Agriculture Robotics & Automation Perspective

By Koji Hasegawa (Kubota Innovation Center Silicon Valley)

Since most of the work involved in growing tree crops like grapes and apples, and on-ground crops like vegetables and strawberries (so-called “specialty crops”) is still done manually, growers are facing problems of rising labor costs and labor shortages. The costliest processes are harvesting, pruning, and weeding (increasingly done by hand rather than with herbicides out of concern for impacts on human health, crops, and the environment). In California, for example, labor costs have risen 30% between 2017 and 2021 and may well rise a further 40% over the next five years as the minimum wage increases. Such a steep rise in labor costs is putting pressure on the business operations of specialty crop growers, and in fact, this pressure is becoming a serious social challenge all around the world.

So, why has mechanization of these processes been so slow in the case of specialty crops, in contrast to rice and row crops? You have probably seen video of rice or wheat being speedily harvested with a combine harvester. Yet, strawberries are still picked by hand.

The reason has to do with the nature of specialty crops. In fields of rice and wheat, there is no big difference in the growth speed of each individual plant and the crops grow to the same height. Consequently, the harvesting process is not very complicated, so it can be mechanized easily. In the case of specialty crops, on the other hand, the position of fruits are scattered irregularly and their ripeness also varies widely. Many kinds of fruits are also easily damaged during harvesting. Therefore, people need to visually judge fruits one by one and to pick them gently to avoid damaging them. Similar things apply to pruning and weeding. The branches to be cut and the weeds to be removed need to be identified precisely, as well as precise action to be taken.

Up to now, these tasks have been difficult to mechanize, because there was no established technology capable of substituting for the human eye, brain, and hand. However, with recent technological advances, mechanization and even automation is becoming a reality. The human eye is being replaced by camera-based imaging technology, the brain by AI, and the hands by robotics. Recently a number of startup companies have combined these elemental technologies to try and find solutions to this social challenge, such as Advanced Farm Technologies and Tortuga AgTech in the field of strawberry harvesting, FarmWise and Carbon Robotics for weeding. They are already offering their services on a commercial basis and many growers are adopting their groundbreaking solutions.

In the coming years, the widespread penetration of such mechanization and automation solutions is likely to depend on two key factors.

The first one, of course, is economics. No matter how many people can be replaced, if the cost of using robots is higher, farm operators will not accept the solution. Unless the cost of the robot solution is equal to or less than the human solution, they will not see the point of

embracing it. This explains why, in addition to improving work precision, speed and efficiency, these startups are also focused on improving COGS (Cost of Goods Sold) and OPEX (Operating Expenses), to achieve better total cost competitiveness.

The second factor is achieving and delivering added value that is unique to robots, i.e., value that cannot be generated with human labor. Returning to the example of harvesting, a robot can make use of GNSS (Global Navigation Satellite System) and harvest data to record the quantity of harvest in each a small area of field. At best, humans are only capable of making rough estimates of large fields; they cannot determine this information with such granularity. The data acquired by a robot can be used to compare yield and crop quality of each area of a field. Furthermore, if the cause-and-effect relationships between inputs and outputs can be clarified by combining them with input data from the other farming process, it could be possible to improve the yield and quality of crops in the following year. If this became a reality, robots would not merely replace labor; they would become an indispensable element of solutions for achieving more precise and efficient agricultural production. As such, they would be highly valued by growers. In addition, as the shift to “smart agriculture” advances, data collection and utilization at every step of the farming process will similarly become more sophisticated, and as a result, we can expect to see the emergence of platforms for managing this data centrally. Such a platform would be a key factor in accelerating the spread of robot-based mechanization and automation solutions.

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