IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Strengthening OSH knowledge and innovation as a driver of EU smart growth

Innovative safety components according to the new Machinery Directive

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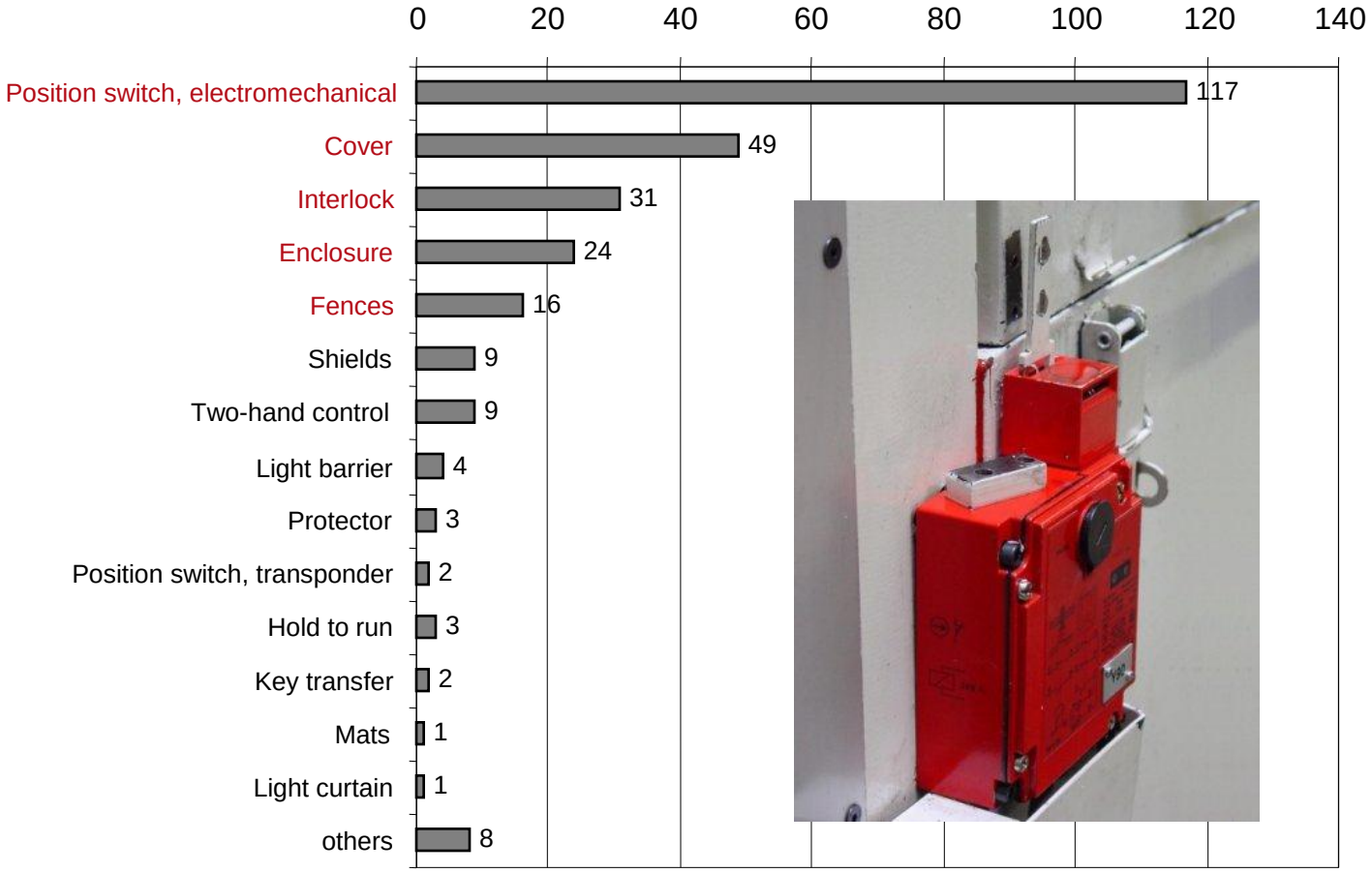
Overview

