Do it like a robot

Automated solutions are at the tip of everyone's tongue at the moment. But there's a lot of spin going on, and sometimes it's difficult to work out the real benefits. Venketesh Dubey, Bournemouth University, gives his perspective.

▲ **Figure 1: The ABB FlexiPicker is a high-speed vision-controlled robot[3]**

In many consumer goods enterprises, finished packaging operations are often the greatest bottleneck to new product introductions. Manufacturers are continuing to face the increasing pressures of shorter product lifespans and growing consumer segmentation into smaller target groups. Manufacturers make considerable investments in packaging machinery, but most budget expenditure is on specific product lines dedicated to a single purpose. With the decreasing cycle of new consumer product introductions, inflexible packaging machinery is regarded as a barrier in the production system. The element that is driving all manufacturers to change is the shrinking product cycle. When products require packaging, a manufacturer needs either a large pool of workers willing to put in multiple shifts of boring, repetitive labour or an automation system.

Automated and flexible

The trend towards packaging variety often demands the flexibility that can be provided by robots. In the packaging world, this means more and different sizes of products and packaging. According to robotic industry professionals, manufacturers that can quickly revamp lines have an edge over the competition[1]. There is a lot of hard automation in packaging and palletising, but robots are now becoming the most effective method of adding agility and flexibility to the system. They facilitate rapid reconfiguration and expand the operating range of the individual machine. The key to this machine integration is the programming environment[2]. Although some fixed automation allows extremely high throughputs, such systems are not very flexible. So if something changes, like box size, they are not easily modified. A robot-based system permits changes to be automatically accommodated with some minor programming changes. Market drivers are forcing manufacturers to consider robotics as they facilitate flexibility and responsiveness to customers. It is argued that flexibility is one of the major benefits to be derived from switching from hard automation to robotics and packing/palletising integration.

Robots have been used in the food industry for about 20 years. They replace either manually repetitive motion tasks or other strenuous work. Economic justification is the main criteria for selecting robots, and to date they have almost exclusively been installed in countries with high labour costs. With decreasing prices and increasing performance, the potential for robotic applications is growing. The proliferation of robotics in packaging machinery compared to just a few years ago has increased rapidly. These new machines are no longer large, articulated arm robots originally designed for the automotive industry that have been adapted for end-of-line applications, such as palletising and case packaging.

Carry on down the line

Increasingly, two- and three-axis Delta robots are operating in both primary packaging systems for product pick-and-place, and secondary operations, such as cartoning and case packaging. ABB's FlexiPicker (Figure 1) is one example of a high-speed vision-controlled robot that is primarily targeted at the food, pharmaceutical and electronics industries[3]. Many of today's packaging-system providers are developing their own robot mechanics which are integrated with their other machinery. Various packaging operations developed by the German companies Gerhard Schubert and International Packaging Systems have recently been making their way into various packaging operations. Most of the machine constituents and basic system composition of these robots have been developed for packaging or robotised packaging lines and put into practical use[4]. It is worth noting that the developments differ from those applied for welding and assembling. With the development of automation technology, Adept Technology is providing technological developments that are specific to the packaging market[5]. The equipment performs pick-up and placement of a product during various stages of the product packaging process. The primary markets served by packaging robotics are those of food, medical products, electronic and consumer goods.

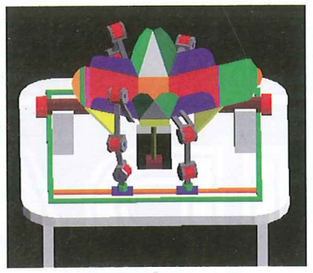
Infinite variety fuels innovation

With the application of robotics in the automotive industry reaching saturation point, there seems to be great opportunities for robotics in packaging. The demand for food packaging and consumer products is going to increase, unlike the receding automotive sector, and this may bring opportunities for funnelling the robotic technologies of automotive industries towards packaging. This will both entail technology transfer and invite bigger challenges at a higher level to be met. For example, it is necessary to constantly meet the changing requirements for variety and innovation in short-run and small-batch consumer product manufacture. This is commensurate with a large range of products going out in cartons, as evidenced from seasonal gifts, cosmetic products and the confectionery market, all of which are becoming increasingly competitive. Carton styles must thus be frequently changed. However, this brings lots of technical challenges, such as:

- What should be the structure of the flexible machine that can be easily reconfigured?
- How to interpret carton geometry from a flat configuration to a fully erected structure? One such approach has been described (Figure 2), but this is yet to be commercially exploited[6]. The concept of morphology in computer graphics may be useful, but how we define the kinematics and automate the whole folding sequence for different cartons remains an unexplored area[7]. This may further include trajectory planning and motion optimisation from the robotic manipulation perspective.
- Control of suction cups and pneumatics for delicate handling of cartons and finished products will further necessitate the use of tactile sensors for the astrictive grasping mode.
- Even though the use of robotic vision in manufacturing sectors is now commonplace, the technology embodied in these devices is poorly matched to the industrial needs of food processors. In particular, food processing imposes special demands upon machinery, and the vision sensors must be programmed to detect the position of single and isolated objects, in addition to overlapping or occluding items. This requires special software designs that integrate both precision guidance and product inspection capabilities, based on image processing.
- Special grippers have to be designed for handling food articles so they have negligible contact with the food items and cause minimal damage. An extension to this may be the inventory of grippers for various operations, such as thermal gluing, laser printing and sticker labelling.
- Food handling hygiene is an important packaging concern that must be factored into design.

Reducing the human factor

These advanced technologies will bring the entire packaging process to an automation level, with the flexibility of defining kinematics and generating motion sequences, leading to finished product packaging. The advantage of such systems is that they both perform the functions of dedicated machines, yet can also replace several workstations for product loading, labelling and package handling. This will ultimately reduce the packaging time and meet the challenges of high adaptability to satisfy the ever-changing demands of styling new product packaging. ■



▲ **Figure 2: A reconfigurable packaging robot[6]**

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