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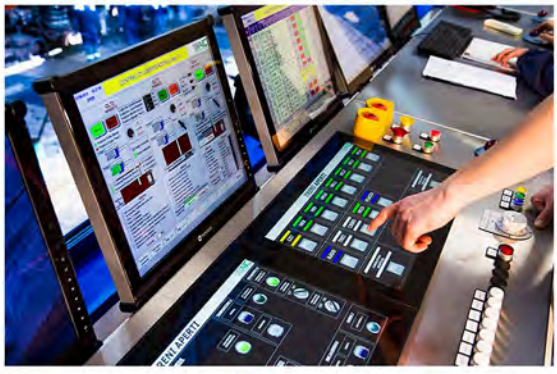

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Robotic Tagging Applications

Author

Antonio Ambra
business development manager,
AIC North America Corp.,
New York, N.Y., USA
antonio.ambra@aicnet.it

Robotic tagging applications can be utilized to reduce manpower costs and improve the safety and quality of final end products. This paper presents an overview of the available technologies, such as vision systems, artificial intelligence and robotics.

This paper presents an automation solution to automatically tag bundles of profiles, sections and rebars in long product rolling mills. The main benefits of the system are increased safety and productivity, cost reduction, efficient and consistent utilization of the equipment, and a full finished product tracking system on-site with the automatic printing of tags.

The topics discussed in this paper are:

- Layout of the robotic island.
- 3D vision system.
- Material tracking.
- Solutions for billet/bundles/coils tagging.

Discussion

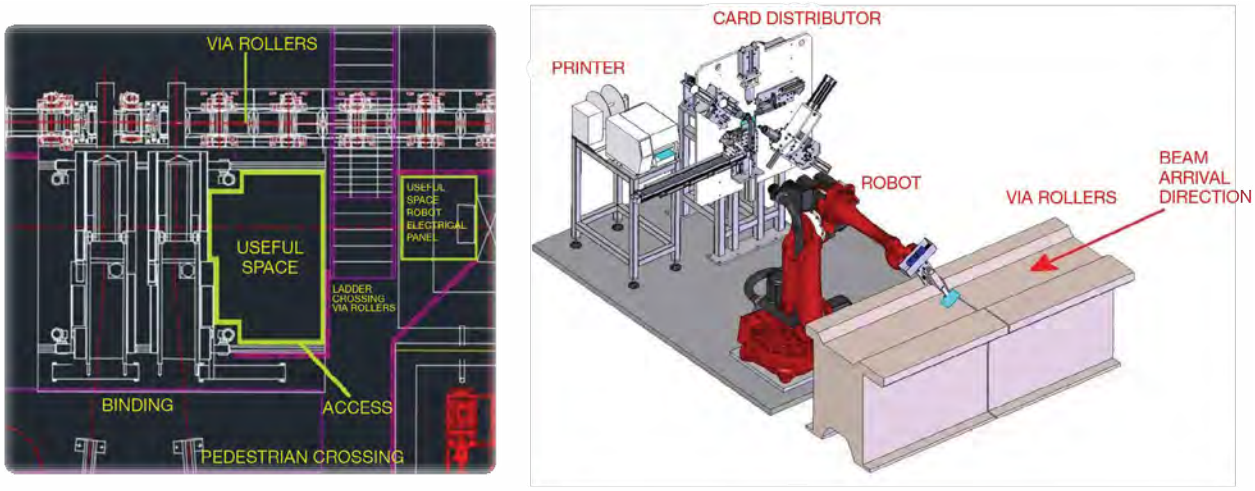
Manual tagging of semi-finished or finished products always leads to errors while identifying the right piece to be tagged. Material tracking, if not directly bound to devices that can automatically tag products, is limited to an approximate identification of pieces without feedback from production plants. That's where the necessity of an accurate automatic tagging system is required. Automatic tagging systems directly connected to material tracking in the plant completely eliminate the percentage of error in mixing heat numbers at the production plant. An automatic tagging system is required as well to keep operators away from difficult positions and tasks, such as tagging material at high temperatures or where cranes are handling heavy products. Eliminating these tasks contributes to having more skilled personnel who are involved in maintenance of systems and not only for operations. A manual tagging island from data collected from plants typically brings an average of 5% bundles not tagged or tagged with the wrong tag, measured on an average of 600 bundles per working shift. This means an average of 30 bundles missing or tagged wrong per shift, measured at the stock area, when manual tagging is performed.

