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## HAL Robotics and A3L develop adaptive self-learning robotic for finishing and polishing

Transformational software companies have developed an innovative self-learning robotic solution to reduce the barriers to adopting automation for finishing tasks.

A3L, a robotic systems integrator based in Sheffield, and HAL Robotics, a human-robot collaboration software company based in London, partnered on a collaborative R&D project through Made Smarter Innovation.

They co-created an automated finishing and polishing robotic cell capable of measuring and reacting to the size, shape and requirements of the part to be processed, thereby making it self-programming and adapting.

Successful tests with plastics and automotive manufacturing processes demonstrated the potential for huge productivity gains.

HAL Robotics’ software has now been developed into a new product, decode, which is being marketed for all finishing processes, while A3L is now applying its tool to other R&D projects.

Chris Needham, Innovation Lead for Made Smarter Innovation, said: “Creating and adopting the latest in digital technology solutions will be key to drive energy efficiency, productivity and growth across manufacturing industries.

“This project is a great example of a hardware and software solution which is capable of automating manual processes and increasing the adoption of technology across the sector.”

### THE INSPIRATION

While many manual operations have been replaced by automation in manufacturing, critical processes such as finishing, sanding and polishing still rely on manual skilled labour which

can be expensive, slow, inconsistent and a production bottleneck. Product variability, in terms of size, shape and geometry, is also a major challenge.

Robotics offer a solution to many of these pain-points, but reprogramming is time-consuming and requires some level of expert knowledge, creating a barrier to wider adoption. It means companies continue deploying human resources on dull, dirty and dangerous tasks.

A3L, a robotic systems integrator focused on delivering automated finishing operations, and HAL Robotics, are on a mission to solve these challenges and increase adoption among manufacturers.

### THE INNOVATION

The project developed three core technological breakthroughs.

Firstly, HAL Robotics created an adaptive programming solution that allows operators with no robotics expertise to influence how a robotic system undertakes a task.

This involved developing two workflows for two use cases, finishing plastic domes and polishing metal car doors.

For parts with complex geometries, like domes, it simply requires an operator to input a set of parameters and the programme automatically generates a 3D CAD model of the part and the basic instructions for the robot. This can be scaled, depending on the geometric inputs, as well as altering process settings like the speed, force, number of cycles, etc.

For parts which require additional polishing based on a human operator’s visual inspection, such as car doors, the programme workflow incorporated digital image analysis which instructed the robot which areas to target.

The second innovation was through A3L’s development of an adaptable end effector - the device that attaches to the end of a robot’s arm - which is capable of dealing with shape change variation and conforms to complex surface geometry. Sensors measuring surface roughness and geometry feed back into a software solution to automatically generate any necessary corrective robot toolpaths to ensure a consistent and even process, and determine when it is complete.

These two technologies were integrated into an automated finishing and polishing robotic cell capable of measuring and reacting to the size, shape and requirements of the part to be processed, thereby making it self-programming and adapting.

The solution is currently being tested by a manufacturer of dome-shaped plastic parts.

The third breakthrough saw A3L begin developing a system which feeds digital images and sensor data into an AI model to determine the surface roughness of consumable abrasives like sandpaper.

### THE IMPACT

For HAL Robotics, the solution has resulted in huge reductions in programming time for finishing processes. A complex reprogramming task that would have taken up to a week to complete, now takes seconds. This not only unlocks massive productivity gains, but it democratises the deployment of robots into previously impracticable finishing processes.



Early results from the plastics manufacturer have been striking, replacing an existing manual process which took up to 10 working days to just 12 hours.

Successful testing on the polishing of car doors has demonstrated enormous potential productivity gains of programming a robot to polish areas identified, freeing up the human operator’s time to do higher value tasks.

Sebastian Andraos, Co-Founder and CEO of HAL Robotics, said: “This Made Smarter Innovation project has been game-changing for our company. We have developed and launched a new software solution, decode, which is not only being marketed for all finishing processes, but is now being adapted for a wide range of potential industry applications from welding and plasma cutting to icing cakes and inspection tasks.

“It has cemented our relationships with A3L and opened doors to new

partnerships, including robot OEMs, and potential investors.”

For A3L, the design and delivery of its highly adaptive tool has improved the company’s capability and knowledge of finishing processes and are now being applied to other R&D projects with potential application to other sectors.

Beyond the industry-ready results of the project, the R&D process has demonstrated clear areas for future focus such as the AI to improve the life of finishing consumables, reduce waste and optimising the efficiency of robotics.

Jim Heley, Director at A3L, said: “We want to grow and become the UK’s top automation specialist for finishing and polishing operations, and to compete internationally. This project has accelerated our journey towards that goal.”

