Image Processing/Optical Measurement

Image Processing, OCR and Optical Measurement
for Heavy Industries

LogoTek

Image Processing and Optical Measurement

LogoTek supplies computer vision and scanner based systems for measurement tasks and machine control. LogoTek also develops OCR solutions for the identification of steel products, e.g. heavy plates, billets and slabs. LogoTek image processing systems are developed for extreme environmental conditions in heavy industries. Components are selected for robustness against vibrations and dirt. If necessary, they are equipped with cooling mechanisms. LogoTek software components include programs for image processing / plain text reading, visualization and the control of peripheral devices (scanners, sensors and illumination). LogoTek has broad project experience in following application fields:

- Character recognition (OCR) of paint marked blooms, slabs, heavy plates and coils

- Character recognition of stamped billets and slabs

- Dimensional measurement of material surfaces with cameras for machine control and positioning of tools

- Measurement of slabs and billets with scanners

- Detection of number and volume of slabs and blooms with high reliability

- Luminance measurement of displays with calibrated cameras

- Infrared camera applications

Identification of Paint Marked Codes

Reading of paint marked text from steel materials has achieved high quality. Using adequate image processing algorithms, even almost illegible codes can be identified reliably. In most cases, advanced machine learning methodology with a dedicated training on the customer's symbol set is needed. Also, well adapted illumination is crucial. By querying a database of valid material identifiers to check the reading results, an additional improvement of identification rates up to almost 100% is feasible. Systems are realized to identify coils, blooms, heavy plates and slabs.

### Machine Control / Determination of Stamping Position

Machine control based on image processing/computer vision allows applications that could not be realized with classical sensor equipment. An application example is to mark billets with digital stamping machines. As this is an additional stamping that shall not interfere with the already stamped heat number, LogoTek developed an image processing system for finding the optimal stamping position. The billet is illuminated using bright HQL-lamps. An image of the scene is taken and the billet coordinates in the scene are determined. Finally, the best stamping position is calculated. The system is tolerant against variations in surface texture and illumination conditions. It reaches a very high reliability.

Identification of Stamped Heat Numbers

The identification of billets, in particular knowing charge numbers, is of great importance for quality assurance in production. Hot stamping of material IDs is a very robust marking technique. On the other hand, hot stamped markings are hard to read for an automatic identification system. Most notably, the billets' rough surfaces and varying illumination pose problems. LogoTek implemented a billet identification system which can be mounted to roller tables. The system permits the reliable identification of passing billets. The system includes cameras, material sensors, illumination equipment, an illumination controller, and specially developed image processing software.

Measurement of Displays / Photogrammetric Survey

Photogrammetric survey is an integral part of the manufacturing of LED and LCD displays. Especially luminance and uniformity need to be checked. This is a process that can be performed with calibrated cameras. For a manufacturer of HMI units and operating panels for avionic applications LogoTek developed a system for the semi-automatic calibration measurement of LED displays. A customized control unit was made that can generate various test pictures in different luminosity ranges. The calibrated camera takes pictures and calculates the luminosity of the displays. The result of the check is stored in a database and can be used to print out test protocols.
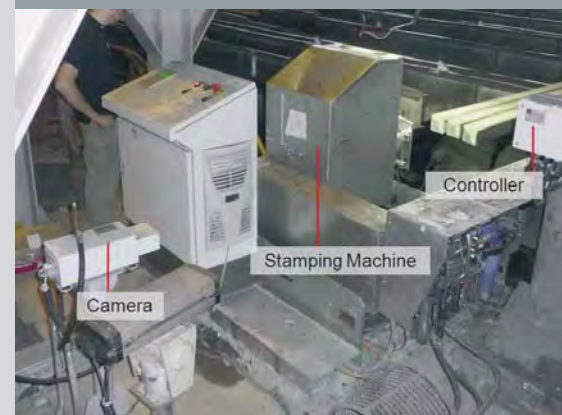
Dimension Measurement of Slabs and Blooms

The accurate measurement of slab dimension and profile is necessary to improve the quality of the manufacturing process. This task can be solved with the help of laser scanners and laser distance sensors. Depending on the material temperature laser devices of class 1 (infrared light) or class 2 and 3 (650nm red light) are used. Especially after continuous casting the environmental requirements are very hard, and special protection housings with air or water cooling are a must.

