

Machine safety: From hardware to software

Author:

Frank Schmidt, Branch Manager Automotive,
K.A. Schmersal GmbH, 42279 Wuppertal

SCHMERSAL

Robot stations usually are guarded with safety fences to ensure the safety of man. The new concepts and innovations in this field however displace the safety functions from the hardware to the software, thus enabling a brand new way of collaboration between man and robot.

The extended hazardous areas in automated automobile production, especially in body construction plants, are guarded with spacious safety fences to separate man's work area from the robots'. The hazardous area however must be accessible for maintenance and cleaning activities. To this end, the safety fences are equipped with safety guards with interlocking devices.

Modular system to safeguard accessible hazardous areas

This safety equipment is often installed and fitted manually, quite a time-consuming and cost-in-effective tinkering job. That is why the Schmersal Group has developed the STS safety doorhandle system, a modular solution enabling an individual adjustment of the safety switching appliance to every safety guard (image 1).

The STS system is available with different types of solenoid interlocks and includes a doorhandle. This means that no further components such as handles or locking mechanisms are required. Optionally, the system can be equipped with a lockout tag preventing the unintentional locking of the safety guard and a centring device that can be used as end stop and for the proper centring of the safety guard – this increases the availability of the machine.

Entrapped – now what?

In actual practice, maintenance and cleaning staff frequently becomes unintentionally entrapped in the hazardous area on larger production lines.

In this situation, the station is ready for operation and constitutes a considerable hazard. Under normal circumstances, the operator cannot clear the hazardous area, unless the safety guard is equipped with a solenoid interlock with an "emergency handle" – a development from Schmersal. This emergency exit, which is included both in the modular STS system and the AZM 200 solenoid interlock (image 2), can be operated without further tools, thus enabling a quick evacuation of the hazardous area from inside.

When, on the contrary, quick interventions in the hazardous area are required to ensure the process safety, the STS system can be fitted with an emergency release. In this way, the safety guard can be opened without needing to follow the usual unlocking procedure.



Image 1: With the modular STS system, the access to robot workspaces can be individually configured.

Safety in system. Protection for man and machine.



Image 2: All-in-one: the integrated “emergency handle” of the AZM 200 enables unlocking the safety guard from inside, i.e. from within the hazardous area.

These standardcompliant functions increase the user’s flexibility and allow for a quick reaction in hazardous situations.

Additional safety in the field of control technology

The innovations in control technology increase the safety of the operating, maintenance and service staff in accessible hazardous areas. The SRB 100DR safety relay module (image 3) completes the SRB PROTECT program from Elan, an affiliated company of the Schmersal Group. The module ensures that the restart of the machine control is only possible after the operator has actuated a reset or restart switch inside the station, cleared the hazardous area and then actuated a second reset/restart button, located outside of the accessible area. After this double reset, the machine can be switched back on.

The virtual safety fence

The flexibility of the robot users would be even more increased, if no safety fence had to be used. This always has been a taboo in automated production; operators were explicitly instructed that their work space was strictly separated from the robots’ for safety reasons. This approach however is about to change, considering the first applications in which the function of safety fence is at least partially integrated in the robot control.

Self-controlling robot

The robot manufacturer Reis has integrated the ESALAN Safety Controller from Elan in his plants (image 4). The Safety Controller monitors all movements of the robot axes in space, i.e. the controller can also detect the interaction of multiple axes. In this way, the so-called Cartesian cams can be defined, for instance on jointed-arm robots, i.e. virtual work spaces with an arbitrary geometry, in which the movements of the robot axes or the robot tool are allowed.



Image 3: The new Protect-SRB 100DR safety relay module provides for additional safety at accessible machine areas.

As soon as the robot arm leaves the authorised work space, the machine is switched off. This is where the mechanical safety functions are displaced to the control, enabling self-control by the robot. The applied safety technology prevents the robot from leaving the zones defined in the control and therefore from jeopardising the operator (image 5).

The new safety control has dualchannel hard- and software and meets the requirements of control category 3 to DIN EN 954-1. It enables the installation of smaller and lighter safety fences or an optimal use of the available space, if the safety fence has to be maintained for specific reasons. The control furthermore requires no hardware components such as safety switches and cam controllers.