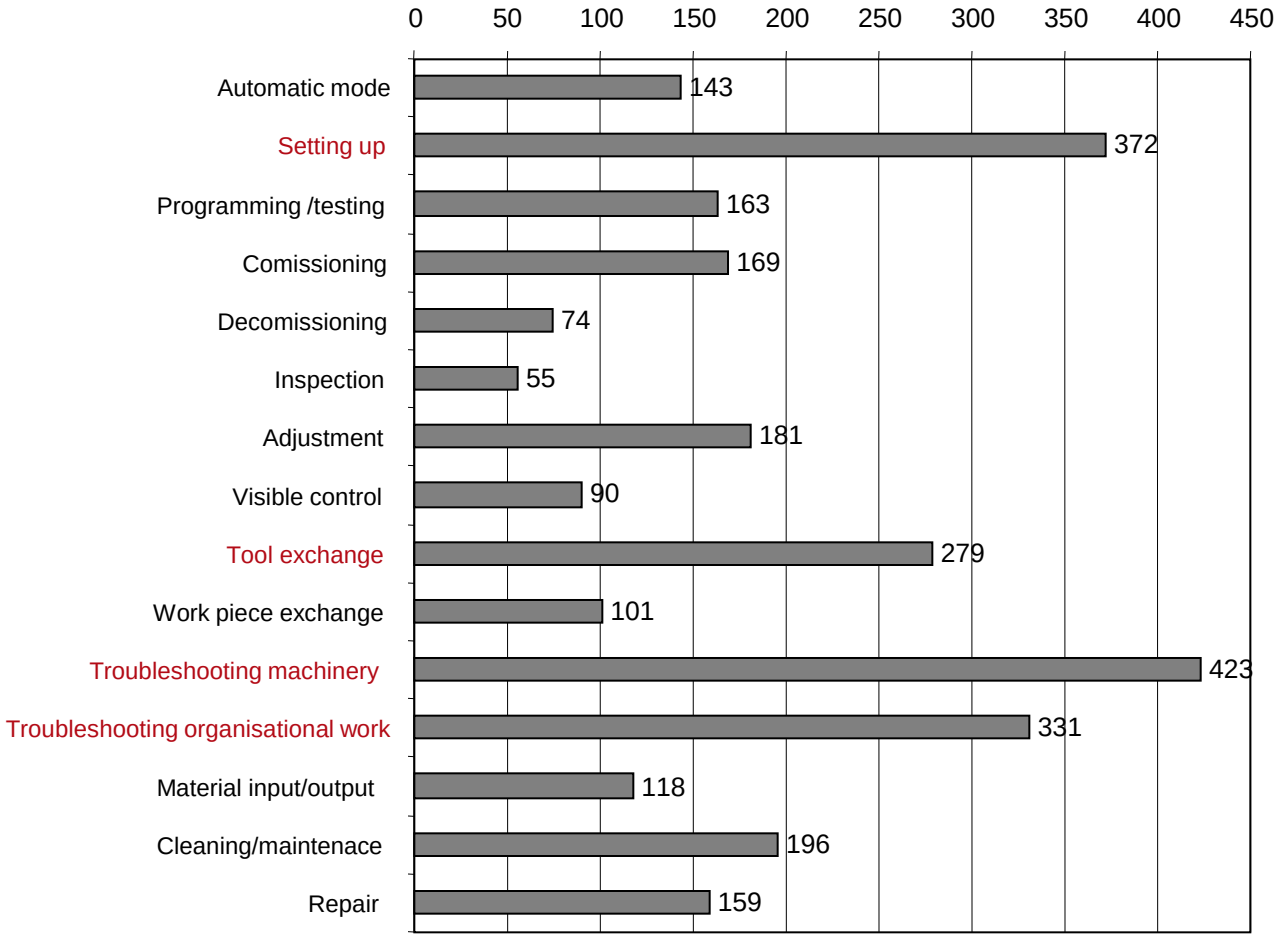
- Machinery 30 years ago: Separation of man and machine
- Developments of the last 10 years: Functional Safety
- Intelligent Sensors and control techniques point into the future
- Examples of new developments
- Consequences

