ROBOTICS IN AGRICULTURE IN INDIA

Agricultural robots are automated machines designed to perform farming tasks with minimal human intervention. Leveraging technologies such as AI, machine learning, computer vision, and GPS, robotics can enhance efficiency, precision, and productivity across the Agri food supply chain. From seeding and weeding to harvesting and packaging, robotics in agriculture is revolutionizing traditional farming practices.

The future of agricultural robotics in India is expected to see significant market growth driven by the demand for efficiency and sustainability. There is a focus on developing affordable, customizable robotic solutions suited to India's diverse farming conditions. These future systems will likely incorporate advanced AI and IoT for enhanced decision-making and feature integrated systems, such as drone-robot hybrids, for comprehensive farm management. Alongside technological advancements, there will be continued emphasis on training farmers to use and maintain these new tools. Details of Agri robotics furnished below.

Sn	particulars	Details
1	What is an Agriculture Robot	An agricultural robot (Agribot) is a machine designed to perform agricultural tasks, either autonomously or semi-autonomously, using sensors, artificial intelligence, and advanced mechanics
2	Is a Robot an AI?	While robots are different from AI since robots need to be physically programmed, whereas AI doesn't, some similarities show how closely these two fields are related. They can work together to increase productivity and efficiency in a company while at the

		same time keeping people safe
3	AI in Robotics	Artificial Intelligence is enabling robots to perform more complex tasks and make decisions autonomously. In robotics, AI aims to better manage variability and unpredictability in the external environment enabling robots to learn from data and improving their performance over time
4	Who is the father of robotics	Joseph F. Engelberger
5	Robots in agriculture operations	• These robots are used for various tasks, including: • **Planting**: Autonomous precision seeders combine robotics with GIS mapping for accurate seed placement. • **Crop Management**: Robots use computer vision and machine learning for tasks like precise pruning, thinning, and spot weeding. • **Harvesting**: Articulated robots with sensors can identify, locate, and pick produce with high precision. • **Livestock Management**: Robots are also used for tasks like milking
6	Nodal agency for robotics	The Ministry of Electronics and Information Technology (MeitY), serving as the nodal agency for

		Robotics, has proposed a two-tier institutional framework to facilitate the implementation of the National Strategy on Robotics, which will be undertaken as the 'National Robotics Mission'
7	What types of robots are used in Indian agriculture	• wide range of robots, or "agribots," are being developed and deployed to automate labor-intensive farm tasks. Examples include: • **Drones:** Used for aerial crop monitoring, surveying land, and precisely spraying pesticides and fertilizers. Government subsidies and initiatives like the Drone Shakti Scheme promote their use. • **Weeding robots:** These autonomous mobile robots use AI and computer vision to differentiate between crops and weeds. Some use lasers to eliminate weeds, which significantly reduces the need for chemicals. • **Harvesting robots:** Equipped with robotic arms and advanced vision systems, these machines can gently pick ripe fruits and vegetables, reducing post-harvest damage. • **Autonomous tractors and ploughs:** These are used for tasks like seeding, tilling, and planting with higher precision than traditional

		methods. ● **Livestock management robots:** Automated systems for milking, feeding, and monitoring animal health are gaining traction. ● **Multi-functional robots:** Companies are developing modular robots that can handle several tasks, such as ploughing, planting, and spraying, to be more cost-effective for farmers.
8	Benefits of using robotics in Indian agriculture	● **Increased efficiency and productivity:** Robots can work continuously with high precision and speed, leading to higher yields and faster task completion. ● **Reduced labor costs and shortages:** By automating repetitive and physically demanding tasks, robots help compensate for the declining availability of farm labor in rural areas. ● **Environmental sustainability:** Precision farming techniques enabled by robots help reduce the overuse of water, pesticides, and fertilizers. This minimizes waste, chemical runoff, and environmental impact. ● **Improved crop quality and yield:** Automation minimizes human error and reduces damage during

