Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 5, Issue. 1, January 2016, pg.96 – 101

Survey Paper on Fruit Picking Robots

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Abstract --- In order to improve robotic harvesting and reduce production cost, a harvesting robot system for strawberry was designed moveable strawberry-harvesting robots (third and fourth prototypes), which can be moulded on a travelling platform, were developed and operated practically in a greenhouse. The harvesting robot is based on the second prototype (Hayashi et al., 2010a); however, item be separated from the travelling unit. Both the robot and the travelling platform are modular system units that can be developed and tuned individually. Combining the harvesting robot and the travelling platform demonstrated the potential for autonomous harvesting in a 2D area in a greenhouse. The harvesting robot was a 3DOF cylindrical type that approached the target fruit from the path side. The results of performance testing showed the electrical power consumption of the travelling platform. By this it was clear that the power consumption was more by considering the success rate and power consumption there was improvement in third and fourth prototype. There was improvement in the machine vision. In order to avoid the power consumption and to increase the success rates some of the proposed ideas are considered.

Keywords --- Strawberry-harvesting robot, harvesting success rate, power consumption.

I. INTRODUCTION

Role of agriculture robots

- To Substitute labour and workers
- To Release from heavy, dangerous, or monotonous operations
- To increase market value of product,
- To produce uniform products
- To make hygienic / aseptic production conditions
- To give successors a hope for economic sustainability of small
- high value farm operations

In 2011, Japanese strawberry (*Fragaria × ananassaDuch.*) production was worth JPY 157.4 trillion (EUR 1.43 trillion). This is as large as the market for staple fruits such as tomatoes, cucumbers, and mandarin oranges (MAFF, 2011). The high market price of strawberries is expected to help stabilize farm finances. However, strawberries are very prone to bruising, so they are harvested in the early morning hours, before the fruits lose their firmness.

Strawberry harvesting is a labour-intensive task, since workers need to exercise great care while handling the fruits.

In 2003, the Bio-oriented Technology Research Advancement Institution (BRAIN) launched a Project to develop a strawberry-harvesting robot for elevated substrate culture, which provides potential advantages for robotic harvesting because the fruits are separated from the leaves. To address unstructured environments encountered in the field, we devised the following development concept. First, the robot would operate only at night to overcome the problem of low work efficiency, and artificial lights are used to ensure constant illumination for image capture. Second, we would adopt methods of detecting, cutting and handling the peduncle that would prevent damage to the fruit. Nighttime operation can help to minimise fruit damage, since the fruit temperature is lower than during the day. Third, the target success rate would be set at more than 60%; perfect work would not be required of the robot.

Therefore, the remaining fruits would need to be picked by a worker, in a form of job-sharing. In other words, the robot works slowly during the night and harvests only the easily picked fruits. Next morning, a worker commences picking the remaining fruits.

Based on this development concept, a strawberry-harvesting robot, which performs autonomous harvesting by moving back and forth along a set of rails, was developed and tested in the field (Hayashi *et al.*, 2010a). Harvesting robots used in previous studies utilised a rail system (Hayashi *et al.*, 2002; Tanigaki*et al.*, 2008) or demonstrated a back-and-forth movement travelling on wheels (Arima*et al.*, 1994; Kondo *et al.*, 1996). Traverse movement is an essential technique for the robot to be used practically, and various methods of implementing have been investigated. A docking system was proposed for a cucumber harvesting

This study aimed to develop a movable strawberry-harvesting robot (third and fourth prototype), which can be mounted on a travelling platform and operated practically in a greenhouse. The harvesting robot is a cylindrical type, based on the second prototype (see Hayashi *et al.*, 2010a). The robot and the travelling platform can be separated, so the robot can be developed and tuned individually before it is installed on the platform. Intercommunication takes place via digital I/O signals. This paper describes the developed harvesting robot and its movement in a greenhouse. Basic performance is investigated in terms of the harvesting success rate, electricity consumption and number of fruits left unpicked.

Strawberry harvesting robots mounted on a travelling platform, were developed and operated practically in a greenhouse. The harvesting robot is based on the second prototype (hayashi et al., 2010a); however, it can be separated from the travelling unit. Both the robot and the travelling platform are modular system units that can be developed and tuned individually.

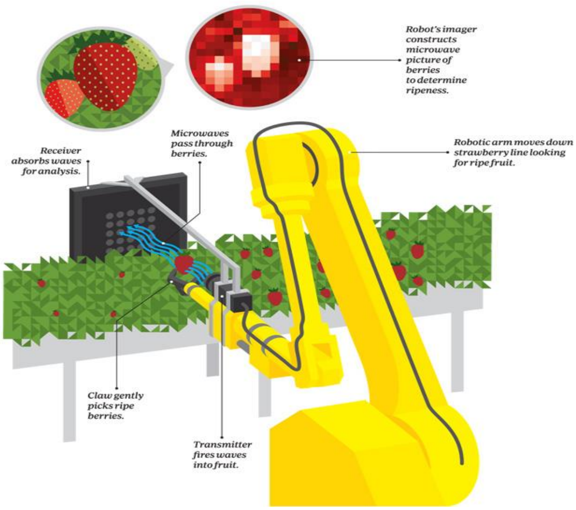

Figure-1 second prototype –strawberry fruit picking robot

Richard Dudley imagines a world where strawberries grow in perfect rows and every day a robot army tastes their colors before harvesting the ripe ones. No, that isn't LSD talking. The research scientist at the United Kingdom's National Physical Laboratory is building a bot that uses multiple wavelengths of electromagnetic radiation to identify the sweetest, ripest fruit — then plucks it from the vine.