Separation by movable guards

Why we need a better integration of safety



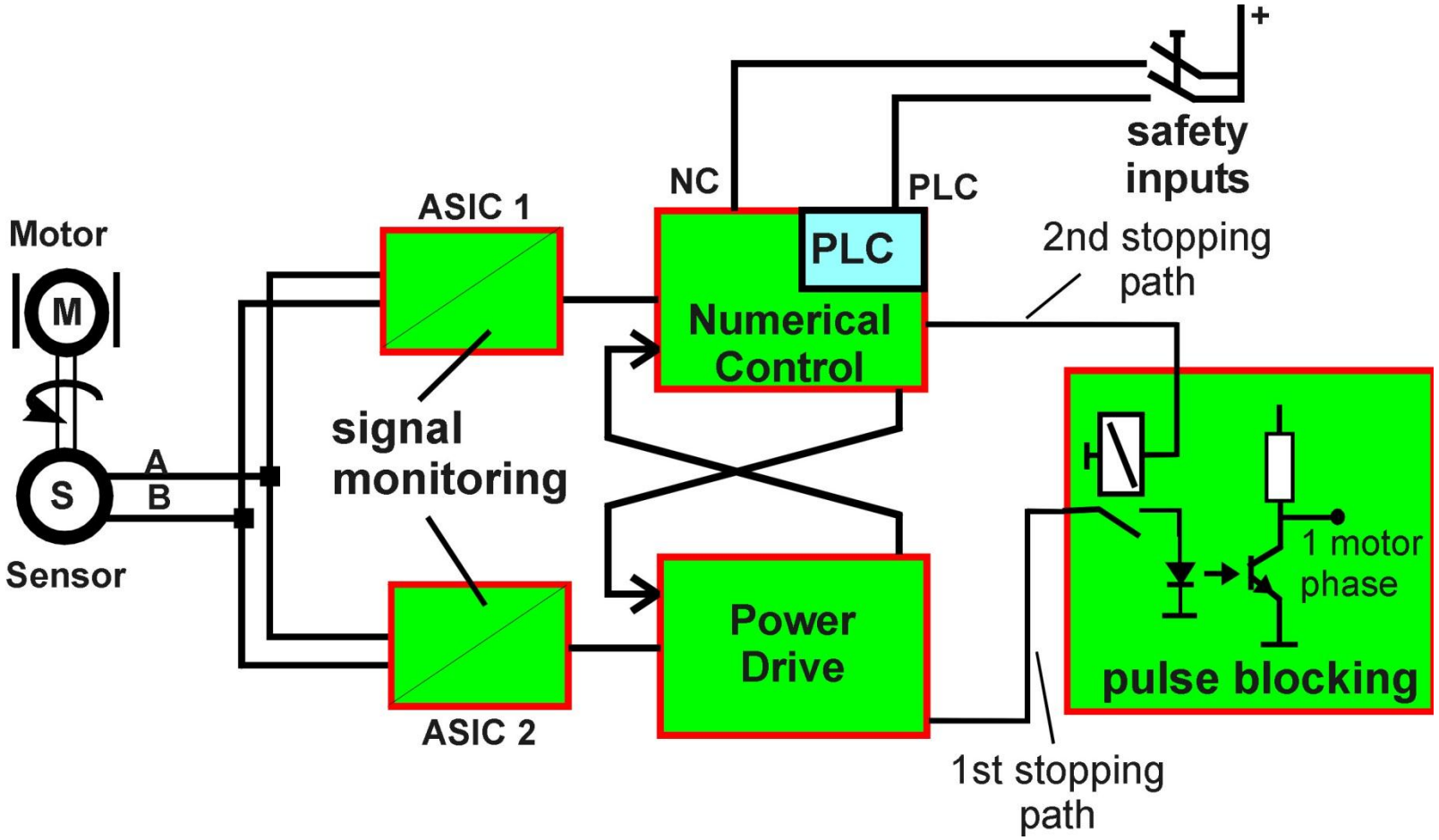
Where we need a better integration of safety



Integrated Safety Systems for cooperative MMI

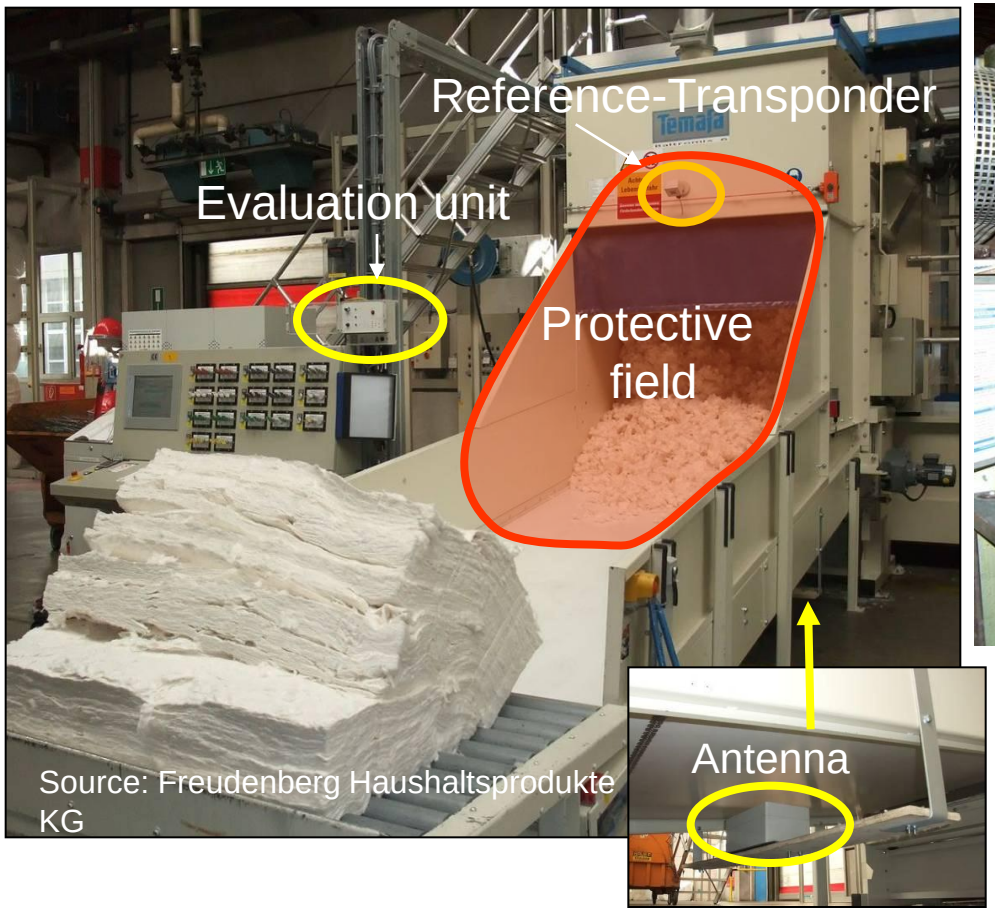
- **Safe Stopping Process**
  fastest stopping process to shutdown all movements
- **Safe Standstill**
  no unexpected movements are possible
- **Safe Operational Stop**
  the complete powertrain is under computer control and monitoring of unexpected movements is active by safe E/E/PES
- **Safely Reduced Speed**
  Monitoring of a movement of maximum acceptable speed by safe E/E/PES
- **Safely Limited (Absolute) Position**
  Monitoring of maximum acceptable positions by safe E/E/PES