		harvesting, leading to better product quality. Data collected by robots helps optimize growing conditions. ● **Enhanced data collection and decision-making:** AI-powered systems provide real-time data on crop health, soil conditions, and weather, allowing farmers to make proactive, data-driven decisions.
9	Technology in Robots	**Machine vision technology:** involves a camera or multiple cameras feeding information to the robot that allows it to locate and access the crops around it. Machine vision makes it possible for robots to perform tasks like weed picking, growth monitoring, harvesting, sorting, and packing. **Satellite location systems:** Robotic farm equipment often relies on GPS information to position and locate themselves on farms. Autonomous field plowing, seeding, or navigating tractors and equipment may use a combination of computer vision sensors and GPS to navigate and act as the driver in robotic plowing trucks. **Machine learning**: Machine learning provides an advanced method of identifying collision paths that can help autonomous vehicles learn to adapt and avoid new or unexpected hazards in their paths. It also enables picking

		and quality control robots to learn as they go, and to develop the best methods for identifying and executing their tasks.
10	Working methodology	• **sensing** – Robots observe and gather data (e.g., plant sensors to detect nutrient deficiencies, water stress, or disease) • **Understanding** – Robots analyse data and assess situations (e.g., automated fruit counting in a packing shed) • **Performing** – Robots take action based on environmental inputs (e.g., robotic arms picking ripe fruit) • **Learning** – AI-driven robots adapt and improve over time (e.g., fruit-harvesting robots that track ripeness and schedule future picks).
11	Focus areas for Robitic Automation in India	The National Strategy on Robotics has identified four priority sectors with the maximum potential of creating large-scale socio-economic impact through robotics adoption and to position India as a global leader in robotics across these sectors by 2030: 1. Manufacturing 2. Healthcare 3. Agriculture 4. National Security
12	Impact of Robotics on Agricultural Efficiency	The integration of robotics in agriculture has revolutionized farming by automating labor-intensive tasks, optimizing resource use, and enabling real-time decision-making. Key benefits

		include: 1. Labour Efficiency – Robotics automates repetitive tasks like planting, weeding, and harvesting, reducing reliance on human labor, especially in areas facing workforce shortages. Robots can operate continuously, maximizing productivity. 2. Precision & Accuracy – Equipped with sensors and AI, robots enhance precision in applying fertilizers and pesticides, reducing waste and environmental impact while improving crop yields. 3. Resource Optimization – Automated irrigation and soil monitoring systems ensure efficient water and fertilizer use, lowering costs and promoting sustainable farming. 4. Increased Productivity – Robotics accelerates harvesting and crop management, preventing yield losses and ensuring timely interventions for pests or nutrient deficiencies. 5. Data-Driven Decision-Making – AI-powered robots collect real-time data on soil, crops, and weather, helping farmers make informed decisions to optimize operations. 6. Adaptability to Change – Robotics enables rapid responses to environmental shifts, such as droughts or pest outbreaks, ensuring resilience in farming

		7.Reduced Time & Cost – Automation speeds up farming cycles, lowers labor costs, and optimizes resource use, making agriculture more cost-effective and competitive. Robotics enhances efficiency, sustainability, and productivity in modern agriculture, ensuring better yields and reduced operational costs.
13	Potential uses of robotics in agriculture	**Crop scouting:** Crop yields are affected by a multitude of parameters like landscapes, soil compositions, moisture, pest pressure, crop maturity, and others. Good agricultural practices need to be implemented at the right time to ensure a good crop yield. Continuous monitoring of data such as leaf area index, crop growth rate, water stress, etc. plays a critical role in optimizing the variable input parameters at different stages of crop growth. Real-time monitoring of such parameters is a tedious and nearly impossible task for a human to execute, hence robots could be considered an ideal case for such scenarios. Given the labour shortage in India, the adoption of robots can enable continuous monitoring of the crop canopy to ensure the detection of pest attacks & crop diseases at an early stage to prevent any further damage to the crop. **Spot Spraying Robot**: Robot vehicles may be leveraged to spray fertilizers to multiple dense locations which may be

		difficult to access manually by farmers. With rapid advancements in computer vision and artificial intelligence, contemporary robotic sprayers are equipped with intelligence systems that allow selective spray of targeted areas compared to traditional mechanised uniform spraying across the crop. Utilising such robotic technologies limits the environmental impact of chemicals used, and consumer exposure to pesticides, and prevents the development of resistance to those substances by the pest.
14	Autonomous Mobile Robots (AMRs)	suggests travel through spaces autonomously to complete their various tasks. Within this category many different types of sensors and data are used to navigate farms including cameras, GPS, lidar, magnetic tape and more Autonomous robots and drones are becoming increasingly popular in various industries, such as agriculture, logistics, and transportation.
15	Internet of Things (IoT):	The integration of IoT technology with robots is allowing for real-time data collection and monitoring, enabling better decision-making and process optimization. The Internet of Things movement will facilitate the introduction of increased intelligence and sensing into most robot systems,
16	What are the main challenges hindering the adoption of robotics in India	● **High initial investment:** The cost of robotic equipment remains a significant barrier for the majority of

