ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 9, September 2018

Harvester and Collector Bot Based Harvesting System

Sridhatta Jayaram Aithal[1]

U.G. Student, Department of Electronics and Telecommunication Engineering, A. C. Patil College of Engineering, Navi Mumbai, Maharashtra, India[1]

ABSTRACT: This paper proposes the new way of Harvesting the Fruits or Crops in the farm using the Swarm Farming concept. Implementation of this seeks the use of two robots which are Autonomously Bonded with each other wirelessly to harvest the fruits inan Green House Environment. The Robots requires the Guided Tracks to move all around the farm. The use of the different technology methods such as Artificial Intelligence, Path Planning, Image processing helps in the producing the better yield and also decreases the loss to farmer. This paper also proposes the new design of Position Encoder which helps in determining the distance of how much the robot has moved from its initial position. The main sole purpose of this paper is to reduce the Farm labour cost, increase the productivity. The bot adds to the advantage of early detection of ripe fruits which can be plucked at the right time so that the fruits don't overripe. It helps the farmer through loss of his money through damage of fruits due to over-ripening of fruit.

KEYWORDS: Swarm Farming; Autonomously Bonded; Green House Environment; Guided Tracks; Artificial Intelligence; Path Planning; Image processing; Position Encoder

I. INTRODUCTION

The Harvesting system comprises of two robots namely Harvesterrobot and Collector robot. They are installed inside a Greenhouse Farm with guided tracks or black line or white line to constitute a whole arena on which the robot follows it to reach the specific fruit tree to reach the goal. The collection of black lines somewhat looks like mesh. In this arena constitutes of two robots Harvester robot and Collector robot both this robot are connected to each other wirelessly. The robot is autonomous it is capable of determining the path to the specific tree itself. Howsoever this brings the whole system to new level of automation.

The Harvester robot uses image processing to identify the fruits using image processing the robot can be capable to identify the difference in ripened and unripe and overripe fruits, it can also take the count and determine the size of the fruit. After identifying the fruit Harvester robot has robotic arm which it collects it and traverses the arena to reach the Collector robot. Collector bot collects the fruit from Harvester Bot and deposits it to the Fruit Bin where it is used for further process.

The overall system is controlled by the minicomputer e.g. Raspberry Pi, Beagle Bone Black etc. The minicomputer is connected to Harvester bot through Serial Communication and through Collector Bot through Wireless medium. The system utilizes Image processing, Path Planning, Artificial Intelligence as a base concept. The robotic arm is based upon sliding mechanism. Coming towards the concept of how much distance the robot has covered is been solved through the design of new proposed position encoder.

This system proposes a new way of farming through the Farmer gets introduces towards a Farming which requires less maintenance cost, Increased productivity, low labour cost.Added technological advantage which collectively emphasizes the use of swarm farming concept with no or less Human interference in the farm to be used for monitoring.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 9, September 2018

II. RELATED WORK

The overall system uses different technological types collectively namely Image Processing, Path Planning, Artificial Intelligence, Sliding mechanism as its underlying base. The part [1] in which authors have used the image processing of simple red color blob detection to detect the red pepper and another method was based on Fruit localization. The Image processing is based on Machine software based on vision sensing is used. The system achieves flexibility through freedom of nine degrees. The part [2] author describes the robot to be clubbed on travelling platform to reach the fruit for harvesting. The target fruit was accessed on path side. The part [3]author describes about a system based on Demeter system in which it navigates around the field using GPS or global positioning system and harvests the crop and also successively avoids the obstacles. The part [4] author describes the new system which works under theprotected crop environment combining the vision algorithm and end affecter design toharvest the sweet pepper.

III. PROPOSED ALGORITHM

A. *Design Considerations:*

- The efficient and reliable image processing technique.
- Robotic arm design which is reliable in picking up the fruit properly.
- Wireless communication between two bots should be continuous.
- Efficient path planning clubbed with artificial intelligence.
- Guided Track e.g. Black line should be true black i.e. sensible to sensor .
- The Position encoder should be reliable and should give accurate distance measurement .
- Autonomous system control of primarily consisting of Harvesting and Collector Robot.