Control systems with better integration of safety

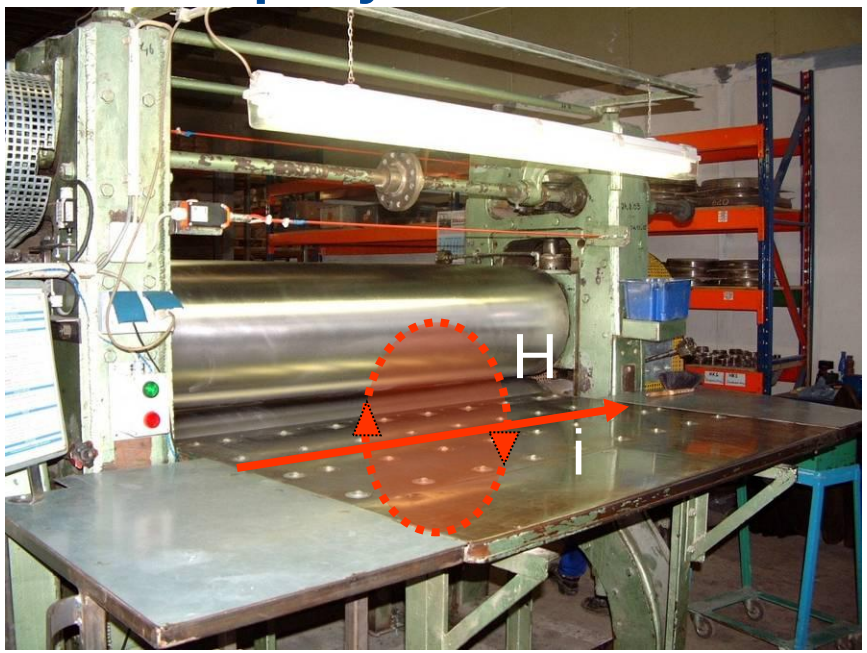


Intelligent systems improve integration of safety

New protective devices by Radio Frequency Identification Devices (RFID) – produced by a small company



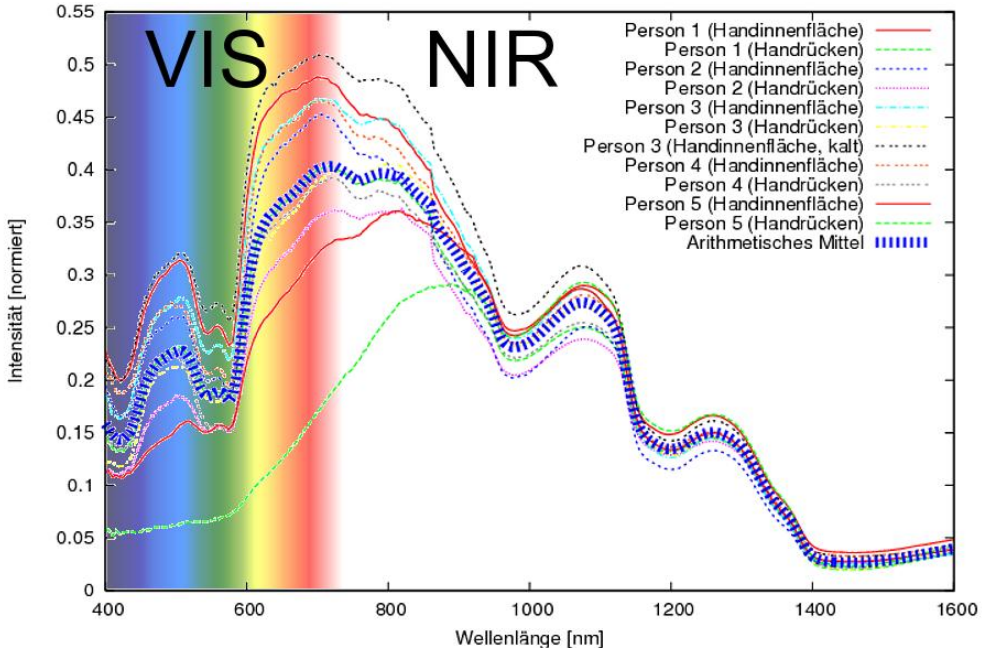
Source: Freudenberg Haushaltsprodukte KG

