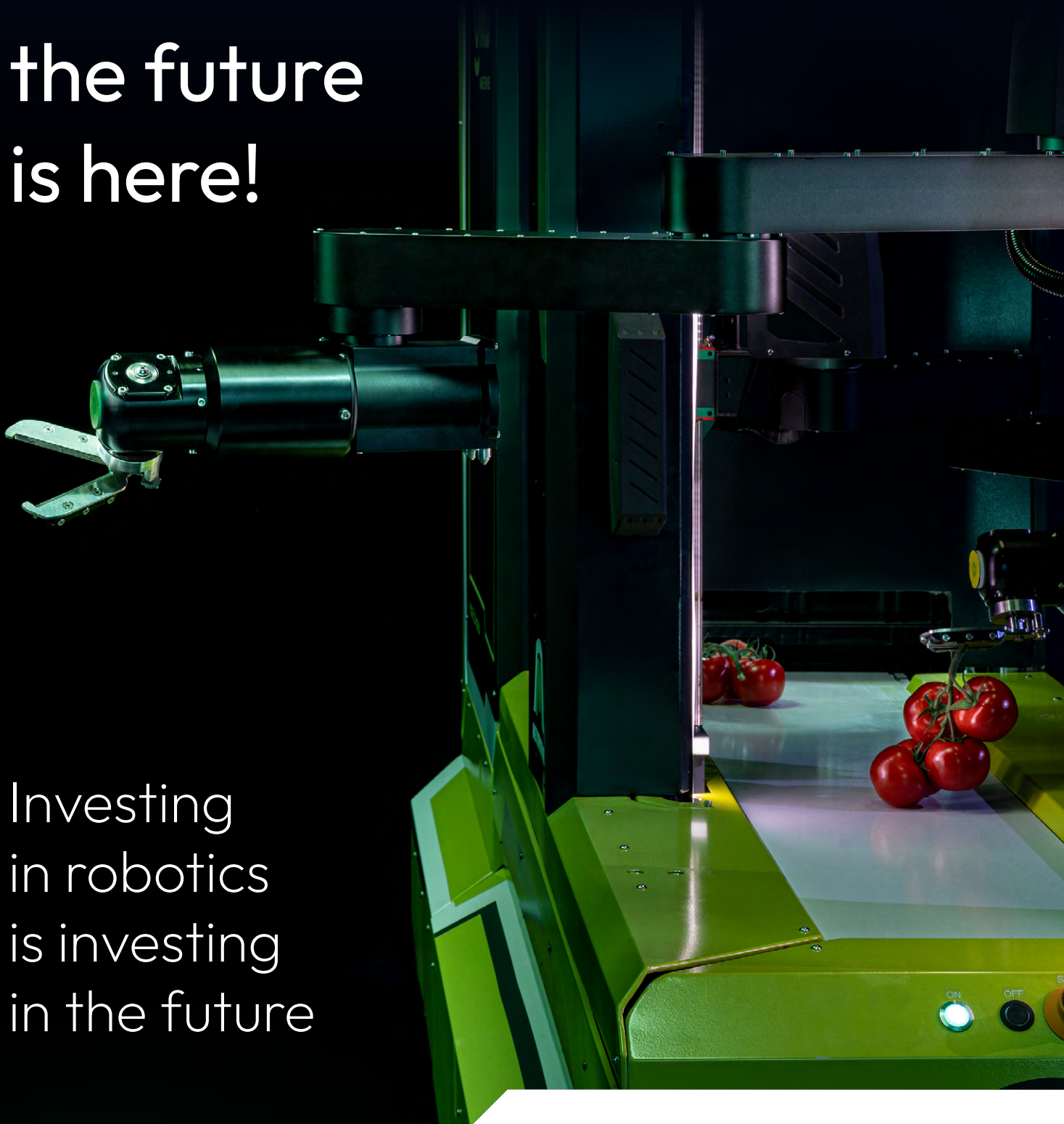


Robotics in horticulture:

the future
is here!