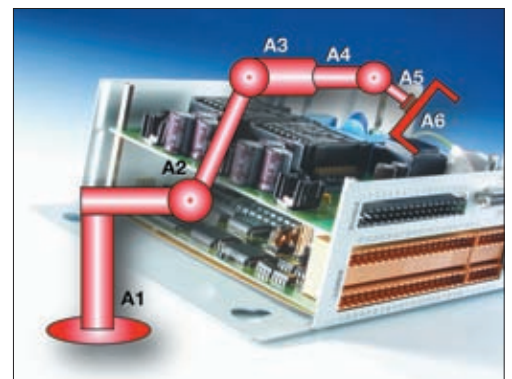


Image 4: Displacement of the safety technology into the controller – with the Safety Controller, collaborating with the conventional robot control and performing safety functions.

Safety in system. Protection for man and machine.

It is also possible to completely remove the safety fence, provided that an additional safety measure is taken. The Safety Controller indeed prevents the robot from leaving its workspace. However, to prevent the operator from penetrating in the robot's workspace, the "Safe Production" mode should be used, where the robot works at reduced speed in defined areas.

New ways of collaboration

In this way, man has direct access to the robot's workspace without interruption of the production process. This is useful, for instance when the robot needs to be programmed: the operator can directly observe the process. The new safety control also offers new opportunities for the collaboration, where the advantages of both partners, i.e. the intelligence and flexibility of man and the inexhaustible power of the robot, come to full bloom. For instance, the robot can hold a part, which is processed by man (image 6). Or the operator can directly supervise an automated process.



Image 6: No longer a utopian dream: man and robot are working "hand in hand"

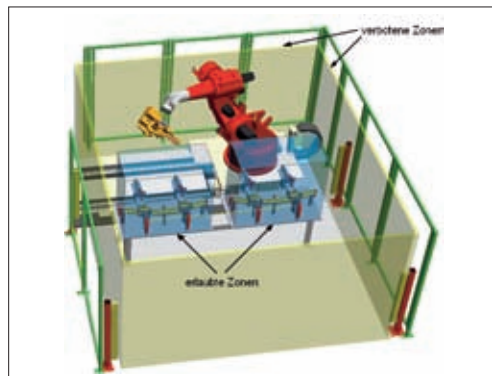


Image 5: With the Safety Controller, so-called Cartesian protection areas can be programmed, which the robot must not leave.

Huge market potential for teamwork between man and robot

As production experts forecast a large potential for this kind of "teamwork", a number of research projects were set up to investigate the possibilities. In the "Assistor" project for instance, sustained by Elan, Reis and the Fraunhofer Institut IPA, the robot is turned into a production assistant, which directly – i.e. without safety fence inbetween them – lends a helping hand to man. The practical experience acquired so far in this project is very promising.

Goodbye good old safety fence?

Although the displacement of the safety functions from the hardware into the software opens many perspectives to automated production, it is unlikely not that virtual safety fence will completely replace the actual fencing. The robot with "production assistant" qualification is rather suitable for assembly processes, quality control or the production of small series in automobile industry, whereas the fully automated production, i.e. in bodywork construction, will continue using the safety fence with secured access. That is why the new safety switching appliances, which will be presented, amongst others, at the Hanover Fair, are highly interesting for robot users.

Copyright:

1-2 K.A.Schmersal GmbH, Wuppertal;
3 Elan Schaltelemente GmbH&Co.KG, Wetzlar;
4-5 Reis Robotics, Obernburg

Author:

Frank Schmidt, Branchenmanager Automotive
K.A. Schmersal GmbH, 42279 Wuppertal

Note:

Die Erstveröffentlichung des Fachbeitrags war in der Fachzeitschrift „Der Konstrukteur, Heft Mai 06“ zu lesen. Mit freundlicher Genehmigung der Schriftleitung und der Autoren.

Safety in system. Protection for man and machine.

K. A. Schmersal GmbH
Industrielle Sicherheitssysteme
Postfach 24 02 63, 42232 Wuppertal
Mödinghofe 30, 42279 Wuppertal

Telefon: +49-(0) 2 02-64 74-0
Telefax: +49-(0) 2 02-64 74-1 00
E-Mail: info@schmersal.de
Internet: http://www.schmersal.com