A Review on Agricultural Robots

Miss. Shwetal Ramesh Gund
Dept. of Electronics & Telecommunication
GHRCOEM, Chas,
Ahmednagar, Maharashtra, India

Prof. V. P. Bhope
Dept. of Electronics & Telecommunication
GHRCOEM, Chas,
Ahmednagar, Maharashtra, India

ABSTRACT

A brief review of research in agricultural robots technologies is presented. Agricultural Robotics is the valid propagation of mechanization technology into bio-systems such as farming, forestry, conservatory, horticulture etc. Currently a amount of researches are being made to increase the robots applications. Some of the contributions made by scientists are portable robot, flying robot, forest robot, Demeter which are completely used for agriculture.

In this paper brief review is being done about the different types of robots which increase the exactness and precision of the agriculture. Experiments are being made on recently anticipated world's smallest, lightweight robot for using them as scouts in farm fields. In emergent countries, like India and Brazil, farmers are attracted in using robots to raise fields of crops, pick fruit, or even for animal husbandry. Currently, agriculture robots must contain human dealings in order to compensate for programming difficulty issues.

Keywords

Agricultural robots, machinery, crop establishment, selective harvesting, and crop care.

1.INTRODUCTION

Agriculture is humankind's oldest and most economic activity. Agriculture provides the food, fiber and fuel necessary for our survival. As the global population is increasing, agricultural production must be twice over if it is to meet the mounting load for foodstuff and bio-energy. Given inadequate land, water and labor resources, it is calculated that the efficiency of agricultural yield must raise by 25% to achieve that goal, while reducing the growing demands that agriculture gives to the environment[1][2].

Applying robotics technology in agriculture is a very new concept. The robots on farms are of various types and in increasing numbers.

The robots can perform agricultural procedures alone such as spraying and motorized weed control, fruit selection, inspecting the farms day & night for an efficient result. This allows farmers to decrease the ecological impact, increase correctness and efficiency, and manage each plant in new ways. The applications of influential robotics are scattering every day to wrap more domains, as the opportunity of replacing human operators provides efficient solutions with return on investment. This is especially vital when the duties, that need to be carried out, are potentially dangerous for the protection or the health of the workers, or when more traditional issues are established by robotics. Large dangerous chemicals or drugs dispensers, dung or fertilizers spreaders, etc. are actions more and more fretful by the deployment of mechanized options.

2. DIFFERENCE BETWEEN CONVENTIONAL TECHNIQUES AND AN AUTOMIZED ONE.

Conventional or traditional techniques depend on human power for lifting, dragging, weed control and fruit picking. Humans are force to work in risky environment while spraying chemicals and pesticides on the crops for bug control. The tractors compress the soil, as they are heavier in weight. They cannot move in terrain environment. These techniques cannot recognize the crop and soil in close propinquity. In the case of automated or mechanized agriculture which uses agricultural robot is exemplified from above problems.

Robots can work impatiently in all conditions; all you have to do is put a program to execute the desired actions. Although, huge sized wheels are necessary in muddy soils, robots having small sized wheels perform well. Robot scouts are engaged to get complete information about the crop such as the occurrence of diseases, weeds, pest infestations and other tension conditions. The lightweight of the robots is a main advantage, since they do not compress the soil as larger machinery does. Robot will stroll on fields to take care for crops for their appropriate growth.

3.1. TYPES OF ROBOTS

1. Demeter.
2. Weed control Robot.
3. Forester robot.
4. Horticulture Robot.
5. Fruit picking robot

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The robots listed above are of two types i.e. Field robots and some are Mobile robots. Field robots work with respect to environment and medium. They modify themselves according to the required situation. Mobile robots are those which have mobility with respect a medium. The complete system moves with respect to situation.

3.2. GOALS

1. To offer access to vulnerable environment.
2. To reduced operating costs because of lower cost of employing robots.
3. Higher overall accessibility of robot workers (no lunch breaks, tiredness or vacations) and many more.
4. To increase capacity to complete bulky quantity of work in less time.