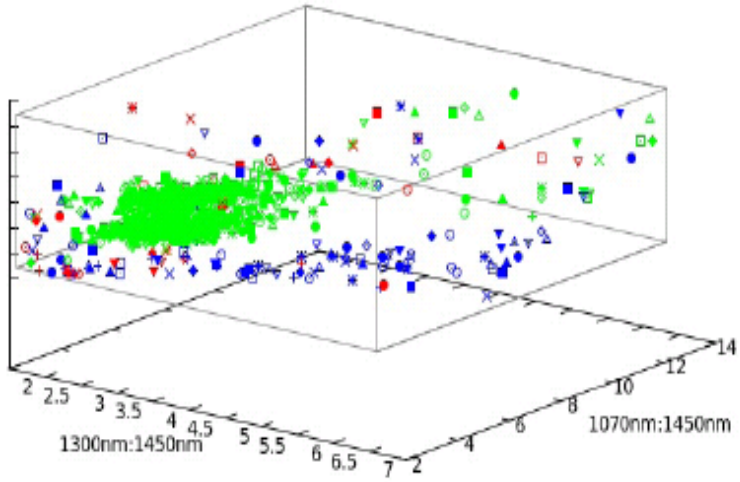


Source: Fa. BURKA KOSMOS

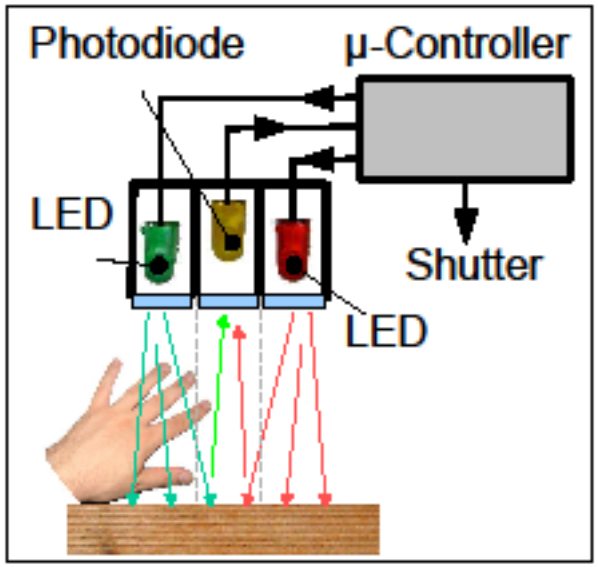
Principle:
A current induced circular magnetic field created by a single conducter (below the table)