B. *Description of the Proposed Algorithm:*

The main aim of the system is to achieve efficient farming through qualitative and efficient harvesting of fruits.

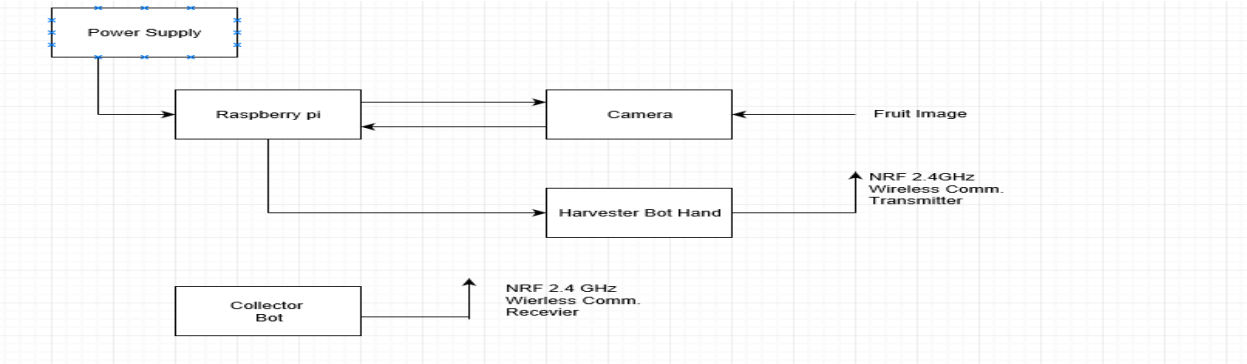


Fig. 1.:Block Diagram of Harvesting and Collector bot system.

The Fig.1 represents the block diagram of the whole system which includes the following components:

1. A Minicomputer.
2. Camera.
3. Harvester Bot.
4. Collector Bot.
5. Wireless Communication Medium.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 9, September 2018

