. It is a 3Amp power supply. The camera module is connected to Raspberry Pi. The motor is then connected to the L293D module which is connected to the Raspberry Pi. Then the robotic arm is connected to the Raspberry Pi to work it to the coordinates given from the image processing. The motor is having a track belt to move it in all the different types of land. This makes it possible to move around and have a more load bearing capacity.

COMPONENTS REQUIRED

1. Raspberry Pi: All the processing is done in raspberry pi microprocessor.
2. Motor Driver (LM293D): This controls the direction of the motor
3. Camera Module: This is used to take the images of the nuts and for locating the storeroom and charging dock.
4. Servo Motors: We have used servo motors in the robotic arm.
5. Ultrasound Sensors: Here we use this sensor to detect whether the container is full or not.
6. DC motors: Hi-Torque DC motor is used to drive the rover

RESULTS AND DISCUSSION

Raspberry pi and GPS testing.

The GPS location of each trees were fetched with the help of a program and the GPS connected to the raspberry pi. On reaching the location of the trees, we save the GPS location data to a file in the raspberry pi memory. This file is used as the map of the land.

Location map and Rover testing.

Once the map file is created, we gave it to another program which then drives the rover to the tree location. First the current location of the rover is determined, then the nearest location from the map file is selected. Now using an algorithm, we determine the required path to reach the tree.

Robotic arm configuring and testing.

Configuring the robotic arm was a tricky challenge. We had to translate the 3D space coordinates into angles in order to give input for the servos. Servos take only PWM signals to determine the rotation angle. We had to make a function which maps the PWM signals to the rotation angle. After we get the angle, we determine the angle required by each servo to reach the nutmeg. Once the arm reaches the nutmeg, the camera verifies and gives a signal to grab the nutmeg.

CONCLUSIONS

There are several ideas for improving upon the prototype generated by this project. This bot can also be designed to pick different fruits like apple, citrus etc., depending upon the farm we can decide the fruits. One of the difficulties that we faced was to get the rover to move to the tree location, since the GPS signals are not fast, the rover tends to take so much time to reach the target tree. In future beacon systems can be used to track the trees and the rover with very high accuracy and speed. Further changes can be done for the processor. We can use google coral instead of raspberry pi. Google coral much efficient in machine learning.

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