Robotic tool with learning capability in assembly

Starting point

Manufacturing companies already use a range of robotic systems – from gripping arms to lightweight robots – that automate factory processes and make the jobs of the people working on the assembly line easier. Each of these machines takes on strictly defined repetitive production steps, requiring complicated modifications whenever any changes are made, and they are therefore primarily suited for mass production from a financial perspective. They can only be used with the support of comprehensive expert knowledge. In the future, humans will direct robots in factories and, depending on current demand, teach them new skills during the production process. These robotic tools with learning capability will work safely hand-in-hand with the people on the assembly line.

Application scenario

Bandorf is a medium-sized family-owned company producing cable harnesses for the automotive industry. The cables vary in routing and length according to the different models and individual customer specifications, and have to be put together with a high level of precision. Intelligent robotic tools help the skilled staff to lay the cables on sizing tables, where the cable harnesses are meticulously assembled. The delicate tools adapt flexibly to work steps that change from one order to the next. As and when required, employees program the self-learning robotic tools manually themselves directly on-site by showing them the necessary processes.

Safe, diverse collaboration
Conventional robotic systems are designed, constructed, programmed and tested for specific tasks by trained specialists. This process typically takes several months and repeatedly incurs high costs that can often only be balanced by mass production. Robotic tools with learning capability, on the other hand, open the door to more flexible automation. They work reliably in collaboration with humans wherever they happen to be needed at the time. To achieve this, they adapt to the humans and their working environment, not the other way round as is generally the case today.

Learning from humans
To help the Bandorf workforce assemble the cable harnesses, robotic tools have to learn the work process and important intermediate steps such as tightening and pretensioning individual sections, among other things. The employees teach the robotic tools their tasks by "taking them by the hand" or demonstrating the individual work steps.

The machine learns independently

Every person has their own way of working and special routines. Self-learning robotic tools respond to this and adapt to their human colleagues. In this way, the intelligent robotic tools can learn specific sequences and techniques from the skilled staff, for example in laying the cable harnesses, and continuously and autonomously improve the skills they have acquired. The direct, expanded collaboration between humans and machines blurs the distinction between specific programming and independent learning. At the same time, tools that are networked can learn from each other, leading to faster learning processes thanks to shared experiences and skills.

Benefits

Automated goods transshipment offers a whole range of benefits:
- **Flexibility:** Small and medium-sized enterprises in particular benefit from tools with a multitude of uses that can learn new skills depending on what is currently needed.
- **New areas of application:** Using robotic tools makes it possible to manufacture new products and smaller batch sizes down to single pieces.
- **High-quality jobs:** In future, these tools will give rise to new, attractive areas of activity for staff in assembly and quality assurance, in addition to productive workplaces away from the production line.
- **Economic potential:** Cooperative robotic tools in assembly boost employees' productivity. Outsourcing to countries with cheap labour is no longer profitable.

Challenges

The following questions have to be addressed before companies can use robotic tools with learning capability in assembly operations:
- **Acceptance:** How can the economic benefits, flexible handling and competitive advantages be made clearer? How can employees' trust in this new kind of tool be built up?
- **Good working conditions:** How can the collaboration between humans and machines be designed in a way that is safe, reliable and manageable?
- **Security:** How can self-learning robotic systems be effectively protected from attack on e.g. the control systems, and how can data be protected from misuse?

What needs to be done?

The following steps need to be taken to ensure this application scenario can become a reality in a few years:
- Further research and development work in the fields of robotics, programming and machine learning
- Development of models for integrating robotic tools with learning capability into operational processes
- Training of production and management staff

The application scenario "Robotic tools" has been developed by the Future of Work and Human-Machine Interaction Working Group of Plattform Lernende Systeme.
You can find out more at: www.plattform-lernende-systeme.de