4. OPERATION OF AGRICULTURAL ROBOTS.

4.1 Demeter:

Demeter is a Robot farmer. It is essential to reduce the labor requirements to grow and harvest the crops through mechanization. The main area of function of robots in cultivation is at the harvesting phase.

Demeter can harvest crops like wheat and alfalfa. This robot is named after the Roman goddess of agriculture. Demeter is able to drive by itself with no human supervision. Unfortunately, farmers or labors get tired and bored to work continuously, and hence agricultural yield lacks down. With a robotic harvester, on the other hand, it never gets exhausted and can work 24 hours a day.

Fig.1: Demeter

Demeter has cameras installed on it that can perceive the variation between the crop that has been sliced and crop that hasn't [2]. This information tells it wherever to drive, where to position its harvester head, and when it has get nearer to the end of a crop string so it can revolve around. Demeter has a motor control function. A worker can travel along with it. Demeter can drive, guide, and control the cutter head while the worker can pay attention on other tasks. The Demeter robot is able to drive by remote control. Or, Demeter can be trained a path and then chase that path with its on board sensors and processor control systems. It can pursue the path through an accuracy of up to 3 cm. The Demeter system provides three levels of mechanization to harvesters, and finally to tractors. First, a "cruise control" aspect, which will involuntarily guide, drive and control the cutter header, will be offered to harvester operators. This aspect will permit the operator to pay attention on other in-cab controls and harvest circumstances, and to better handle emergency situations. Secondly, a "drone" aspect will be provided, permitting one operator to vaguely control numerous harvesters [2]. Thirdly, a completely autonomous mechanism will be developed that will permit a harvester to totally harvest a field without any human control.

Advantages: The first two stages of the Demeter allow smaller amount, lesser-experienced operators to offer performance equivalent to or superior than the existing harvester performance on the typical farm. At the final stage of automation, performance will be sustained with no human supervision.

4.2 Weed Controller:

Working in farm frequently involves a harsh situation such as restricted work space and soft, unbalanced or rough surfaces. The growth of new weeding technologies that can lessen human effort by 50% to 100% in organically cultivated sugar beets and vegetable and also use of herbicide by 75-100% in high value crops[1][2][3]. They can also be used in vegetation, which are broadly separated. This methods use robots in the farm, to substitute operators on steerage hoes. A four-wheel-drive weed-seeking robot was invented by the Danish Farm Research Authority. The duty of the weed-removing machine is to get rid of or destroy the weed. Crops that are developed in rows can be weeded by operating a hoe in between the crop rows. Labor intense systems that engross an operator controlling the tractor, with another person controlling the hoe. An smart hoe uses vision systems to recognize the rows of crops, and steer itself precisely between them, significantly dropping the need for herbicides.

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Fig. 2: Weeding Robot

Weed recognition is depended on color photography. The equipped robot facilitates production of weed maps recognizing plant. Vision-guided intra-row farmer, able to achieve mechanical weed control inside the row of sugar beets plants, thus totally reducing the need for chemical weed control [4]. A self-directed mobile robot for agriculture operations is controlled by its two wheels at the back, each individually driven with a DC-servo motor operational with encoder, brakes and tachometer. The steering instrument is an Ackerman-steering operated with a DC-servo-motor. The electrical power is supplied by batteries or by a fuel-driven generator the systems looks at a definite environment including several plants. With the information that the sugar beet plants are sown in rows and with a certain stable distance between them, it is possible to organize the sugar plant from the weed plant. It could be reducing farmer's money right from the beginning. For harmless night work, field obstacles can be planned into every field map so the tractor can involuntarily take prevention action.

4.3 Robots Used In Forest:

Treebot: A courageous mobile robot is serving scientists monitor ecological changes in forests. The hi-tech Tarzan of the robot world, named as Treebot, is the first of its kind to join networked sensors, a wireless net link and a web cam [2].

