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Review on: Role of robotics in horticulture

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Abstract
A robot is an automatic device that performs functions normally ascribed to humans or simply a machine in the form of human. It is a machine that senses the environment, processes and responds to the sensor's information with a computer command. As labour is a major cost for horticulture where nearly 50% of production costs for fruit is only for hired labour, intensive horticultural crops require much more skilled labour than broad scale agriculture. Hence, there is a need for efficient utilization of robots in the field of horticulture. Some of the types of robots used in horticulture are Demeter, robot for weed control, fruit picking robots, drones, forester robot, robot suit and vitirover solar robot. These robots are used in horticulture for weeding, crop scouting, micro spraying, irrigation, selective harvesting, sorting and packing, parks and golf courts, polyhouses etc.

Keywords: Robots, robotics horticulture, labour

Introduction
"A robot is a mechanical, artificial agent and is usually an electromechanical system. Robot is a machine especially programmable by a computer capable of carrying out a complex series of actions automatically". Robots can be guided by an external control device or the control may be embedded within [1]. The word robot comes from the Slavic word "robota", which means "slave/servant" [2]. Most existing crop robotics studies focus on horticultural or industrial crops, but grains and oilseeds may be of low preference for robotics entrepreneurs because most grain and oilseed production are already mechanized". Robotics would only need to make that equipment autonomous [3].

The Fields in which robots have been introduced
Those areas in which dirty, dull, and dangerous missions takes place where human worker have a threat to his life and most difficult jobs where human worker has to apply terrible effort to accomplished it are replaced by the robots. Those fields in which high accuracy is required are also replacing the human workers. Following are the fields in which robots are introduced [4].

In the Field of Medicine*:* Robotically assisted surgery was developed to overcome both the limitation of minimally invasive surgery or to enhance the capabilities of surgeons performing open surgery.

Military Applications: Military robots are now used by the united states Army. They are remote control vehicles of unmanned which are used in military application.

Robots in The Mining: Robots are now doing jobs like lying explosives, going underground after blasting to stabilize a mine roof or mining in areas where it is impossible for humans to work of even survive.

Industrial Robots: According to the Robotic Industries Association, an industrial robot is an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes which may be either fixed in place or mobile for use in industrial automation applications.

Robots Fishes: Robot fish developed by British scientists are to be released into the sea off north Spain to detect pollution. If next year's trial of the first five robotic fish in the northern Spanish port of Gijon is successful, the team hopes they will be used in rivers, lakes and seas across the world.

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Robots in the Hotels: To serve the customers in the hotels Robotics engineer have designed REEM H1 Robots which act as member of staff serving at table.

Cleaning Robots: cleaning robots have been designed to clean different things and areas. The designer of cleaning robots depends up on the purpose and area of cleaning.

Robots in the Classroom: smart classes were introduced which uses the computer and projectors to show readily the picture as well as the learning get easier. These were the first robots without intelligence in the classes but now Japan has introduced a Robot teacher which is programmed to do all the human teacher activities. These robot teachers are capable of taking attendance, interact with the students and teaches subjects which is programmed them.

Robotic Cars: Robotic car technology being developed at Oxford University that interprets its surroundings and makes decisions about where to go could eliminate the agony and cost of traffic jams [4].

Scope of farm robots in India
Our farm equipment companies and researchers have developed a lot of small and heavy farm equipment for traditional farming needs but some kind of robotic and pneumatic mechanism are required in precision farming [5]. As robots have entered in the mentioned above fields it is important to think that till, why the robots are not entered in the farming field? If the robots are being used for weed control, that will help to reduce the herbicides usage and the produces will turn into an organic, the same way robots can be used for transplanting the seedlings to avoid intensive labour. There are lot of hurdles taken in the agriculture sector in all countries but specially in India. Farmers decreasing in India a daily report from the newspaper. They are great men who provide food for us but now a day's farmers are reducing more in number. Many are leaving the farming profession by telling some repeated common sentences that it is no longer profitable and none want to get losses and it is becoming risky day by day. So many disadvantages. Also, the youngsters are not interested in that. So, they are ready to work in construction companies and not in farmland [6].
Most of the farm operation is done by using the tractor as a prime mower with attaching different implements on it. At present intercultural operation mainly carried out by using manually operated implements such as Wheel hoe and weeder are very popular for horticultural crops and paddy field. Robots in horticultural sector are widely used in harvesting, drone spraying, field monitoring, sorting, grading, packing of final horticultural produce and in nurseries and greenhouses to some extent [5].

The problems of traditional farming
Lack of Knowledge of using fertilizer: adequate amount of fertilizer will benefit the farmers but surplus quantity damages the crop as well as the yield. The lack of knowledge of the usage is damaging the crops and hence giving the problems to the farmers. Even some farmers mistakenly drink the water added with fertilizer for the plants and lose their lives.

Lack of Man Power: The farm workers are paid less than the construction labour. So, to earn livelihood many of workers are choosing the straight path work in construction and different areas but not farming.

Farmers Suicides: It is a report from an agriculture region Maharashtra, Andhra Pradesh and Karnataka states of India that more than 17,000 farmers have suicide and end their lives from 2006-2007. All the above-mentioned crisis can be eradicated and Indian farming and agriculture sector can be improved for a very large extent by the use of Robotics with smart intelligence devices and making smart robots that benefit to the agriculture sector and farming and cattle grazing. All the researches are on and we need a good time for the establishment of the technology in the farming [4].

Need of Robotics in horticulture
- Labour a major cost for horticulture Nearly 50% of production costs for fruit are for hired labour. Intensive horticultural crops require much more skilled labour than broad scale agriculture
- Land mechanization.
- Reduce crop losses by harvesting at proper time.
- Skill and availability when it is needed.
- Cost of labour
- Skill level and experience of labour often not available.
- Machines with sensors are objective and product can be consistently monitored
- Uniform quality of output [4].

