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AGRICULTURAL ROBOTS: A STEP TOWARDS TO MECHANIZATION OF FARMING

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Abstract

Developing countries are focusing on mechanization of farming to produce quality and healthy food for growing population with economical use of fertilizer and irrigation. Robotics in agriculture has potential to do agricultural operations like weeding crop scouting irrigation and matured fruit picking etc. Robotic applications are more economically feasible than conventional systems in terms on money, efficiency of different inputs.

Introduction

Agriculture is oldest and still it's most important financial as well as food source for rural peoples, providing our basic needs for daily life. According to a new UN DESA report, world population is expected to reach 8.5 billion by 2030, 9.7 billion in 2050 and 11.2 billion in 2100. To compensate food demands with growing population, it is essential to produce more than double agricultural production with limited land, water and labor resources without damaging soil productivity and environmental conditions. It is estimated that the efficiency of agricultural productivity must increase by 25% to meet that goal, while limiting the growing pressure that agriculture puts on the environment.

The word "robot", made its way into English from Czech in the 1920s, means slave or forced labor and it was pioneered by Karel Capek through a play, Rossum's Universal Robots (R.U.R.), which anglicized "robot" as a man-like machine. A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks. Agricultural robots or agbot is a robot deployed for agricultural purposes.

Robotics and automation can play a significant role in our society meeting 2050 agricultural production needs. From last decade's robots have played a key role in increasing the efficiency of fertilizers, weeding, pesticides, insecticides and harvesting of fruits and reducing the cost for development of agri-robot. In the past five years, combination of GPS- and vision-based self-guided tractors for crop management like removal of weeds and picking of matured fruits already are being available commercially. More recently, farmers of develop countries have started to experiment with robotic systems that automate or augment operations such as tillage,fertilizer application, spraying of pesticides, pruning, thinning, and harvesting, as well as mowing, and weed removal. In the fruit tree industry workers riding robotic platforms have shown to be twice as efficient as workers using ladders. Advances in sensors and control systems allow for optimal resource and integrated pest and disease management. This is just the beginning of what will be a revolution in the way that food is grown, tended, and harvested.

Classification of Robots: Classification of robots Robots are broadly classified based on its locomotion and the way it is controlled.

Robots, based on locomotion are further classified as stationary and mobile robots.

1. Stationary robots: Robots cannot move from one place to another and remain stable. It works with intelligence from the place, where it is installed. Eg: e-nose, e-tongue, grain elevators etc.
2. Mobile robots: Robots that can move from one place to another with the predefined pathway.

These robots are further divided based on the way and the environment it is designed to work. They are categorized as following

a. Land based robots: The robots that are designed to work on land

1. **Wheeled robots**: Movement of robots on wheels. Standard wheels allow the robot to move in the forward direction while an orient able wheel helps the robot to move in both forward and backward directions. Robots with ball wheels stirs and en-routes multidirectional movements.
2. **Legged robots**: Locomotion of robots depends upon the orientation of legs.
3. **Tracked robots**: Tracks facilitate robots motion on terrains, hard and uneven surfaces.

b. Aquatic robots: The robots that are designed to work in water Eg: autonomous underwater vehicle

c. Flying robots: The robots that are designed even to work in air Eg: drones

d. Hybrid/Wheel-legged Robots: Wheel-legged robots are irregular robots with multiple functions. Wheels can make your robot move faster, are easier to design and build. Legged robots on the other hand are excellent on uneven surfaces and rough terrain. E.g. jumping or hoping robots

Few examples of robots developed for agricultural purpose are

- Harvest Automation is a company to develop robots for greenhouses
- Strawberry picking robot from Robotic Harvesting and Agrobot.
- Casmobot next generation slope mower
- HortiBot - A Plant Nursing Robot,
- Lettuce Bot - Organic Weed Elimination and Thinning of Lettuce
- Rice planting robot developed by the Japanese National Agricultural Research Centre
- The IBEX autonomous weed spraying robot for extreme terrain, under development
- FarmBot, Open Source CNC Farming
- Auonomous mapping, phenotyping and weeding for crops and livestock monitoring.

