smart skills
smart sustainable agriculture

Course 3: Mechatronics in Agriculture

M2: Agricultural Robots

Co-funded by the European Union

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contents

In this module, Learners will understand the role of robotics in agriculture, recognising how it improves efficiency and sustainability. They will identify key agricultural robots, and the benefits and challenges of robotic integration. The module will help learners adopt a forward-thinking mindset for sustainable farming while also considering the ethical and social aspects of robotics

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01

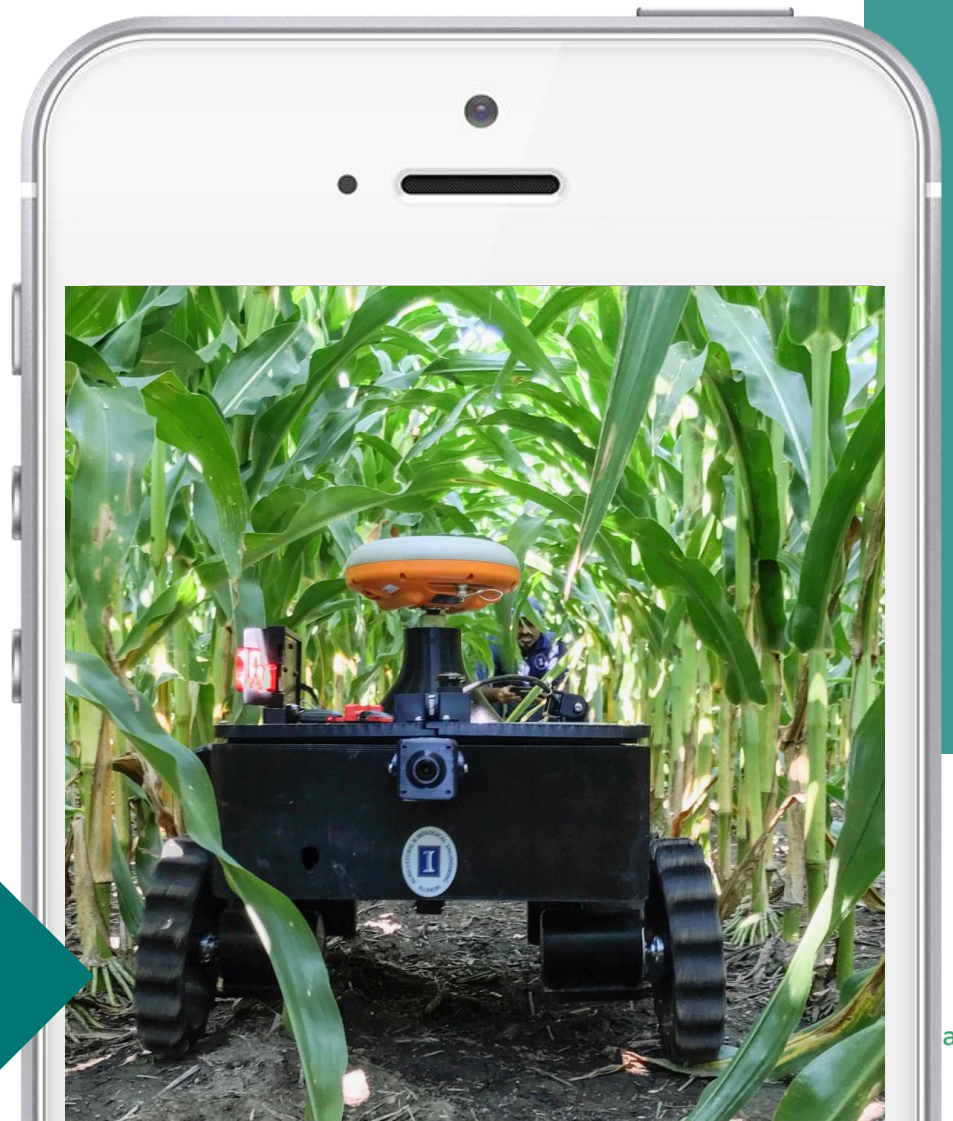
INTRODUCTION TO AGRICULTURAL ROBOTICS

Introduction to Agricultural Robotics

Agricultural robotics is revolutionising modern farming, enhancing efficiency, precision, and sustainability. These advanced systems automate labour-intensive tasks, reducing costs, increasing productivity, and addressing labour shortages.

This **module** explores how robotics is transforming farming, provides an overview of key robotic solutions, and discusses the opportunities and challenges in their adoption.

Click for more info



agriculture

How Robots are Transforming Farming Practices

The introduction of **AI-driven robots** is reshaping agriculture by automating repetitive tasks such as **planting, weeding, harvesting, and sorting**. These robotic systems use **computer vision, machine learning, and sensor technology** to operate with high accuracy and efficiency.

Key transformations in agriculture with robotics include **reduced labour dependency**, as robots replace or assist human workers, addressing labour shortages. **Increased precision and productivity** allow AI-powered machines to perform tasks faster and more accurately than manual labour. **Lower environmental impact** is achieved through targeted application of water, fertilizers, and herbicides, minimizing waste and chemical runoff. Additionally, **enhanced scalability** enables farms to increase production without proportionally increasing labor or resource use.

Example: Autonomous fruit-picking robots use **AI and cameras** to identify ripe fruits, reducing waste and optimising yield.

Robotic Weeders

Robotic Weeders detect and remove weeds **without herbicides**, using **mechanical arms or laser technology**. This reduces chemical dependency, promoting **eco-friendly farming**.