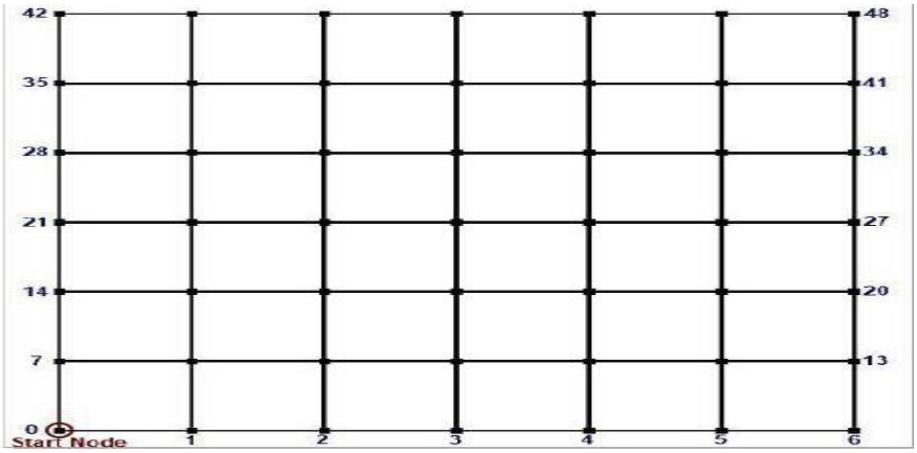


Fig .2.: The Arena

The main system is implemented on the arena shown in Fig. 2. The Arena constitutes of dimension of 9x9 feet by dimension and numbering of nodes is done accordingly. The Black lines on the Arena depicts the path on which the robots traverses and in certain trees can be kept. The Harvester robot has the capability to collect the Fruit of one tree completely at a time and handover it to the collector bot which will place it in the fruit bin. The Harvester Bot is planned on the sliding design of railing mechanism. The railing mechanism consist of two arms of which one is stationary and other one is attached to moving module which moves across the railing track of stationary arm vertically. This arm which is attached to the moving module has the free rotation axis of 0 to 180 degree and it also holds the camera and gripper which is used to hold the fruit. There are four servo motors used one is installed to move the moving module up and down for vertical movement through the lever mechanism on the railing and second servo motor is attached to the moving module where it holds the gripper and camera which can make the movement of 0 to 180 degree freely and such that the lower 90 degree angular movement of this arm will be used in plucking and dropping the fruit to the dispatch mechanism. Third servo motor is used in opening the door of dispatch mechanism in the deposition zone. The Fourth servo motor is used for gripper to hold the fruit and release the fruit to the dispatch bin. The stationary arm will be mounted on the platform of the robot vertically in the front section and also the dispatch bin will be placed will be place in the front of robotic platform.The robot will follow the Black line based value of white line sensor. The robot will also identify the Node based on the valuesof the white line sensor. The Node is set to count in the program code where each Node is identified and the corresponding flag variable is updated and based on the condition to the specific Node the robot will take specific turn or action specified. The robot will traverse the arena to visit the fruit tree and will collect the fruit from all the four sides on the dispatch bin. And from there it will traverse to the Collector bot to handover the fruits and the Collector bot will deposit the fruits in the fruit bin. After Harvester bot has handover the fruit to the Collector Bot it will move toward the next Fruit tree to perform the similar action as described above. The Robot traverses the Arena using A-star algorithm. The Image processing of identifying different fruits is done using the color HSV model which can be made faster and optimised then the conventional thresholding technique.

The representation of tree in initial representation can be used as pipe of 11cm in diameter and height of 40cm can be used. Thus according to the function the Bots perform their respective activities. The Harvester Bot performs the harvesting the fruits and traverses the arena to handover the fruits to the Collector Bot. The Collector Bot traverses arena to reach the fruit bin and drops the fruit at respective fruit bin. The fruit taken for consideration is Apple, Blueberry, Orange. The System is able to detect the type of fruit, size of fruits: either large small or medium and count the number of fruits. The System utilises white line sensors or Infrared sensors to sense the line and utilises the position encoder to measure the distance robot has travelled which is high use during taking turn at the node and while harvesting the Fruits near the tree. The Full system is autonomous system in which the Harvester Bot communicates with the Collector Bot in Wireless medium using nrf24l01 or similar like devices.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 9, September 2018

Fig .3.Side view of Harvester Bot

.Fig.4. Front View of Harvester Bot.

Fig.5. Back View of Harvester Bot.

Fig.6. IR line sensor of Harvester Bot/ Collector Bot.

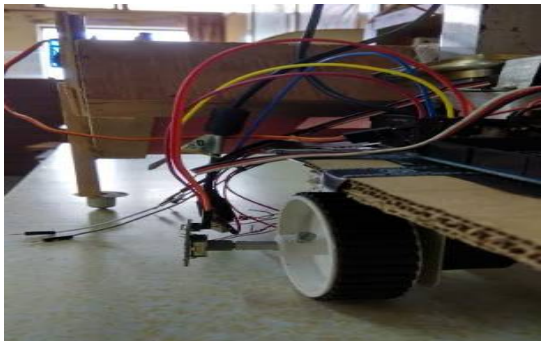


Fig.7. Left wheel Position Encoder Sensor.

Fig.8. Right wheel Position Encoder.

Fig.7. and Fig.8.represents the position encoder coupled with the axis of wheel. The Rotary Encoder used here is depicted as Position Encoder.As the Rotary encoder is capable of calculating the angle of the shaft Thus by relating the angle of rotation with the amount of distance the wheel moves in one degree which depends on diameter of the wheel, the difference in reading of the angle or reading of the angle if the initial angle is 0 degree obtained from the Rotary encoder can be used to calculate how much distance the robot has moved from its initial position. It also helps robot during taking turn of exact 90 degree and 180 degree during taking turn across nodes in arena of Greenhouse.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 9, September 2018

IV. RESULTS

The Result of the whole system can be classified through categorical results obtained.. The Harvesting Robot operation relies majorly on the Image Processing, Path Planning. The Fig.9, 11, 13 shows various detection of Fruits using Image Processing whereby the circle stands on the detected fruit. The Fig.10, 12, 14 shows the type of detected fruit along with its size feature i.e. Perimeter and Area through which the size of Fruit can be determined. Through taking repetitive counts in the program the count of the fruit can also be obtained. The Fig.15.shows the path planning result of which helps the robot to traverse through the Arena easily with the help of virtual mapping technique and the path provided is free from obstacles which is implemented through A-star Algorithm.The Fig.16.shows the output readings obtained for Position Encoder which provides information on the amount of distance moved by robot.