Strawberries are a fickle, high-value crop, and harvesting them is costly. Lucky for Dudley, though, they can be grown in a variety of robot-picking-friendly ways. He isn't first to the droid-worker game — organizations in Spain, Japan, and the United States have produced tractors with gripping arms — but all of them have the same disadvantage: They have trouble differentiating between the leaves and the fruit. Dudley's 'bot solves this problem by analyzing the plants with a combo of micro-, radio, terahertz, and far-infrared waves.

So far, microwaves work best for strawberries. The waves find the fruit and measure its water content — an indicator of ripeness — effectively taking a taste test. "With microwaves, leaves are actually quite transparent," Dudley says. He describes it as a safe "x-ray eye," since actual x-rays would irradiate the crop. He hopes to work with a company that builds robotic arms to make the tech a commercial reality for farmers within a year. Sounds — er, tastes — like a winner. Harvesting in a 2d area in a greenhouse. The harvesting robot was a 3dof cylindrical type that approached the target fruit from the path side. the results of performance testing showed the electrical power consumption of the travelling platform for path travel and traverse motion to be 107.8 w and 103.4 w respectively, and that of the fourth prototype robot for picking motion and steady state were 123.4 w and 121.0 w respectively.

Figure 2 - Third prototype robot

With multiple cameras and sharp pincers, this robot resembles an insect pest. However, it could help revolutionize fruit picking.
It takes more than a green thumb to be a great farmer, super-human vision helps as well. The Institute of Agricultural Machinery at Japan's National Agriculture and Food Research Organization, along with SI Seiko, has developed a robot that can select and harvest strawberries based on their color. Ripened berries are detected using the robot's stereoscopic cameras, and analyzed to measure how red they appear. When the fruit is ready to come off the vine, the robot quickly locates it in 3D space and cuts it free. From observation to collection, the harvesting process takes about 9 seconds per berry. Creators estimate that it will be able to cut down harvesting time by 40%. Prototypes are currently being tested in the field with marketable versions expected in the next few years. This artificial agriculturalist was recently recognized by the 4th Annual Robot Award of the Year in Japan. You can see If we adapt its combination of visual acuity and manual dexterity for other produce, the strawberry harvesting robot could help reshape industrial agriculture.

Figure 3 -Fourth prototype robot.

A typical berry field one square kilometer in size takes about 500 hours to harvest. With its speedy evaluation, the strawberry picking robot could cut this down to around 300 hours. Not only that, but every berry would have quantifiably similar level of ripeness based on color, and would be harvested with a minimum of bruising. Robots will also be able to harvest during the night allowing for the fruit to reach market closer to optimum freshness. These improvements in speed and quality will likely translate to millions of dollars saved each year for the industry as a whole. Even if we focus on strawberries alone, robots like this one make a lot of sense.

Figure 4 – Camera monitoring the riped fruit

Japan's strawberry-harvesting robot images the berries before deciding if they're ripe. Strawberry fields will forever be changed by robots that can automatically identify and pick ripe berries, according to Japanese researchers. Developed by the minds at an organization aptly abbreviated IAM-BRAIN (that's the Institute of Agricultural Machinery's Bio-oriented Technology Research Advancement Institution), the machines can harvest more than 60 percent of a strawberry crop. The robot targets berries that are at least 80 percent red.

Even though each machine takes nine seconds to pick a strawberry, they can cut harvesting time from 500 hours to 300 hours for a 1,000-square-meter field (about a quarter-acre), BRAIN's Shigehiko Hayashi explains in the video below.
The robots can also pick strawberries at night. There's more video of the machine at work here, on BRAIN's Japanese page. The berry bot has a stereo camera system that images the strawberries in 3D. Image-processing algorithms gauge their ripeness, and if a berry is at least 80 percent red, the machine neatly snips it at the stem and deposits it in a bin.

Figure 5- image sensor

Japanese farmers are field-testing experimental versions of the robots and testing is expected to be complete by the end of the year. A commercial version might also be able to harvest crops like tomatoes. Doubtless fruit that doesn't color while ripening is more challenging for robots to recognize and pick properly.
Meanwhile, the machine recently harvested an excellence prize at the annual Robot Awards sponsored by Japan's Ministry of Economy, Trade and Industry (METI). Other winning robots included that winsome fembot HRP-4C from Japan's National Institute of Advanced Industrial Science and Technology (AIST).