## Detection of Load Changes and Number of Material Pieces

Automatic detection of crane load pick up for purposes of automatic material monitoring requires high quality sensors. Especially if multiple slabs or billets are carried at the same time, dynamic effects of load pick up (swinging of the load) are a challenge. LogoTek has developed a system that is able to count the number of billets picked up by a crane. This is based on laser scanner technology. Two scanners, one on each side of the lifting beam automatically assess the volume of picked up material and (using knowledge about a billet's size) compute the number of billets from this. The data processing is done on an industrial PC inside the crane cab. This PC is also used for the visualization of the warehouse / storage yard. The system operates highly reliable in several cranes that are used for billet transport.

Measurement of Steel Slab Positions

The location of objects in the 3D world can be measured with laser scanners. A German steel mill for example needed exact measurement of slab positions. The data are fed into a warehouse management system. LogoTek solved the task by installing laser scanners on the cranes. The floor profile beneath the crane is scanned, LogoTek-developed analysis software computes the outline coordinates of the slabs and sends them to the warehouse management system. The scanner is controlled by an embedded PC running under the Windows XP operating system. The scanner software includes functionality for continuously monitoring system health. Operational states and diagnostic information (e.g. about dirt contamination of the scanner) are logged to files.

Infrared Camera Applications

Infrared cameras are suitable for the contactless detection of temperature, the localizing of temperature leakages in furnaces and the monitoring of ladle temperature. LogoTek has realized a system for the monitoring of the heavy plate temperature on a cooling bed. Also for the isolation check of furnaces an infrared camera was used.
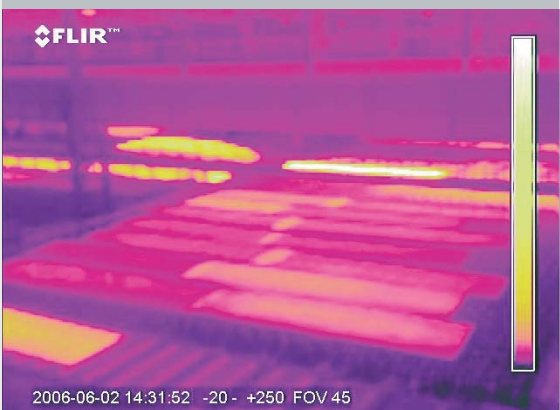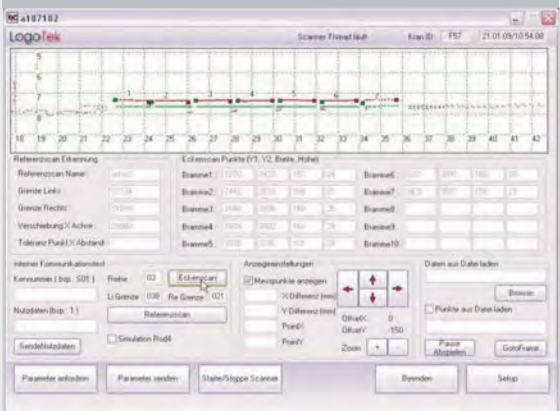
Basis of the development work of image processing projects is the LogoTek Image Processing Application Framework IPA. The IPA is a software library for the simple development of image processing applications for the steel industry. It is based on the image processing standard tools HALCON and is using a user friendly interface pro-grammed in C++. The visually attractive user interface incorporates functions for visualization, parameterization, archiving and communi-cation. A client software with database connection can be provided to realize client-server applications (IPA-HMI) and training of characters.
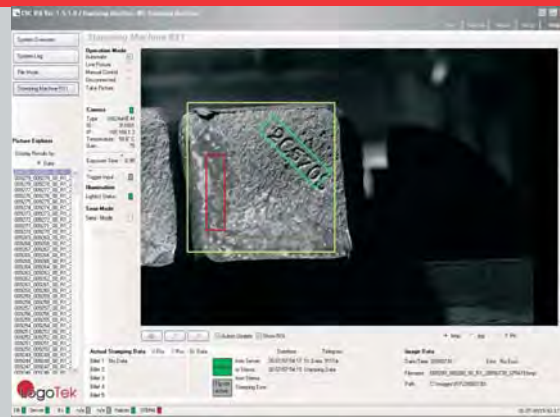
Technical Data