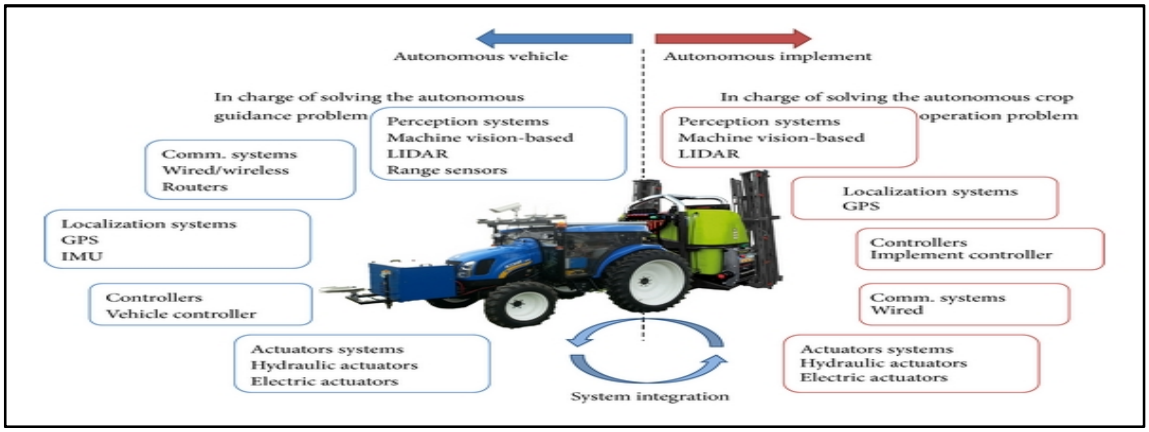

Fig.1 automated robotic system with different components

Application of Robotics in Agriculture

1. Ploughing:Robot has the ability to plugging, cultivating and leveling of soil as well as bury crop residues to increase the productivity
2. Planting: It can also done some planting method includes broadcasting, seed drilling, row planting etc. in an effective manner.
3. Grafting: It is labour intensive practices. Use of robots for grafting can save lots money as well time.
4. Irrigation and watering: Automation in agriculture envisages monitoring and controlling the irrigation, that directly or indirectly affect the growth of crops.
5. Weeding and weed mapping: To locate the exact location, density and identification of weed species of weed in the field. Autonomous robotic system developed for weed control system in ploughed land. This system comprised of two mechanisms one for detection of weeds and obstacles present in path by sensor technology and second for weed removal.
6. Spraying: Spraying of chemical causes many damage to the human health. Thus, an autonomous pesticide spraying helps in avoidance of human exposure to hazardous chemicals as well as increased accuracy and precision with minimizing waste.
7. Data collection: Agricultural robotics system was designed, constructed, and operated with multiple sensors, including crop height sensor, crop canopy analyzer, normalized difference vegetative index sensor, multispectral camera, and hyper spectral radiometer to measure various experimental data of crop.
8. Harvesting: The robotic technologies used stereo vision for harvesting of quality produce of high value crops such as cherry, tomato, strawberry and mushrooms, etc. Automatically performing robots have 60-70 % success rate in fruit harvesting operations.
9. Post-harvest technology: After harvesting of produce of high value crops, the next step is grading of quality produce to take more value of harvest.

Advantages of Robotics

- do not get sick or tired and they do not need the time off
- can operate with closer tolerances
- offer fewer errors and at higher speeds
- higher quality products can be sensed by the machines accurately
- can be used in various fields in the agriculture
- can easily work around the trees , the rocks , the ponds and the other obstacles
- Can reduce up to 80% of farm's use of pesticide
- may perform more or different tasks in the future
- can create the jobs for the people who have to make the robots and who have to fix the robots
- offers high placement accuracy , the autonomous outdoor and the indoor function , and reduced production costs

Drawbacks in robotics

- very high initial cost of robots
- in certain situation lacks capability to respond in emergencies, which cause inappropriate and wrong responses,
- lack of decision-making power,

- need the maintenance to keep them running
- loss of power,
- it is reported that robots even injures human beings.

Conclusion

The exploitation of robots in agriculture will rally round in near future and guarantees the increased food production. Robotics and automation can, in many situation, increase productivity, safety, efficiency, quality, consistency of products as well works continuously even in an unfavorable conditions without any humanity needs and illnesses. It is also evident from the research that there is a significant potential for applying these autonomous systems in various agricultural operations when it is possible to

This is just the beginning of what will be a revolution in the way that food is grown, tended and harvested. In future the numbers of robots in different agricultural fields will be increased. Scientists from around the world are also designing midget robots to scout battlefields, search for victims trapped in rubble and record images in agriculture fields.

References

Blackmore, B. S., Stout, W., Wang, M., and Runov, B. 2005. Robotic agriculture – the future of agricultural mechanisation?5th European Conference on Precision Agriculture.ed. J. Stafford, V. The Netherlands, Wageningen Academic Publishers. pp.621-628.

Emmi**, L.,** Gonzalez-de-Soto**, M.,** Gonzalo Pajares**, M., and** Gonzalez-de-Santos**P. 2014.** New Trends in Robotics for Agriculture: Integration and Assessment of a Real Fleet of Robots. The Scientific World Journal.**2014**:21.

Pedersen, S.M., Fountas S. Have H Blackmore B.S. 2006. Agricultural robots- system analysis and economic feasibility. Precision Agriculture, **7**:295-308

Tanujapriya B., Murthy B.N.S., Vasanthu S., Jaganath S. 2015. Robotics The future for farm Mechanization. International Journal of Research in engineering and applied sciences. **5**:171-181

Fig. 2 Nutrient management through Automated Robot **Fig.3 Fruit picking Argo-robot**