An automatic tagging island is mainly composed of an anthropomorphic robot 6-axis, a 3D vision system installed on the robot wrist, a set of printers for the identifying tags, a machine to create or distribute the tags, a welding machine, and an electrical panel that commands

Figure 1

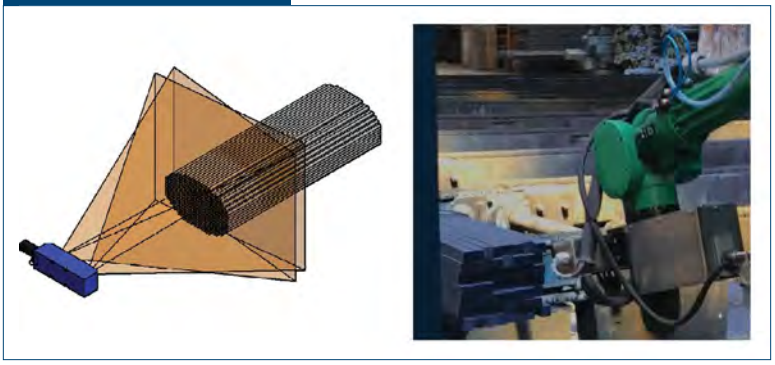
Manual tagging area. All tags are pre-printed; a percentage of human error is present.

Figure 2



Typical area necessary for the island installation and its engineering.

Figure 3

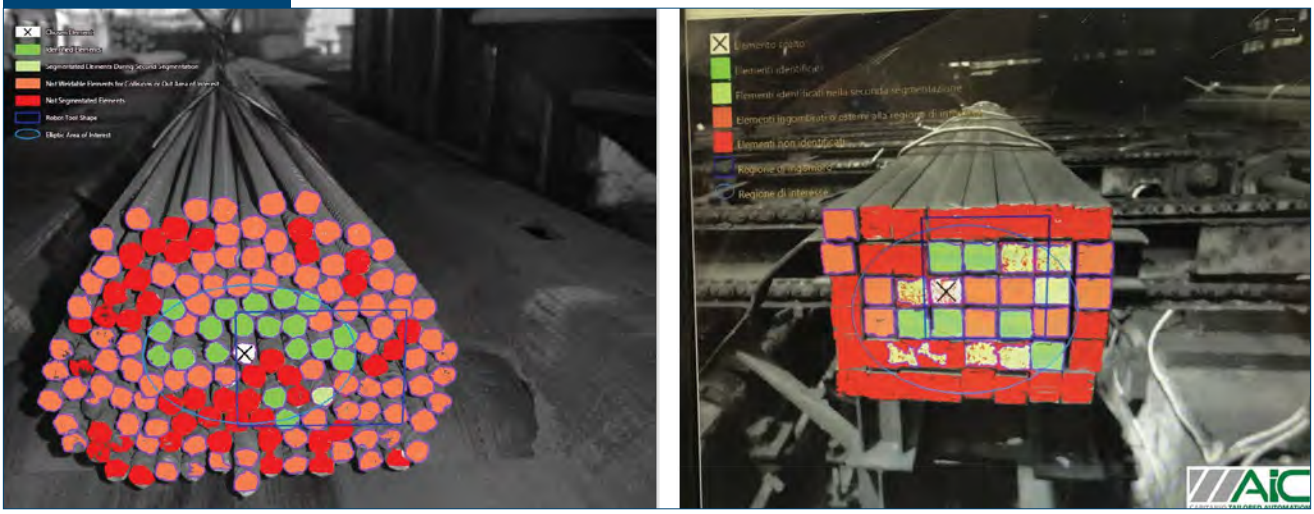


3D vision system during acquisition.

the complete island and includes the relevant human-machine interfaces (HMIs) for diagnostics and alarms. The island is installed in limited space on-site and completely contained in an industrial container properly designed and engineered to include all the machines in a conditioned and protected area.