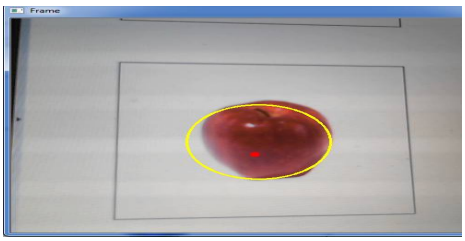
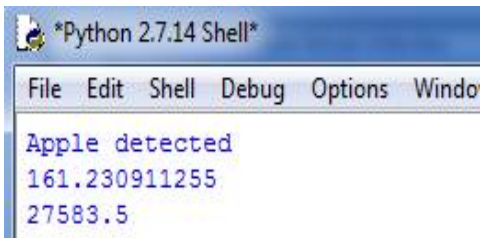


Fig.9. Image processing detection of Apple



.Fig.10. Image Processing Apple detection details.

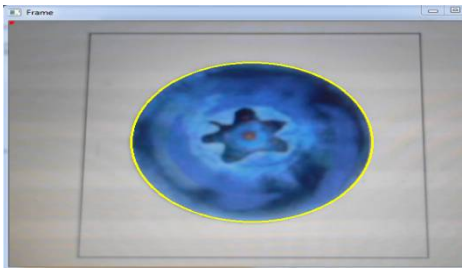


Fig.11. Image processing detection of Blueberry.

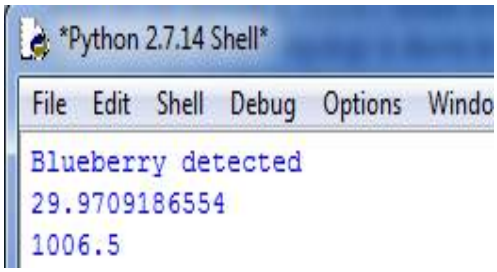


Fig.12. Image Processing Blueberry detection details.

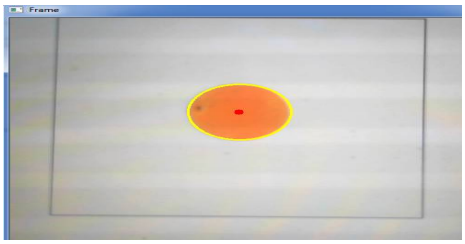


Fig.13. Image processing detection of Orange.

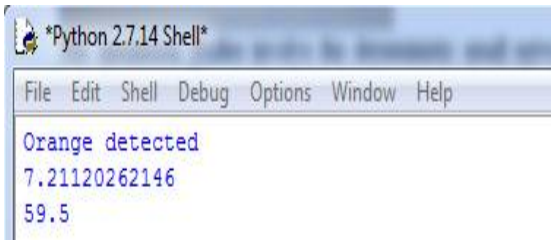


Fig.14. Image Processing Orange detection details.

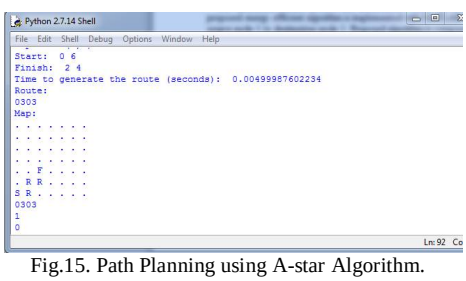


Fig.15. Path Planning using A-star Algorithm.

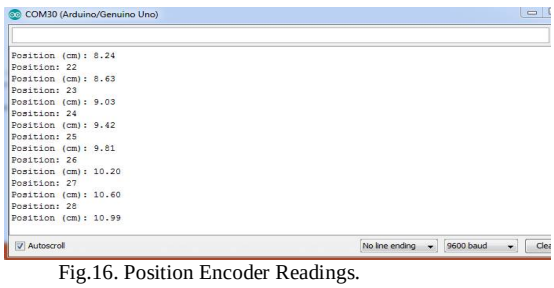


Fig.16. Position Encoder Readings.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 9, September 2018