The above mentioned robot has the following drawbacks
1. It was picking 1 at a time which was taking more time
2. The power consumption
3. It had a sharp pincher which could damage the strawberry

II. PROPOSED SYSTEM

1. Having multi point that could pick many ripen fruits at a time which is an advantage approach that could save time. In less time more no of fruits would be plucked.
2. The third and fourth prototype were power consuming .instead of the power if we implement using the solar energy in the following ways the robots consuming power would be saved. As we know we have many developed solar vehicles , solar heaters, solar cookers all these consumes solar energy. For the robots to move we can implement the principle used in solar vehicles. Components used are solar panel, solar charger, battery, motor, electric tricycle and speed control solar panel. A photovoltaic module or photovoltaic panel is a packaged interconnected assembly of photovoltaic cells, also known as solar cells. The photovoltaic module, known more commonly as the solar panel, is then used as a component in a larger photovoltaic system to offer electricity for commercial and residential applications.

A. Solar charge controller

Solar battery chargers are an inexpensive, environmentally friendly, and convenient way to make sure your batteries are always fully charged and ready to go all the time. The problem with charging a battery from a solar panel is the Sun. It does not shine all the time and clouds get in the way. Our eyes adjust to the variations in the strength of the sun but a solar panel behaves differently. As soon as the sun loses its intensity, the output from a solar panel drops enormously. they become useless as soon as the brightness of the sun goes away

B. Battery

Given the current market, lead-acid is the only viable battery technology for electric vehicle conversion. The following is a list of criteria to use in selecting an electric vehicle battery.

1. Voltage. Batteries are available in both 6V and 12V units. Most standard, wet-cell, golf cart batteries are 6V units. Most sealed batteries are 12V units.

2. Amp-hour rating. The capacity of a battery is rated in amp-hours. This rating must be specified with a given discharge rate.

3. Discharge rate. The discharge rate of a battery is the minimum length of time during which the battery must be discharged in order to meet the specified amp hour rating.

4. Watt-hour rating. The watt-hour rating is a true indication of the energy Capacity of a battery, like the amp hour rating, this rating must be specified with a discharge rate. The watt-hour rating of a battery is the amp-hour rating multiplied by the specified voltage of the battery.

5. Energy density. Energy density is the energy capacity of the battery, in watt-hours, divided by the weight of the battery, in kilograms. This is a critical factor in selecting an electric vehicle battery-the amount of energy a battery carries per unit weight.

6. Cycle-life. Cycle-life is the number of times a battery can be fully discharged before replacement. However, in most real applications, a lead-acid battery will exceed its specified cycle-life, therefore in the battery will not be large energy can be converted and stored in batteries and then how it can be used to run the vehicle. May be with the staffs permission you may be able to use your college‘s water heater solar panel if there is any. The project includes lots of calculations on how much energy can be stored, how fast the energy can be stored, how maximum efficiency can be achieved etc.

Half reactions to represent these two components, and to explicitly show the transfer of electrons The oxidation half-reaction shows the species which is donating electrons The reduction half-reaction show the species which is receiving electrons We can also write the net reaction (or overall reaction) for the cell, the balanced sum of In the solar vehicles that consists of solar cells it consume the solar energy and gets charger. This charger energy is converted into electrical energy that makes the vehicles move. As solar energy is seasonal it cannot be used during the winter seasons so instead of solar energy it is replaced by batteries that makes the robot to move. By using the sharp pincher while picking the fruit when it is holded by these there is a chance of fruit getting damaged so instead of using the steel or metal pincher to hold if we use the wood device to hold the fruit getting damaged will be avoided.

III. CONCLUSION

In this paper we have seen the robots used in strawberry harvesting and also come across the disadvantages of the robots. To over cum these disadvantageous we have cum up with new design and implementation of devices

1. Instead of using single pincher multiple pinchers can be used by which in less time more fruits can be harvested.
2. Instead of using the power supply to make the robots move we can use solar energy the principle used in solar vehicles in order to move them . As in other season which solar energy does not support battery could be used.
3. Sharp pincher is being used in strawberry picking this could damage the fruit instead of this if we use the devise made of wood the damage caused to the fruit can be stopped.

ACKNOWLEDGEMENT

I am extremely thankful to New Horizon College of Engineering management for their constant encouragement and support for doing the research work.

REFERENCES

[1]. Arima, S., Kondo, N., Shibano, Y., Yamashita, J., Fujiura, T. &Akiyoshi, H. (1994). Studies on strawberry harvesting robot (Part 1). *J. JSAM*, 56(1), 55–64.

[2]. Bontsema, J., Van Kollenburg-Crisan, L. M., & Van Henten, E. J. (1999). Automatic harvesting of fruits. *Proceedings of BRAIN International Symposium*, Omiya, Japan, pp 44–51.

[3]. Hayashi, S., Ganno, K., Ishii, Y., & Tanaka, I. (2002). Robotic harvesting system for Egg plants. *JARQ*, *36*(3), 163–168.

[4]. Hayashi, S., Shigematsu, K., Yamamoto S., Kobayashi K., Kohno Y., Kamata J., & Kurita, M.(2010a), Evaluation of a strawberry-harvesting robot in a field test.