How robots work?
Robots can move and sense. They require multiple sensors and controls that allow them to move in an unknown environment [7].

Robots usually have five parts:
1. Sensors
Sensors send information in the form of electronic signals back to the controller. They can give robot controller information about its surroundings. Robots can be designed and programmed to get specific information that is beyond what our senses can tell us

2. Controller
It is also called as computer. Controller functions as the brain of the robot. Controller also allows the robot to be networked to other system, so that it may work together with other machines, processors or robots.

3. Drivers/Actuators
It is the engine of the robot. It is defined as "a mechanical device that produces motion".

Types
- Hydraulic motor
- Stepper motor
- Pneumatic motor
- DC motor
- Servo motor

4. Arms
Usually, a robot arms are like human arms with a shoulder, elbow, wrist and fingers. The arm is a part of robot that positions the end-effectors and sensors to do their pre-programmed business.

5. End effectors
End effectors are the last link (or end) of the robot. In a wider sense, end effectors can be seen as the part of a robot that interacts with the work environment [7].

Ex: Gripper, vacuum pump, tweezers, scalpel, blow torch.

Types of robots used in horticulture
1. Demeter
Demeter is a robot that can cut crops and looks like a normal harvester, but can drive by itself without any human supervision [8]. It has cameras on it that can detect the difference between the crop that has been cut and crop that hasn't. this information tells it where to drive, where to put its cutter head and when it has come to end of a crop row so it can turn around. This robot can also be driven by remote control. It can be taught a path and then follow the path using its on board sensors and computer control systems [9].

2. Weed controller
A four-wheel drive weed seeking robot was developed and the task of the weed removing device is to remove and destroy the weed. Crops that are grown in rows can be weeded by running a hoe between the crop rows. An intelligent hoe uses vision system to identify the rows of crops, steer itself accurately between them, considerably reducing the need of herbicides. Weed identification is based on colour photography. The equipped robots help production of weed maps identifying plants [7].

3. Fruit picking robot
These robots need to pick up fruits without damaging the branches or leaves of the tree. The robots must be able to access all areas of the tree being harvested. The robot can distinguish between fruits and leaves by using video image capturing. The camera is mounted on the robot arm and the colours detected are compared with properties stored in the memory. If a match is obtaining, the fruit is picked. If fruit is hidden by leaves, an air jet can be used to blow leaves out the way for a clearer view. The pressure applied to the fruit is sufficient for removal from the tree, but not enough to crash the fruit. The shape of the gripper depends on the fruit being picked [10].

4. Drones
A drone is a flying robot. To get a bird's eye view of the land. Offers a quick and easy way to check on the progress of crops and determine where they may need to replant or direct pesticide application [11].
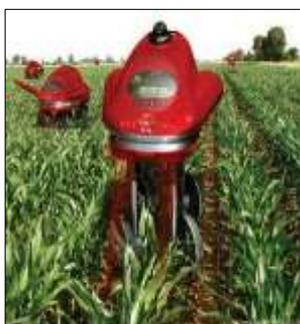
5. Forester robot
This is a special type of robot used for cutting up wood, pruning and for harvesting pulp and hard wood in the forests. It employs a special jaws and axes for chopping the branches.

6. Robo suit
This is designed specifically to work like pulling radishes etc. The suit has eight motors fitted over the shoulders, elbows, back and knees to provide a power boost to the wearer [12].

7. Vitirover solar robot
It is smart autonomous robot. This little robot uses the sun to power the electrical motors. Since, the vineyards are large it was a bad idea to store energy into a battery and when the battery has lower power to return at the base for recharging the battery. Using a solar panel this robot could work for hundred hours without pause. It could cut grass and weeds to within2-3cm of vine and has a speed that allows him to work 500 meters per hour. For owner it is important to not to damage the vine, robot is equipped with sensors that keep the grass cutting blades away from vines. Vitirover could work in slopes of 15% and uses GPS coordinates for each parcel when the robot should work.

| Demeter | Weed controller | Forester robot | Fruit picking robot |

| Vitirover solar robot | Drones | Robot suit |

Applications
- Weeding
- Crop scouting
- Micro spraying
- Irrigation
- Selective harvesting
- Sorting and Packing
- Parks and golf courts

▪ Polyhouses

Advantages of Robots
▪ Robots can work 24hours a day without rest.
▪ Robots are extremely accurate compared to humans.
▪ Robots can perform tasks more quickly than humans.
▪ Robots can work in very dangerous conditions
▪ It can reduce farms use of pesticide.
▪ Maximum robots are small to move easily between plants.
▪ Robots are lighter in weight than equipped tractors used for inter cultural operators which avoid soil compacting.
▪ Robots avoids maximum problems associated with labour.
▪ The robots are not getting sick or tired, and the time off is not needed.
▪ The robots can deliver products of high quality and lower the cost of production.

Disadvantages
▪ It costs a lot of money to make or buy robots.
▪ They need maintenance to keep them running.
▪ The labours can lose their jobs.
▪ The robots can change the culture / the emotional appeal of agriculture.
▪ High energy cost and maintenance.
▪ The high cost of research and development.
▪ Lack of access to poor farmers.
▪ Robots lack decision making power.

Conclusion
Agriculture robots can reduce the cost of cultivation by controlling the use of labour, efficient use of fertilizers, pesticides. The jobs in agriculture are a drag, dangerous, require intelligence and making quick decisions, hence robots can be rightly substituted with human operator. Workload on farmers minimized by using robots and field operations can be completed in time. The higher quality products can be obtained by this technique and it is best for future farming.

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