Investing
in robotics
is investing
in the future



Introduction

In an ever-expanding and improving world, keeping up with technology is imperative. Currently, the rate that technology is advancing is greater than ever before. With recent advancements in automation, vision technology, artificial intelligence and machine learning, paired with advancements to software and hardware platforms, the potential to use innovation to overcome challenges in horticulture has never been greater. Now is the time to look at the development of robotics technologies and their potential in horticulture.

Considering the latest horticulture trends and developments, robotics may provide solutions that reverse the negative trends while pushing the positive ones forward. One of the largest industry-wide challenges in horticulture is the labor shortage and rising costs of labor. A lack of skilled greenhouse workers can result in business disruptions and overall, negatively impact greenhouse operations. New innovations such as tomato harvesting robots are a solution for at least one factor involved in labor shortages. But the opportunity to develop a greenhouse robot does not end with harvesting tomatoes; the possibilities of what a greenhouse robot platform can do in the future are endless.

While much robotics technologies have not been integrated into a complete autonomous growing solution for greenhouses, it will not be long before this vision becomes a reality. In just about any industry, the key to leading these improvements is not just through implementing new technologies but by pioneering innovation. This often involves being an early adopter of the technology and getting involved during various stages of development. It also allows you to direct the innovation. Early adoption of cutting-edge technology not only keeps you ahead of the competition but also positions you as a leader in the field.

The thought of robots becoming the “face” (or “arms”) of greenhouse workers may seem mindboggling and like a vision of the future. But, if the advent of the personal computer in the 1970s has taught us anything, it’s that once innovative technology is created, we can’t live without it – After all, chances are that you are reading this on your computer or smartphone. So why would we think it would be any different with regards to robots?

Now you are likely wondering what the robotic revolution may mean for your horticulture business. In brief, investing in robotics for greenhouse automation has the potential to address industry-wide labor shortages, provide business continuity, increase profits, provide potential for scalability and sustainability. Greenhouse robots open the door to endless possibilities, so the question is, will you lead the innovation and shake hands with a robot?



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I.

The biggest trends & developments in horticulture



Labor scarcity

Like any industry, both good and bad trends impact the horticulture industry. Two of the major horticulture trends that are negatively affecting the industry are the scarcity of labor and rising costs of labor. Finding greenhouse workers has become increasingly difficult, making it tough for producers to adequately monitor, maintain and harvest their crop. Not only are greenhouse workers difficult to find, but the cost of labor is also on the rise which can impact revenue and business continuity. At the same time, many greenhouses are increasing in scale, requiring more labor hours. Fortunately, with the increasing scale of greenhouse production systems comes a greater opportunity to innovate using automation and robotics to address the concerns of labor scarcity and cost.

Autonomous greenhouse

One of the positive trends within greenhouse horticulture is the push to create a so-called 'autonomous' greenhouse environment. To date, there have been major developments in creating complete greenhouse solutions that are able to fully operate autonomously; from self-operating climate control systems that utilize artificial intelligence to calculate and create the ideal climatic growing conditions in the greenhouse, to fully automated robotic solutions that perform labor-intensive crop work.

**Robots are available 24/7
and don't need a break -
just the occasional
battery change.**

By automating the greenhouse production, labor shortages will have less of an impact on operations, which in turn provides business continuity. Aside from addressing labor shortages, automation via robotics has many additional applications and benefits. The push for greenhouse robots that harvest and box tomatoes, provides many solutions to current trends and challenges. But greenhouse robots can do more. By utilizing and integrating vision, remote sensing, or artificial intelligence technologies, for example, the opportunities for the future are endless.

2.

Investing in a robot platform is investing in the future

Analyze and implement on the go

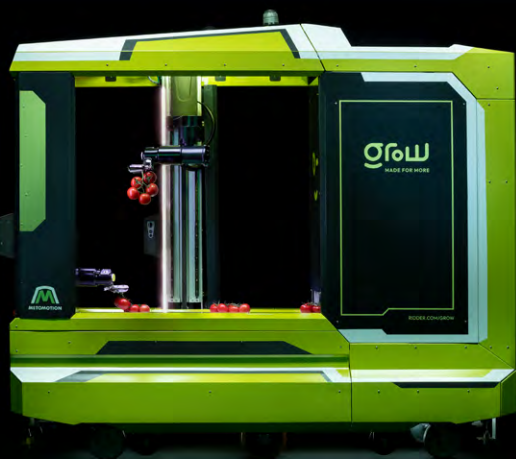
When thinking about integrating robots into the greenhouse, the possibilities are endless. Robots will not just harvest fruit, with the recent advancements in technology, but also more data can be collected and analyzed in real-time. The task and potential of analyzing this data in real-time, is no small feat and exceeds human capabilities. Integrating artificial intelligence into a greenhouse robot allows for real-time control optimization over production and quality. Greenhouse automation requires communication between all technologies working together in the greenhouse. A platform that includes robots will allow for effective monitoring and communication with other technologies in your greenhouse is imperative.