Fig. 3: Treebot

It is powered by and moves up and down special cables to take samples and dimensions intended for vital analysis. Treebot has been invented by scientists working at the US Center for Embedded Network Sensing, California. Pinpoint precision Programmed with open-source computer code, Linux, the Treebot is a essential addition to researcher's environmental monitoring kit, according to one of the project leaders, Professor William Kaiser. "One of the goals is to make use of dispersed sensors to obtain information about the environment," he said. "It is very significant in the biology society to appreciate the communication between the atmosphere and the forest environment." Understanding slight changes in sunlight, carbon dioxide levels and dampness gives scientists critical indications and predictions about ecological change. But 90% of all interface between the environment and atmospheric circumstances occurs high up in the forest covering, and it is a dispute taking thorough measurements and monitoring conditions over a epoch of time. The Treebot, which in technical terms is a node in a Networked Info mechanical System (Nims), helps by being furtive enough to journey through the jungle canopy along particularly constructed electrical system, night and day.

4.4 Forester robot:

This type of robot is used for cutting up of wood, nurture trees, and pruning of Christmas tree and for harvesting tissue and hard wood in the forests. It occupies a special jaws and axes for cutting the branch. The forester robot having six legs moves wonders in the forest.

4.5 Fruit picking robot:

The basic principles of fruit picking robots have been developed since the near the beginning of 1980′s. These principles have begun different new techniques to the harvesting of crops. However, to entirely develop the fruit picking robotics machinery, offerings from high-tech industry, a farm tools manufacturers and agricultural product groups must be required. To initiate with, the fruit picking robots require picking ripe fruit without destructing the leaves or branches of the tree.

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Fig. 4: Fruit picking robot

Mobility is precedence, and the robots must access all areas of the tree being harvested. The robots must be intelligent, and have a human-like interface with their environment through wits of touch, vision, and picture processing. The robot can discriminate between leaves, fruits and branches by using video image processing. The camera is installed on the robot arm, and the colors recognized are judged against with properties accumulated in memory. If a match occurs, the fruit is selected and picked. If fruit is concealed by leaves, an air jet can be used to propel leaves out the way so a perfect view and access can be acquire. The robot arm is covered in rubber to reduce any damage to the tree. It has 5 degrees of freedom, allowing it to move, up, down, in, out, and in spherical and cylindrical action patterns. The force applied to the fruit is adequate for picking from the tree, but not enough to squeeze the fruit. This is acquired by a feedback process from the gripper device, which is driven by a pneumatic or a hydraulic system. The shape of the gripper is based on the fruit being picked, such as plums, compress very easily, while others, like oranges are not so inclined to bruising. The robots should access all areas of the farm in order to achieve all of the fruit. Noteworthy work has been done in the manufacture of end effectors in France. They are proficient of harvesting citrus and apples. The restrictions of these systems were mainly in their incapability of picking the fruits, which were enclosed by the branches.

5. AUTONOMOUS GUIDANCE SYSTEM

A brief overall review of the past 20 years of global research in agricultural vehicle guidance technologies is presented in terms of a framework for agricultural vehicle autonomous guidance system.

The key elements are navigation sensors, computational methods, navigation planners and steering controllers[3].