		Indian farmers, who own small or marginal landholdings. • **Lack of technical knowledge:** Many farmers in rural areas lack the technical skills needed to operate, maintain, and troubleshoot advanced robotic systems. • **Poor infrastructure:** Reliable electricity and internet connectivity are crucial for many robotic systems, but these are often inadequate in rural India. • **Fragmented landholdings:** India's small, scattered farms pose a challenge for large-scale, autonomous machinery that is more suited for bigger farms. • **Cultural resistance:** Many traditional farming practices are deeply ingrained, and there may be a reluctance among some farmers to embrace new, unfamiliar technologies. • **Job displacement concerns:** A key concern is the potential for automation to displace manual laborers, which requires careful management and the creation of new, tech-focused roles.
17	**Future Prospects of Agricultural Robotics in India**	he future of robotics in agriculture in India is poised for exponential growth, with developments promising to

		revolutionize the sector. 1. AI and IoT integration: The next wave will be powered by IoT in agriculture, where robots will be connected to smart sensors and cloud platforms. These systems will allow real-time decision-making, reducing crop loss and maximizing output. 2. Autonomous multi-functional robots: Future farming robots are expected to handle multiple tasks such as seeding, spraying, and harvesting autonomously. This multifunctionality will make them more cost-effective and attractive for Indian farmers. 3. Customizable and modular designs: Robots designed specifically for crops like sugarcane, wheat, cotton, and rice are being tested. Modular builds will allow farmers to add or remove functions as per seasonal requirements. 4. Skill development and adoption programs: With increased emphasis on digital literacy and agricultural automation training, more farmers are expected to embrace robotic tools. These training programs will make operations like calibration, maintenance, and data analysis more farmer-friendly. 5. Drone-robot hybrids and aerial automation: The future will see a convergence of

		aerial drones and ground-based farming robots, offering 360-degree automation from surveillance to action. This kind of integrated smart farming setup can boost both sustainability and efficiency
18	**Government** **Initiatives and Support**	Recognizing the potential of robotics in agriculture, the Indian government has launched various initiatives: • Subsidies and Financial Assistance: Programs to provide financial support for purchasing agricultural machinery. • Research and Development: Funding for R&D in agricultural technologies through institutions like the Indian Council of Agricultural Research (ICAR). Skill Development: Training programs to educate farmers on the use of modern agricultural tools and technologies.
19	Innovative Agri robots startups n india	Innovative startups in agricultural robotics are leveraging AI, computer vision, and advanced mechanics to tackle significant farming challenges like labor shortages, sustainable weeding, and harvesting efficiency. Details of few stratups and supliers of Robots in india furnished below ● **Niqo Robotics:** Specializes in robotic weeding to boost crop yields and reduce farming

		expenses through precision agriculture. ● **Garuda Aerospace & Marut Drones:** Leading companies in India's agricultural drone market, offering solutions for crop monitoring, spraying, and land surveying. ● **Rowbotix Agtech Pvt. Ltd.:** Based in Pune, this startup is developing robotic farm equipment that uses AI and machine learning to enhance operational efficiency and precision. ● **Aarav Unmanned Systems:** A significant player in the use of drones for precision agriculture, including crop monitoring and surveying.

Agricultural robotics and drones have greatly improved efficiency and productivity by enabling precise resource utilization, optimizing workflows, and minimizing waste. Technologies like autonomous tractors, drones, and robotic harvesters enhance farming operations, increase yields, and promote environmental sustainability. As advancements continue, robotics are set to revolutionize agriculture and food production, fostering innovations that can help tackle global food security challenges while ensuring sustainable resource management

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