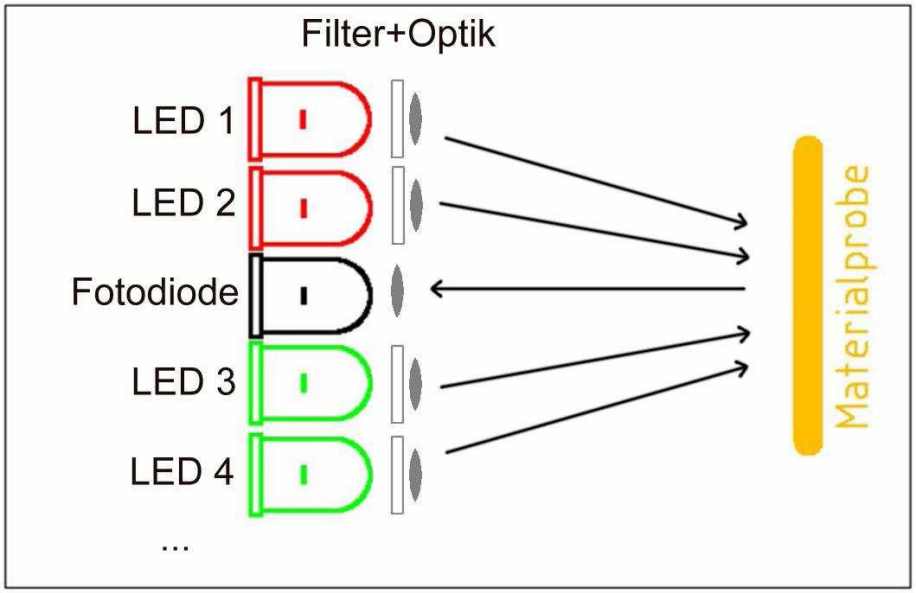
Spectral Signature of human skin





Hand recognition in the near infra-red



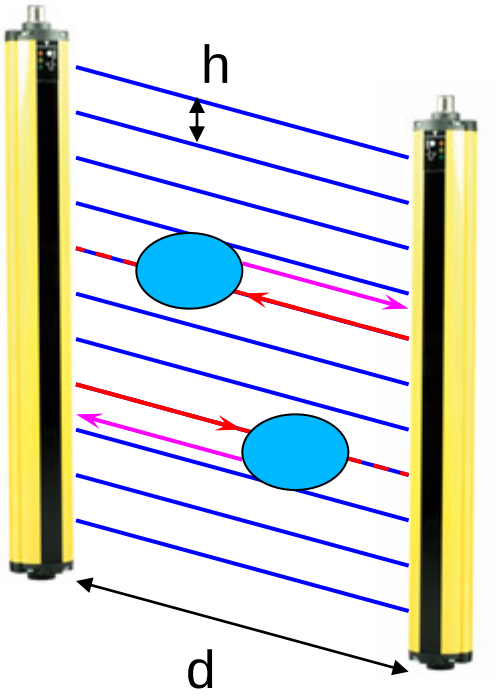


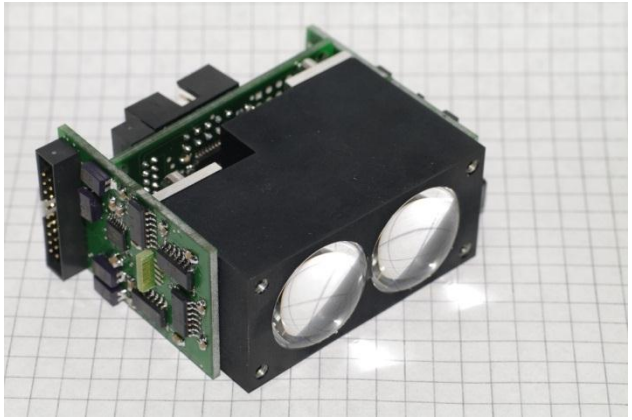
- We achieve: simple and practical Detection- und Classification-Principle by spectroscopic means
- Reliable, skin-type independant, robust, cheap, fast

No gloves when using a drilling machine!!!

- At a German car manufacturer a worker lost his hand when using a drilling machine with gloves.
- We converted the drilling machine with the new sensors, so it could only be started without gloves.
- We used a Triple-LED in the NIR with ATMEL-Controller for hand recognition.
- We realized a start interlock
- The new push button is in production by a well-known producer of safety switches

