AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 04 Issue: 11 November 2023 Article No: 08

Mobile Robot in Agriculture: Advancements, Applications and Future Prospects

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SUMMARY

Mobile Robot in agriculture explores the integration of robotics in farming. These mobile robots have advanced features like sensors, AI and GPS, enhancing their role in precision agriculture, crop monitoring, weeding, pest control and harvesting. They reduce labour costs and environmental impact. Crop monitoring helps optimize irrigation and fertilization, while weed and pest control reduces chemical use. The future holds promise, with ongoing research aimed at improving capabilities and reducing costs. Challenges remain including adoption costs and regulatory standards. In summary, mobile robots are reshaping agriculture, offering efficiency, sustainability and productivity improvements.

INTRODUCTION

In the last few decades, India's agriculture sector has undergone a significant transformation. India has come a long way from conventional farming techniques to modern farming. Technology has finally taken over Rural agriculture's problems, which is continuously developing new solutions for enhancing productivity. The ultimate aim is to help farmers in growing high-yield crops to feed the increasing world population. Artificial intelligence and technical advancements have created smart devices like drones and moisture sensors possible to achieve this sustainable growth. Robots used in agriculture are one such example.

Mobile Agribot

Mobile agricultural robots refer to autonomous or semi-autonomous robotic systems specifically designed and developed to perform various tasks in agricultural environments. These robots are equipped with advanced sensors, actuators and control systems, allowing them to navigate, interact with the environment and carry out specific agricultural operations without direct human intervention. Mobile agricultural robots can come in various forms, including ground-based robots, aerial drones or even underwater robots, depending on the specific tasks and requirements of agricultural operations.

Methodology and Role of Agribot

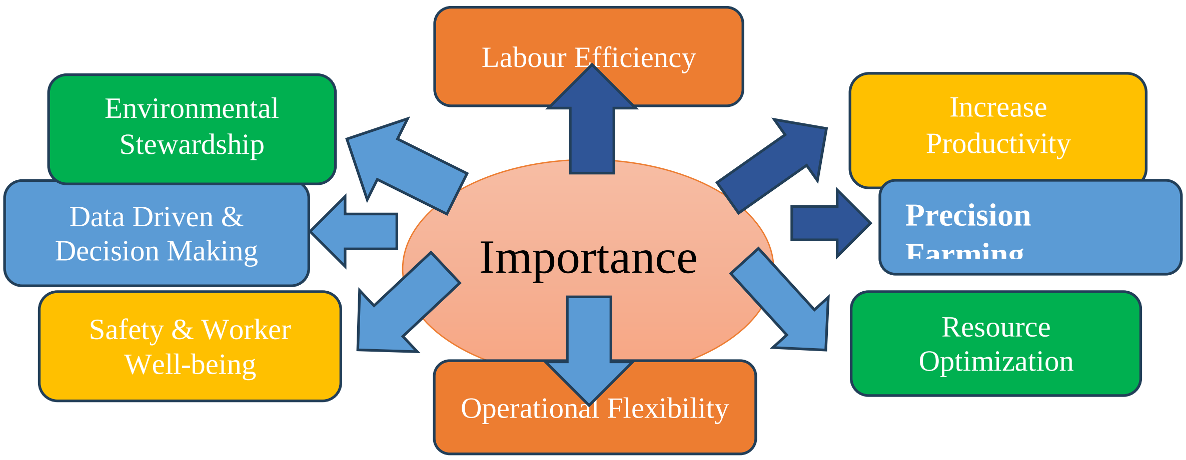

Fig. 1. Role of Agribot in multiple domains

Agribots facilitate precision agriculture, a revolutionary approach that optimizes resource utilization. Equipped with sensors and AI-driven algorithms, these robots can collect and analyse real-time data on soil quality, weather patterns and crop health. By precisely applying water, fertilizers and pesticides wherever needed, farmers can minimize waste, conserve resources and achieve higher crop yields. By connecting robots to a network of smart devices and data-sharing platforms, farmers can remotely monitor and manage their farms in real-time, even from distant locations. This level of remote accessibility allows for more informed decision-making, greater control over farming operations and the ability to optimize resource usage continually.

Advancements of Mobile Agribots:

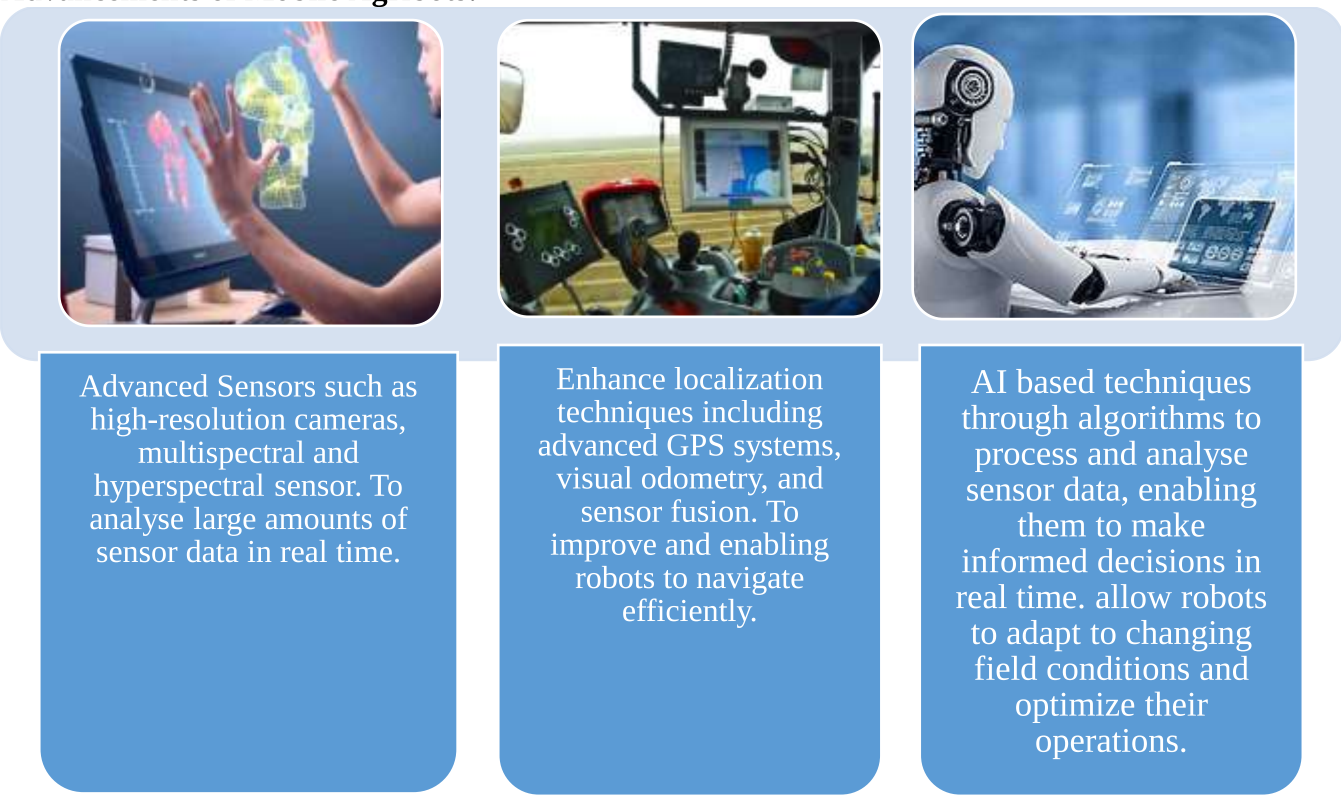

Fig. 2. Advancement of Agribots in various applications

Fig. 3. Role of mobile Agribots in agriculture

Applications of Agribots:

Crop Monitoring and Assessment:

Aerial Imaging: This enables farmers to monitor crop health, detect diseases or nutrient deficiencies and assess overall plant growth.

Remote Sensing: Mobile robots integrated with multispectral or hyperspectral sensors can collect data. This data provides insights into plant stress levels, biomass estimation and yield prediction.

Precision Spraying and Fertilization:

Targeted Application: Mobile robots with precision spraying and fertilization systems can deliver agrochemicals and nutrients precisely to specific areas of the field.

Variable Rate Application: By analysing real-time data on soil conditions, crop health and nutrient levels, mobile robots can adjust application rates of fertilizers or pesticides.

Harvesting and Picking:

Autonomous Harvesting: Mobile robots equipped with robotic arms and computer vision systems can autonomously identify and harvest ripe fruits, vegetables or other crops.

Selective Picking: Mobile robots with advanced vision systems can selectively pick crops based on size, ripeness or other quality parameters. This enables higher product quality and reduces waste.

Weed Detection and Management:

Weed Identification: Mobile robots with computer vision technology can identify and classify different weed species in real time. This information helps farmers implement targeted weed control strategies, reducing the need for herbicides and minimizing crop yield losses.

Precision Weed Treatment: Mobile robots equipped with mechanical or chemical weed control mechanisms can selectively apply treatments only to the targeted weed plants. This approach minimizes the use of herbicides and reduces environmental impact.

Soil Sampling and Analysis:

Soil Sampling: Mobile robots can collect soil samples from different locations within a field, ensuring representative sampling. This data helps farmers understand soil fertility, nutrient levels and pH, facilitating precise fertilization strategies.

Soil Analysis: Mobile robots integrated with soil analysis sensors can provide real-time measurements of soil properties, including moisture content, organic matter and nutrient levels. This enables data-driven decision-making for optimal soil management.

Irrigation and Water Management:

Precision Irrigation: Mobile robots can monitor soil moisture levels and deliver water precisely where needed, optimizing irrigation practices. This reduces water waste, enhances water-use efficiency, and promotes sustainable water management in agriculture.

Drainage Monitoring: Mobile robots can assess field drainage conditions by collecting data on waterlogged areas, ensuring proper field drainage and preventing waterlogging-related crop damage.

Livestock Monitoring and Management:

Animal Health Monitoring: Mobile robots equipped with sensors can monitor livestock health parameters, such as body temperature, heart rate or milk production. This enables early disease detection, timely interventions and improved livestock management.

Herding and Feeding: Mobile robots can assist in herding animals or delivering feed in livestock farming operations. This automation reduces labour requirements and ensures efficient and consistent feeding practices.

Future Prospects of Mobile Agricultural Robots:

- Advancements in AI and automation for increased efficiency.
- Specialization for tailored farming tasks.
- Collaboration in swarms to cover larger areas.

- Integration with smart farming ecosystems for data-driven decisions.
- Remote monitoring and control for convenience.
- Reduced environmental impact with precision farming.
- Lower costs and wider adoption for broader benefits.

CONCLUSION

In summary, mobile agricultural robots are revolutionizing farming practices by combining technology, automation and data-driven approaches. Their advancements, applications and future prospects provide significant opportunities for improving productivity, sustainability and profitability in agriculture. By leveraging these innovative technologies, one can build a more efficient, resilient and sustainable future for the agriculture industry.

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