[#Oz - 2021 - From sowing to hoeing - YouTube]

Example: Naïo Technologies' Oz Robot autonomously navigates fields, uprooting weeds while protecting crops.

Click on the Video to see an example

Robotic Pickers

Robotic Pickers use **computer vision and robotic arms** to pick fruits and vegetables **with minimal damage**. These robots can operate **day and night**, maximizing harvest efficiency.

Example: FFRobotics' Apple Picking Robot mimics human hand movements to carefully detach apples from trees.

Click on the Video to see an example

[Automatic fruit picker demonstration by FF Robotics : IFTA 2017 - YouTube]

Robotic Harvesters

Robotic Harvesters automate **grain, vegetable, and fruit harvesting**, optimising **speed and quality**. They reduce post-harvest losses by preventing **bruising and spoilage**.

AGROBOT Robotic Strawberry Harvester - YouTube

Example: Agrobot's Strawberry Harvester scans and picks ripe strawberries **without damaging the plants**.

Click on the Video to see an example

02

OPPORTUNITIES & CHALLENGES IN ROBOTIC INTEGRATION

Opportunities in Robotic Integration

The integration of robotics in agriculture presents significant opportunities, including:

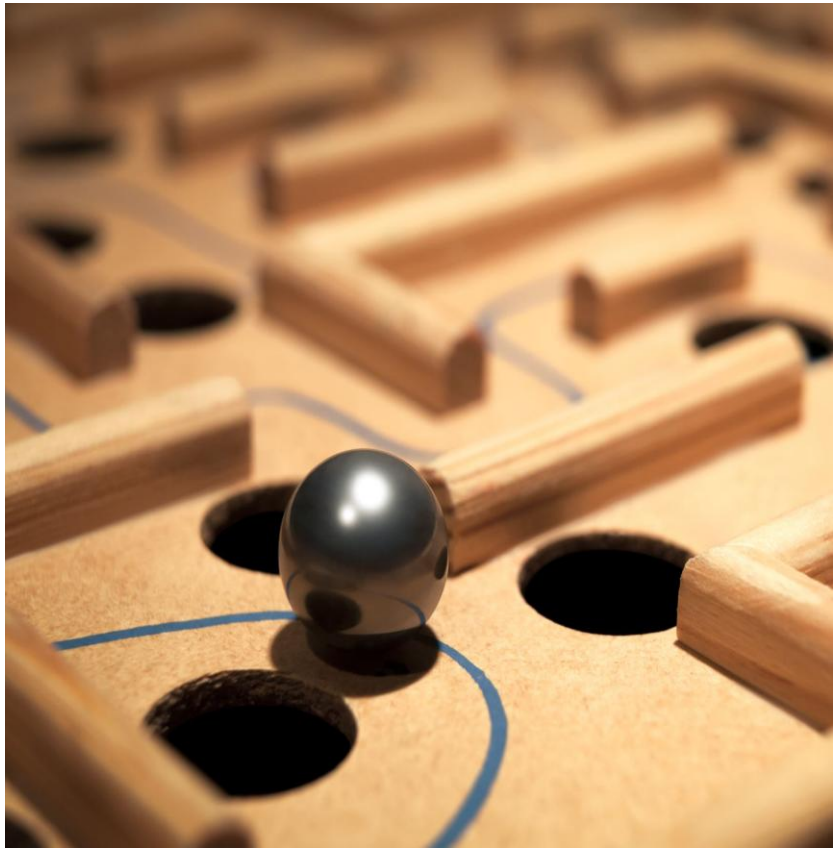
- **increased efficiency**, as robots work continuously, unaffected by fatigue or weather conditions
- they also provide **cost savings** over time, as robotic systems, despite high initial costs, reduce long-term labour and operational expenses
- additionally, data-driven farming benefits from AI-equipped robots that deliver real-time insights for **better decision-making**.

https://www.roboticstomorrow.com/story/2015/04/agrobot-strawberry-harvesters/5950/

Challenges in Robotic Integration

However, several **challenges** remain:

- **High initial investment** is a major barrier for small and medium-sized farms, as robotic solutions require substantial upfront costs.
- **Technical complexity and maintenance** also pose challenges, as farmers need specialised training to operate and repair robotic systems effectively.
- **Limited adaptability** is another issue, as farming environments are unpredictable, making it difficult for robots to operate efficiently in uneven terrain, extreme weather, or highly variable crops.



Challenges in Robotic Integration

https://siamagazin.com/meet-the-agrobot-a-robotic-strawberry-harvester/

Beyond technical challenges, regulatory and **ethical considerations** must also be addressed:

- As **robots replace human labour in some farming tasks**, policies should ensure that workers are reskilled and transitioned into new roles rather than being displaced.
- **Regulations on AI use** in farming and ethical concerns regarding automation and data privacy will need careful management.

Agriculture is the most healthful, most useful, and most noble employment of man, and today, robotics is making it more efficient, sustainable, and innovative than ever before.

Thomas Jefferson

04

LET’S PRACTICE

Learner Exercise:

Practical Activity: “Spot the Robot in Agriculture”

- Research one real-world example of an agricultural robot used for planting, weeding, harvesting, or monitoring.
- **Task:** Write a short description (100-150 words) explaining how it works, its key benefits, and any challenges associated with its use.
- **Optional:** Find an image or video of the robot in action and share key takeaways.

Group Exercise:

Discussion Prompt:

What farming tasks do you think should be automated next? How could robotics solve key challenges in modern agriculture?

Purpose: This engages learners, encourages critical thinking, and allows them to connect theory with real-world applications.

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