3D laser profilometry combined with machine learning for tracking purposes and quality check of metal objects

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Non-Destructive Testing (NDT) is generally necessary for objects where defects emerge over the time due to wear and tear and where their use on the market is stipulated by their ability to pass periodic examinations required by law. Gas cylinders fall under this category, however gas cylinders re-testing is not only about NDT: it is also the creation of track records which allow to monitor and update essential information during each cylinder lifespan (e.g. re-testing dates and centers, markets etc.). For this reason, gas cylinders re-testing is often associated to tedious paperwork. Thanks to our new automatic line, we make this process digital and completely paperless: while a wide range of sensors acquires and stores the necessary information in our platform, our software approves the compliance according to a set of user-defined parameters and current regulations. The core of the machine is a combination of Ultrasonic Testing (UT) and Machine Vision (MV) able to perform examinations and quality checks, while the result of the whole process is a pallet of ready-to-use cylinders with a new engraved conformity mark. Each inspected gas cylinder is traced during its whole life cycle through the data engraved on its shoulder: this information is read, interpreted and digitally stored in combination with all the other data collected during any re-testing process. Physically, this is possible thanks to the use of 3D smart laser sensors placed in different locations of the line: two sensors acquire a high resolution profile of the cylinder shoulder at the entrance and at the exit of the line, while a third one provides profile data needed to look for a free space where the machine engraves a new conformity mark once all the quality checks, UT Included, have been successfully passed. Acquired data profiles are automatically combined by the sensors themselves into 3D surface images and then, through GenICam interface, sent and elaborated in our software: firstly, a set of advanced mathematical filters rectifies the surface curvature and segments the characters from the background, afterwards, a pre-trained Neural Network and a specific combined syntax and lexicon convert those character shapes into ASCII values and probabilities (OCR). Previous machines for gas cylinder testing weren't actually fully automated: one or more users were constantly required for data entry, small handling and merging output data between different testing systems. Today, with our solution, the conformity assessment becomes completely automated, with a double benefit on productivity and human work: users are not anymore simple data entry operators, they supervise the process and take those decisions the software wasn't able to independently take. Thanks to the machine learning OCR, new fonts can be learnt and the system improves its performance over the time, as well as, we have the possibility to easily train the network to cover different cylinder types with different engraving data.