Here is the commercially usable result



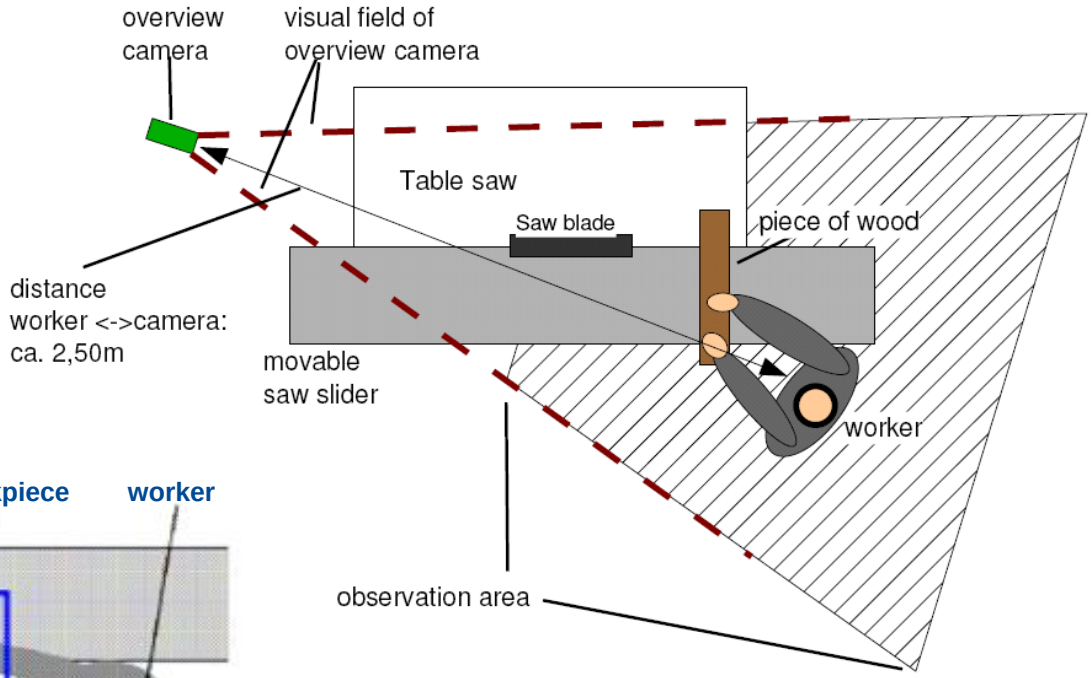


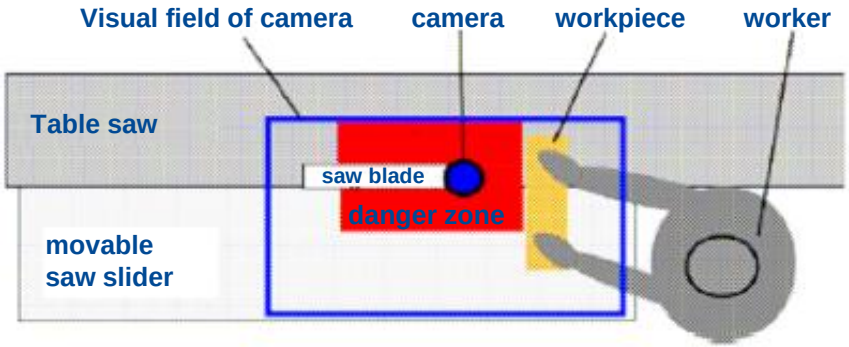
Active Research-Project „**Spectral Light Curtains**“

- Aim: Supplement of commercial Light Curtains
- max. distance: d=1m (up to 1,8m possible)
- spacing h=2,5cm; beam diameter ∅=1cm
- measurement time < 10ms
- also to discriminate: Gloves/Workpiece
- funded by NRW and EU