V. CONCLUSION AND FUTURE WORK

The Results obtained can be implemented on the system to form an overall Harvester and Collector Robot. The overall system is highly efficient because of proper implementation of Image Processing which helps to detect the Fruit type and it's size and it's count. The Path Planning provides the proper path to navigate for the Harvester and Collector robot through the arena with avoiding the obstacles. The new design of Position Encoder provides proper distance measurement for robot so that it can easily navigate through the Arena of Greenhouse such that it can easily turn across nodes and also to move a specific distance before the tree before harvesting. The artificial intelligence in the overall system binds the working of two robots autonomously where robots communicate with each other through wireless medium with no human interference needed. The Future scope of the system is that it can be effectively utilized for making the farming fully autonomous with the use of robots to plough and sow the farm or plantation and also maintaining thetemperature, water level and Harvesting and various other characteristics for a highly efficient farming and plantation.

REFERENCES

1. Jochen Hemming, C. WouterBac, Bart A.J. van Tuijl, Ruud Barth, Jan Bontsema and ErikPekkeriet,'A robot for harvesting sweet-pepper in greenhouses', International Conference of Agriculture Engineering, pp.1-8, 2014.
2. Ashwini K,'Survey Paper on Fruit Picking Robots',International Journal of Computer Science and Mobile Computing, Vol. 5, Issue 1,pp. 96-101, 2016.
3. Tom Pilarski, Mike Happold, Henning Pangels, Mark Ollis, Kerien Fitzpatrick and Anthony Stentz,'The Demeter System for Automated Harvesting', Autonomous Robots, Vol. 13 Issue 1, pp. 9-20, 2002.
4. Christopher Lehnert, Andrew English, Christopher McCool1, Adam W. Tow1 and Tristan Perez,'Autonomous Sweet Pepper Harvesting for ProtectedCropping Systems',IEEE Robotics and Automation Letters, pp. 1-8, 2017.
5. Krishnaswamy R. Aravind, Purushothaman Raja and Manuel Pérez-Ruiz,'Task-based agricultural mobile robots in arable farming: A review', Spanish Journal of Agricultural Research, pp. 1-16, 2017.
6. Davinia Font, TomàsPallejà, Marcel Tresanchez, David Runcan, Javier Moreno, DaniMartínez,MercèTeixidó and JordiPalacín,'A Proposal for Automatic Fruit Harvesting by Combining aLow Cost Stereovision Camera and a Robotic Arm',Sensors, pp. 11557-11579, 2014.
7. ShivajiBachche,'Deliberation on Design Strategies of Automatic Harvesting Systems: A Survey', Robotics, pp. 194-222, 2015.
8. PayalSrivastava, Neda, Ms.Kriti,'Robotic Farmer',IJEDR, Volume 5, Issue 2, pp. 827-830, 2017.
9. S. Mehta and T. Burks, 'Vision-based control of robotic manipulator for citrus harvesting', Computers and Electronics in Agriculture, Vol. 102,pp. 146–158, 2014.
10. E. Van Henten, B. Van Tuijl, J. Hemming, J. Kornet, J. Bontsema, andE. Van Os, 'Field Test of an Autonomous Cucumber Picking Robot', Biosystems Engineering, Vol. 86, no. 3, pp. 305–313, 2003.
11. E. J. Van Henten, D. a. Van't Slot, C. W. J. Hol, and L. G. VanWilligenburg, 'Optimal manipulator design for a cucumber harvestingrobot', Computers and Electronics in Agriculture, Vol. 65, no. 2, pp.247–257, 2009.
12. C. Hung, J. Nieto, Z. Taylor, J. Underwood, and S. Sukkarieh, 'Orchardfruit segmentation using multi-spectral feature learning', in IEEE/RSJInternational Conference on Intelligent Robots and Systems (IROS),2013.

BIOGRAPHY

Sridhatta Jayaram Aithal: I'm an undergraduate student currently studying in 4th year of Bachelor of Engineering, Electronics and Telecommunication stream at A. C. Patil College of Engineering, Navi Mumbai, Maharashtra, India. My current research Field of Interest is Artificial Intelligence, Robotics, Internet of Things, Data science, Big Data Analytics, Data Mining, ApplicationDevelopment using Android.