Functional Overview

Applications	OCR
	Optical measurement (camera based)
	Optical measurement (2D scanner based)
	Machine control applications
Functions	Image processing
	Camera-/Scanner control
	Illumination control
	Parameterization
	Visualization
	Status monitoring
	Archiving
	Plausibility check (with database)
	Communication with Level 1/2 systems
Developed in	HALCON / C++
Extensions	IPA-SERVER, IPA-HMI

OCR

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Character types	Paint marked identifications
	Stamped codes
Features	OCR based on a neural classificator. Individual character training and plau-sibility check allows reading rates near to 100%

Interfaces

Ethernet/TCP/IP	Telegram communication with layer 2/3 computers Exchange of identification results, status information and others
ODBC	Database interface for communication with warehouse management and material tracking systems Connection to Oracle, SQL-Server and Access-databases
OPC	Interface to automation systems for machine control (PLC connection via OPC and Ethernet)
RS232/RS422	9.6 kB ... 460.8 kB, ASCII-telegram exchange

Archiving/Logging

Archiving	Image data in adjustable file folders. Database entries for processed images.
Logging	ASCII-files with status information. Telegram logging

In larger material tracking systems the IPA can be extended by the database server application **IPA-SERVER** and by various HMI-Stations (**IPA-HMI**) connected to this server. The **IPA-HMI** is a database client application that is using image data and database contents stored on the database server.
The IPA-HMI incorporates functions for visualization of processing and recognition results, for status monitoring and protocol print. An inte-grated user management allows the individual adaptation to different user groups. Thus some display masks are only available for users with appropriate access rights.

The **IPA-SERVER** application coordinates the data transfer between IPA-Stations, Server and HMI. With this software also the data trans-fer to level 2/3 host computers is organized. The server application is running as a resident program on the database server. A graphical user interface allows monitoring and communication tests in an easy way. Supported are SQL-servers and Oracle.
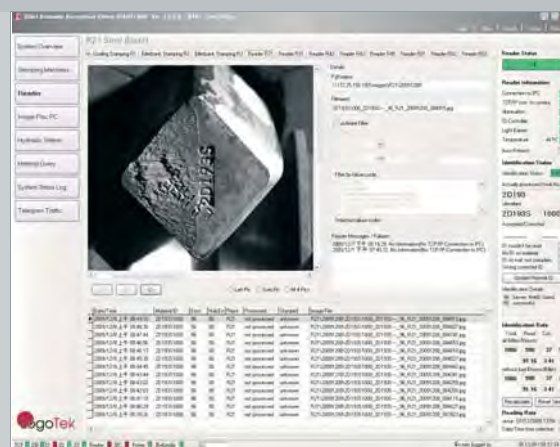
IPA-HMI

Components for Image Processing

As part of image processing systems, LogoTek supplies various accessories for cameras and illumination:

Cameras
All cameras used by LogoTek are extremely robust and well proofed in several projects under harsh environmental conditions. Cameras manufactured by IDS are preferably used.

Lenses
LogoTek supplies of lenses of various manufacturers, including filters and lens controllers.

Illumination
The LogoTek delivery scope includes HQL or LED illumination and flash lights in robust metal housings. For extreme environments (e.g. for applications near molten metal) the illumination has own cooling devices.

Electrical cabinets
For image processing applications in the heavy industries robust protection housings are needed. These cabinets include cameras, industrial PCs, illumination controllers and network components.

Camera Housings
A wide variety of camera housings is available for all kinds of applications. This includes camera housings with air purge and Vortex cooler for reliable operation in environments of up to 100°C.

More accessories on request

Located in the south of Germany, LogoTek develops innovative systems for the automation of industrial processes. LogoTek is specialized in logistic systems that allow a material tracking based on identification technology. An important component of these systems are image processing solutions for OCR and optical measurement.

Illumination/flash lights

Dust protection / Vortex cooler

Swivel heads

Camera protection housing with Vortex cooler and dust protection

Lenses