The ability of a greenhouse robot to analyze and implement solutions in real-time shows that it is much more than just a machine to harvest your crops. Greenhouse robots have the potential to scan the crop and perform diagnostics for plant health, apply biocontrol and provide insights for more precise application of crop protection in targeted areas. A robot collects and stores huge amounts of relevant data related to the crop, fruit production and ripeness levels, which it can use to contribute to more accurate yield prediction. Better harvest forecasting will help the grower to get a better grip on the marketing of his produce.

Investing in a sustainable future of your business

The use of robots in greenhouses is an investment in the future from a sustainability point of view. Robotics will allow you to grow more with less. You can expand your company without having to grow your workforce, or having to worry about finding skilled labour. Investing in robotics is also investing in a sustainable workspace for your human workers; they can be deployed more effectively in better working conditions performing less strenuous and repetitive tasks.

Being an early investor in a robot platform may seem daunting, however, investing in a platform now is investing in the future. Investing early on creates the opportunity to help shape what the final platform will look like. The producers that invest in the greenhouse robot technology early on are contributing to innovations that will eventually shape the future of the horticulture industry.



3.

Why robots are here to stay

If 50 years ago, someone was to suggest that robots would become a standard fixture in greenhouse production, would you have believed it? With the technological advancements that have occurred over the last 50 years since the introduction of logical processors and information technologies during the Third Industrial Revolution in the '70s, it's easy to picture robotics in greenhouses as a reality. But when Industry 3.0 just began, it may have seemed like a far-off dream, maybe even something to aspire to.

As we breach the horizon of Industry 4.0, with the application of data, information, and communications technologies through concepts such as Big Data, IoT (internet of things) and BI (business intelligence) setting new standards, it's clear that integrating sophisticated robotics into greenhouses is not a far-off dream for the future but a logical and realistic next step. Considering the advancements to date in the agriculture sector from remote sensing, aerial imaging, and other precision agriculture methodologies along with the development of artificial intelligence and machine learning – are you surprised that robots are being developed for harvesting, maintaining, and monitoring greenhouse crops? This will push the industry even closer to a fully autonomous greenhouse.

Like computers that were developed during Industry 3.0 that are indispensable and now constantly at our fingertips, the robots being developed as part of Industry 4.0 are here to stay, too.



4.

When will robots be available for your horticulture business?

So, what is the status of robotics in horticulture? And when will a solution be available? Well, robots for greenhouse automation are on the horizon. The trends and developments related to labour and scarcity of skilled expertise are the main driver behind the fast-paced development of key enabling technologies. In the first phase, the technology will initially help to address things like labor shortages and labor costs by providing solutions for performing labour intensive tasks and collecting data. But the robots will be designed with scalability in mind, meaning that additional technology and applications can be added to the existing robot as they're developed. After all, if we can build a robot to gently handle fragile clusters of tomatoes for automated harvesting, what can't we do?

Status of robotics in horticulture

To put into context where the technology currently stands when talking about robots for horticulture automation, it is important to understand the concept of Technology Readiness Levels (TRLs). TRLs were created by NASA to assess the readiness of a particular technology and have since been a widely adopted standard for understanding the status of technology along its development path from inception to completion. There are nine TRLs, with the first level being the earliest stage and the ninth TRL being when the technology is fully complete and proven successful.