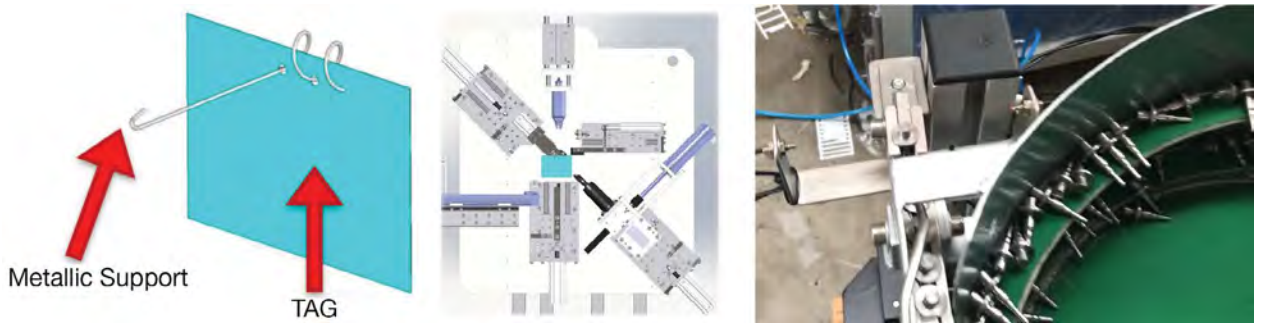
Anthropomorphic robots are well-proven devices and can be inserted in several different applications in the steel industry. "Foundry" models are specifically designed

Figure 4



Examples of results of 3D vision system. Key: White with black cross = chosen item to tag; Green/yellow = alternative sites; Orange = suitable but with limitations; Red = unsuitable; Blue square = region of obstruction; Blue circle = region of interest.

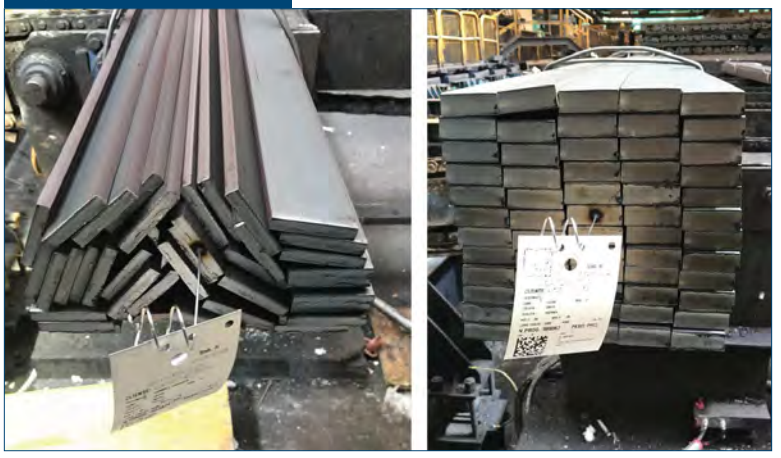
Figure 5



Metallic support, machine for metallic support, stud dispenser.

to work in harsh environments and are versatile for different applications. The 3D vision system adopted by AIC is a double-camera vision system without using a laser beam, specifically engineered for harsh environments. With this system there is no need to "scan" the product in order to create the cloud of 3D points. A simple acquisition, similar to a picture, is enough in order to recreate the 3D profile of the product. The sensor used is a matrix sensor and not a profilometry. In this way no special movements of the robot are needed to finalize the material scan, only positioning the bundle on the conveyor is required. Scanning time is about 1.2 seconds and thanks to this timing the robotic island works in plant with a production of up to 180 tph. The 3D vision system can automatically detect the kind of product without any specific setting thanks to advanced analysis algorithms.

Figure 6



Metallic support on bundles.

Printers installed inside the tagging island are thermal transfer printers designed with an external tag charger to handle up to 10,000 tags, able to cover one full week of production without the need of replacing the tags and ribbon. Tags can be applied using a metallic support built inside the island by a specially engineered machine or can be applied by the use of a stud. Metallic support is used to keep the printed tag far away from the head of the bundle in case the application is done

Figure 7

(a) (b)

Stud application (a) and tag with stud on bundles (b).

when material temperatures are still high. Studs are used when the application is done on relatively cold material where it's not a problem to keep the printed tag to minimum distance between the head of the bundle and the tag itself; for this purpose a welding machine is used.

Conclusions

A material tracking system directly connected to an automatic tagging system assures the tagging of each product with the right identification data, improving traceability of the finished product. Connection to the database makes the traceability complete, following the product in the production sequence until the end user. Automatic tagging reduces the number of bundles not tagged to 0.2% of the produced bundles, measured on a shift production of 600 bundles, which means one bundle not tagged per shift as an average. Measures have been taken on a rebar rolling mill plant where the robotic tagging application is running at 180 tph with a cycle time of 8 seconds, where the bundle is stopped on conveyor for tagging; 1.2 seconds is the timing dedicated to 3D scanning of the bundle. ✦

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