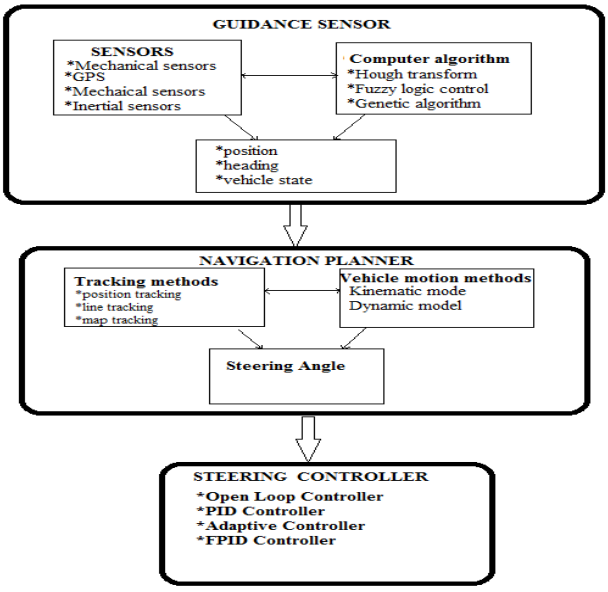

Fig. 5: Framework of agricultural vehicle autonomous guidance system

6.AGRICULTURAL ROBOTS USING VIRTUAL INSTRUMENTATION

An agricultural robot is design with an internet based remote control by using LABVIEW. Fuzzy controller is intended to change the speed of the robot and the direction-finding angle according to the desired mentioned position. Atmega16 Microcontroller is used to control robot. The Robot control is carried out from a isolated place using web publishing tool in LabVIEW.

This LabVIEW software replaces expensive and complex equipment by less expensive and simpler hardware. The agricultural Robot with the fuzzy controller can be operated from any remote computer. Thus this agricultural Robot control minimizes the manpower and becomes beneficial and cost-effective.

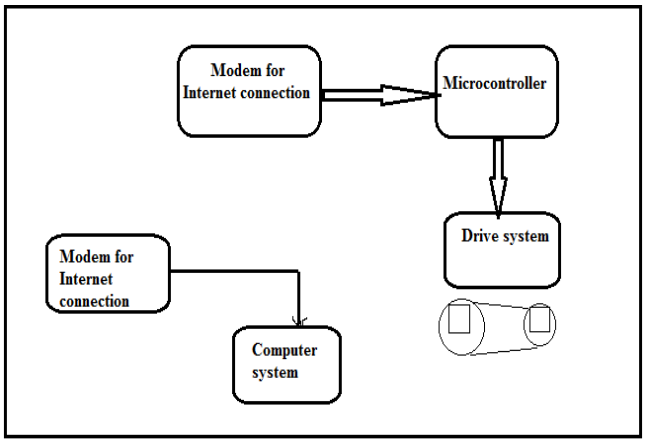

Fig. 6 : Internet based control loop

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ADVANTAGES:

1. The Robot does not get tired or sick and does not break.
2. It can work with closer tolerances i.e.so every round is at full field capacity, less errors at higher speeds.
3. If the driver's seat, controls and cabin can be eliminated than machines can be made lighter and cheaper.
4. It can be used in a variety of fields like medicine, mining space research and agriculture.
5. It can be used to study the different planet's environmental conditions.
6. The robots could effortlessly work around rocks, trees, ponds and other obstacles.
7. Small fields could be worked almost as proficiently as large tracts of land.

DISADVANTAGES:

1. Robots are not liable.
2. A periodic human supervision in the farm is necessary for the near future.
3. Robots could alter the culture /emotional appeal of agriculture.
4. Energy issues costly.

CONCLUSION:

Agriculture robots are thus increasing the productivity in large scale. The other troubles connected with autonomous farm equipment can perhaps be overcome with machinery. This equipment may be in our prospect, but there are significant reasons for judgment that it may not be just replacing the human driver with a machine. It may mean a review of how crop production is done. Crop production may be done in good health and cheaper with a group of small machines than with a few large ones. One of the advantages of the smaller machines is that they may be more satisfactory to the non-farm population. The jobs in agriculture are dangerous, a drag, require intelligence and quick, though highly recurring decisions hence robots can be rightly replaced with human operator. The higher superiority products can be sensed by machines (firmness, color, weight, size , density, ripeness, , shape) precisely. Robots can evolved the quality of our lives but there are some drawbacks.

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