Currently, the status of many new robot technology being developed for greenhouse applications is everywhere on this skill, with some of the most promising new solutions somewhere between a TRL of 7 or 8. What this means is that the technology is between a prototype and system completion. At the moment, these robots are being implemented into real growers' greenhouses to help fine-tune the technology. Some of these robots can accurately harvest fruits like strawberries or tomatoes, but the technology still has some learning to do in getting it up to speed and surpassing the harvesting efficiency of a human laborer.

Integration of robotics in your daily operations

An important factor to consider when implementing robotics inside commercial greenhouse operations is the integration into existing situations. As most of the infrastructure is already there, new technologies should be designed in a way that they can be adopted and implemented without having to retrofit the structure, logistical systems or installations. Additionally, robots and the existing human workforce should be able to work side by side.



Early adopter of technology

What now is needed moving forward is for more innovative growers to adopt the technology during the final stages of TRL. Early adoption of this technology will position you as a pioneer of robotics for greenhouse automation and will push the boundaries of innovation, providing endless possibilities for the horticulture industry.

TRL 9

Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space).

TRL 8

System complete and qualified.

TRL 7

System prototype demonstration in operational environment.

TRL 6

Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies).

TRL 5

Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies).

TRL 4

Technology validated in lab.

TRL 3

Experimental proof of concept.

TRL 2

Technology concept formulated.

TRL 1

Basic principles observed.

5.

Recap & Conclusion



As advancements in technology continue to develop and labor shortages become more and more prevalent, the horticulture industry has an opportunity to strive for innovative solutions. Adopting technology for use in the greenhouse will help growers continue to meet demands for high-quality, sustainable crops.

Current trends in horticulture include labor shortages and costs, and a push toward a more automated greenhouse operation. The good news about the push for greenhouse automation is that it may help to address the shortage in labor that many growers are currently experiencing. By having a more automated greenhouse fewer workers are needed, minimizing the risk of disruption of business. An exciting opportunity on the horizon, however, is the use of robots in the greenhouse and the problem-solving potential they would provide.

Robot technology for the greenhouse is not yet fine-tuned but investing in the technology now is an investment into the future. By investing early, you will be helping to push the current version of the greenhouse robot to completion while driving innovation towards future versions that incorporate things like plant diagnostics and targeted application of pest control or nutrients. While it may be tough to predict exactly what future iterations of a greenhouse robot will look like or what it may be capable of, one thing that is clear is that robots are here to stay.

Many of the most pressing issues facing greenhouse production currently do not have reasonable solutions. The creation of a greenhouse robot that can harvest tomatoes, and can integrate future technology and innovative solutions, addresses many of these greenhouse issues. Now that the robot can quickly identify ripe tomatoes and delicately yet efficiently harvest them, the future possibilities seem endless. As with the previous waves of the Industrial Revolution, once a technology that improves life exists it is unlikely to go extinct and Industry 4.0 is no exception.

The potential that greenhouse robots have to revolutionize your greenhouse operations is endless. By investing in this technology now, you will help push the technology into its final phases, pioneering innovation in robotics for greenhouse automation.

Will you GRoW your greenhouse operations?

Reserve your GRoW today!

Do you want to be a pioneer of robotics for greenhouse automation? Shaking hands with a harvesting robot is only a click away. Go to ridder.com/grow and save a spot on the waiting list for the GRoW robotic platform, the first autonomous greenhouse robot that uses two arms for collecting and boxing your tomatoes.

Partners in innovation - About Ridder and MetoMotion

The tomato harvesting robot, GRoW, is a collaborative project between Ridder and Metomotion. Ridder is a worldwide leader in smart solutions for the controlled environment agriculture market that aims to design a complete system around plant growth, considering current and future needs. Metomotion is a pioneer in the field of robotics, pushing the limits of innovation to provide advanced, intelligent robotic systems. Together, Ridder and Metomotion have formed a partnership to develop GRoW, leaning on the expertise each company brings to the table to innovate. As problems facing the agriculture industry become more complex, the need for collaboration between experts in different areas has

never been more important. This is exactly what Ridder and Metomotion aim to do. Together with the innovation ecosystem they've created, they hope that GRoW will be the first step in solving some of the major issues facing greenhouse production and are committed to growing and innovating as new challenges arise. GRoW is not fiction, it's reality and has two arms to prove it.

Reserve your GRoW

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