Grower Summary

HNS 203

Limitations to implementing robotics in UK ornamental horticulture

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AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

There are challenges in implementing robotics in UK ornamental horticulture, in particular due to the large variability in plant species and varieties. However, there are also automation opportunities that can help make growers more competitive in the near term, and there is scope for customised innovations leading into the future.

Background

As with the rest of the UK horticultural sector, the production of ornamentals is heavily dependent on manual labour. This manual labour is typically imported, as it is in most western European countries, from eastern Europe, Asia, and Africa. Growers thus rely upon the availability of such imported labour at a reasonable cost. This availability depends on complex financial (e.g. minimum salary, salary competition with other industries), personal (e.g. attractiveness of the local amenities, availability for seasonal labour), and political factors (e.g. availability of visas, exchange rates).

Robotics and automation are increasingly being suggested as a means to help resolve manual labour issues in agriculture in general (Bac et al., 2014) (Duckett et al., 2018). That is, to assist with traditionally human-centred operations where perception, decision making, and dexterity are required. For example, harvesting, pruning, precision spraying, and transportation operations could be partially or fully automated to alleviate a grower's reliance on manual labour. Building on the AHDB project GROWBOT (Sena & Howard, 2020), this report aimed to identify remaining issues in the uptake of robotic technology for ornamentals, and to identify potential ways of resolving them.

Summary

The main scope of this study was to investigate the remaining barriers for automation of agricultural tasks in the ornamental sector in the UK. It should be noted that the authors of this report are researchers in the cross-section of robotics, machine learning and sensors applied to agriculture, and the report should therefore be taken with this perspective in mind. Further work exploring simpler mechanical solutions, and going more in depth on machines that do not use sensory feedback to operate, is likely needed. This report focuses on cut stem grower, plug plant growers, and nurseries. It attempts to document the current procedure for each production step, to highlight the most important challenges, and opportunities, for

automation, and in this way serve as a piece in the puzzle for gradually increasing the level of automation for these producers. We hope the report can be useful for end-users, academics working on technical solutions for agriculture, and technology providers interested in developing products for this application of automation and robotics.

Most robotic solutions will normally apply to single plant species, i.e. plant types with defined morphological characteristics that the robot can be programmed and fine-tuned for. Taking that robotic system and applying it to another plant species with a different morphology and requirements would mean re-programming and obtaining new datasets. Simpler automated solutions, like conveyor belt systems, also require considerable scales of operation to make the investment worthwhile. However, there are specific challenges that can likely be met by increased automation in the near future.

As explored in the previous AHDB GROWBOT project (Sena, 2019), robot learning can help target low batch-size tasks for ornamentals. In addition we believe there are specific opportunities for each type of grower that should be explored as a priority. For example, the counting and grading of cut stem flowers, where there is automated machinery available for flowers with a higher price-point, but where lower-cost/smaller-scale solutions based on off-the-shelf robot arms, soft grippers and machine learning may be feasible in the medium-term. However, targeted RD&I projects with a relevant technology provider are needed to integrate and bring such robotic solutions to working prototypes, and ultimately to market.

Similarly, the grading of plug plants may be possible, where the large variety of different plants to grade may be overcome by generating the data sets required for machine learning on-the-job by current skilled staff during a transition period. Or, the application of mobile robots for addressing gapping in nursery plant stock. Here solutions are available on the market, but may at the moment be difficult to justify in terms of cost for smaller operations. Wider adoption and larger-scale production may help bring the price point down for such systems.

There are commonalities to some of the challenges that may be exploited in making cross-grower solutions with bigger potential markets. For example moving, and grading, plants. This would require resolving the issues related to handling a wide enough array of different plants, but the flexibility offered by light industrial arms, soft grippers, and machine learning is promising. More work is needed to explore these opportunities, and to ensure the solutions proposed are grounded in the needs of the growers, both practically and financially.

Financial Benefits

Increased automation can likely provide cost savings for UK growers of ornamentals, but needs to be tailored to the scale of operation, and varieties of plants grown. Given the

difficulties in obtaining, and high cost associated with, imported skilled manual labour, automation can also help increase predictability of operations.

Action Points

- Explore opportunities for working with research partners and technology providers to customise technology to needs, for example through Innovate UK funding
- Help foster, and work with, robotics research initiatives to identify and solve tasks specific to ornamental plants culture
- Consider the full system-of-systems when optimising operations for automation/robotics, for example by merging tasks
- Reduce variability of the environments and tasks, for example the number of different sizes of trays or pots, which can facilitate the deployment of traditional automation, machine learning solutions, and autonomous robots
- Avoid cramped spaces: High space utilization can sometimes make robot navigation and grasping tasks more complex