Person- and Hand-Recognition by Cameras

- coarse-to-fine strategy with camera and hand camera





Person- and Hand-Recognition by Cameras

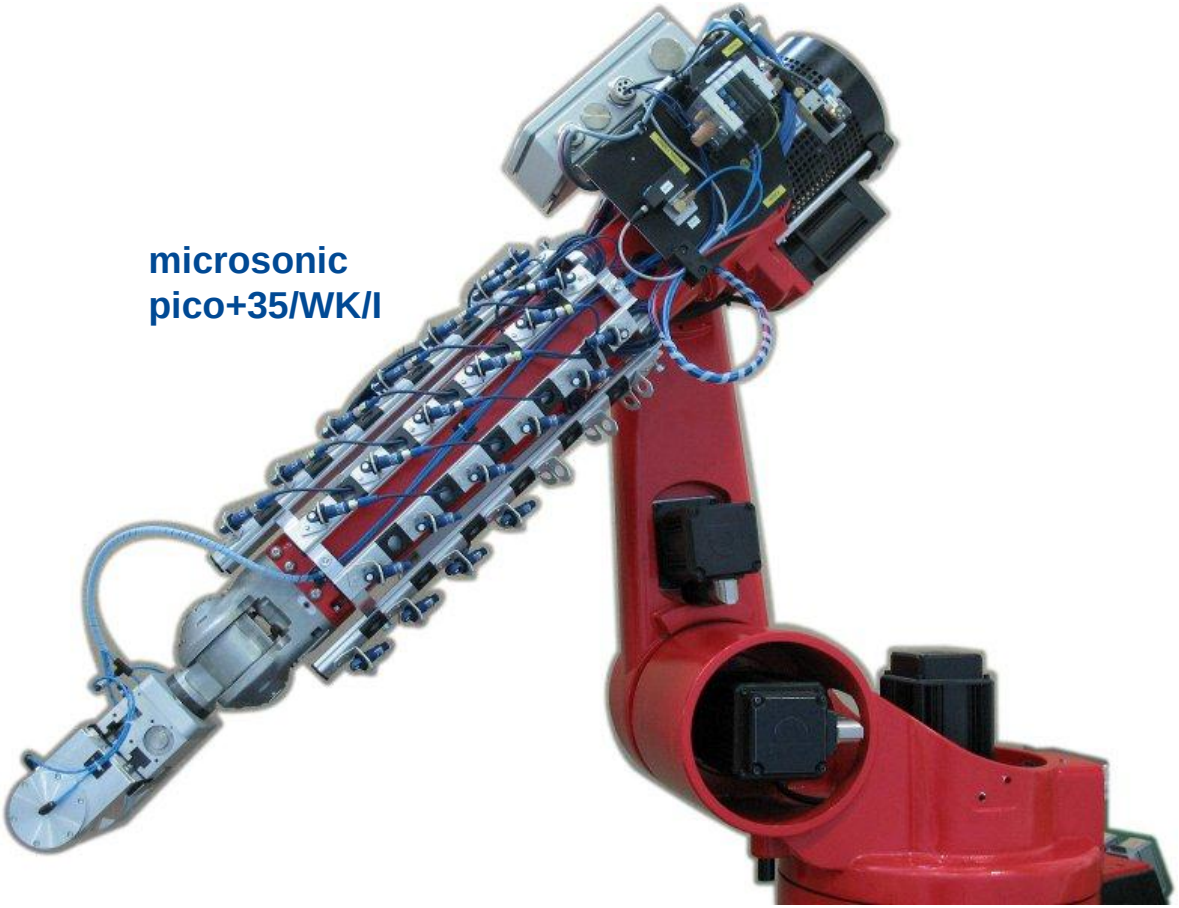
Design

- Initial detection of head-shoulder-region by edge information
- Foreground/background segmentation by alpha-blending
- Combination of different colour spaces (RGB, YCbCr, HSV) for face detection
- Face classification using Gabor wavelet representations of known faces
- Motion-tracking of detected faces
- Training by machine learning algorithm AdaBoost based on haar-like features
- Hand-tracking by CAMSHIFT-approach

Results

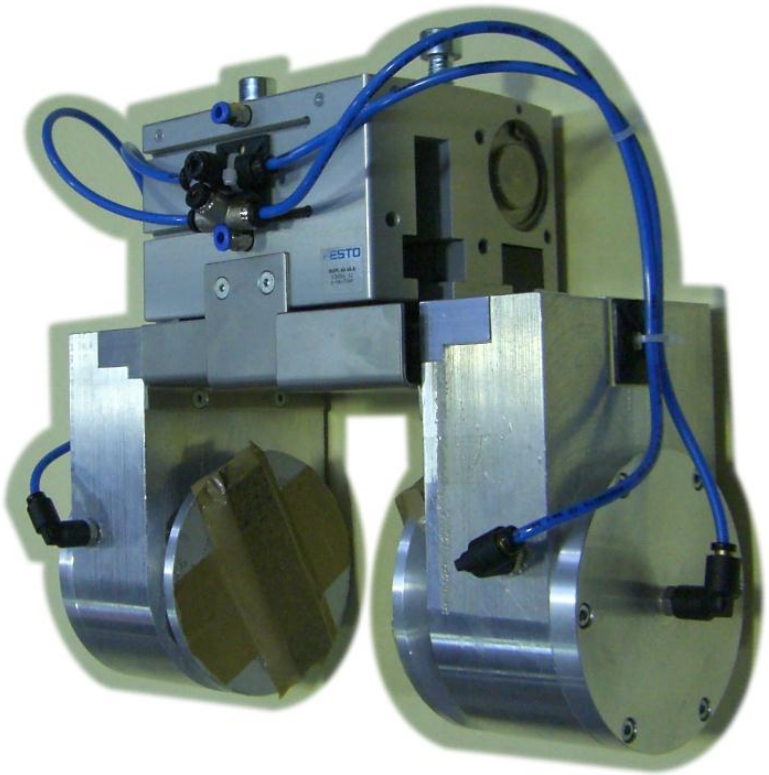
- Person-recognition with tracking, inhomogeneous background and changing illumination:
  - Safety $5 * 10^{-3}$
  - Availability 0.96
- Hand-recognition with workpiece and changing illumination:
  - Safety $4 * 10^{-2}$
  - Availability 0.98

Placement of ultrasonic sensor arrays for robots



Safe manipulator of the new robots

- No electrical components
- Automatic recognition of unparallel planes
- Pneumatic reduction of gripping force, below the risk of harm
- Fitting to unparallel material by adapters
- Patent pending



Consequences

- The more we integrate safety into the process, the more it will be accepted by the user.
- Integration means to integrate safety technology into the production process with safe protection devices and safe control systems.
- As a consequence safety technology becomes more complex, within the design and by using it (complex installation procedures).
- Investigations for usability will become more and more important.
- The user has to be integrated into the design process of machinery.
- The new slogan is: „Human Integrated Manufacturing“.

Thank you
for your attention

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