Interreg North-West Europe
COTEMACO
European Regional Development Fund

Success Story

Feasibility study for cobotic quality test cell for custom-made windings in BLDC-motors

Mirmex Motor, BEL

(c) Mirmex Mot

Feasibility study for cobotic quality test cell

Company description

Mirmex Motor is a Belgian company based in Mont-Saint-Guibert. They developed a patented technology to design and create SBLDC motors with customizable geometries by printing patterns on a flexible material. Their motors are smaller, more easily configurable and have a longer lifetime than standard motors.

Goal

Automatic quality inspection of PCBs with the aid of a cobot, both visually and electrically.

Motivation/Starting Point

Mirmex applied to the SME support program with the aim of finding an automated solution for the manual quality inspection steps in their current production process. This inspection consists of two main parts. The first is an end-of-line electrical test, where the motor is placed in a test-bench that verifies the end-to-end current and resistance. The second is a begin-of-line visual inspection, where an operator inspects the motor under a microscope to detect defects in vias and tracks that might break soon. Both these inspection tasks are currently performed by a human operator, but they are repetitive and tedious. This motivated Mirmex to consider exploring automated systems, in order to free up the operator for other tasks. This is a challenging problem since the motors are thin, flexible, and can have a large variance of dimensions. Moreover, the visual defects can be very small.

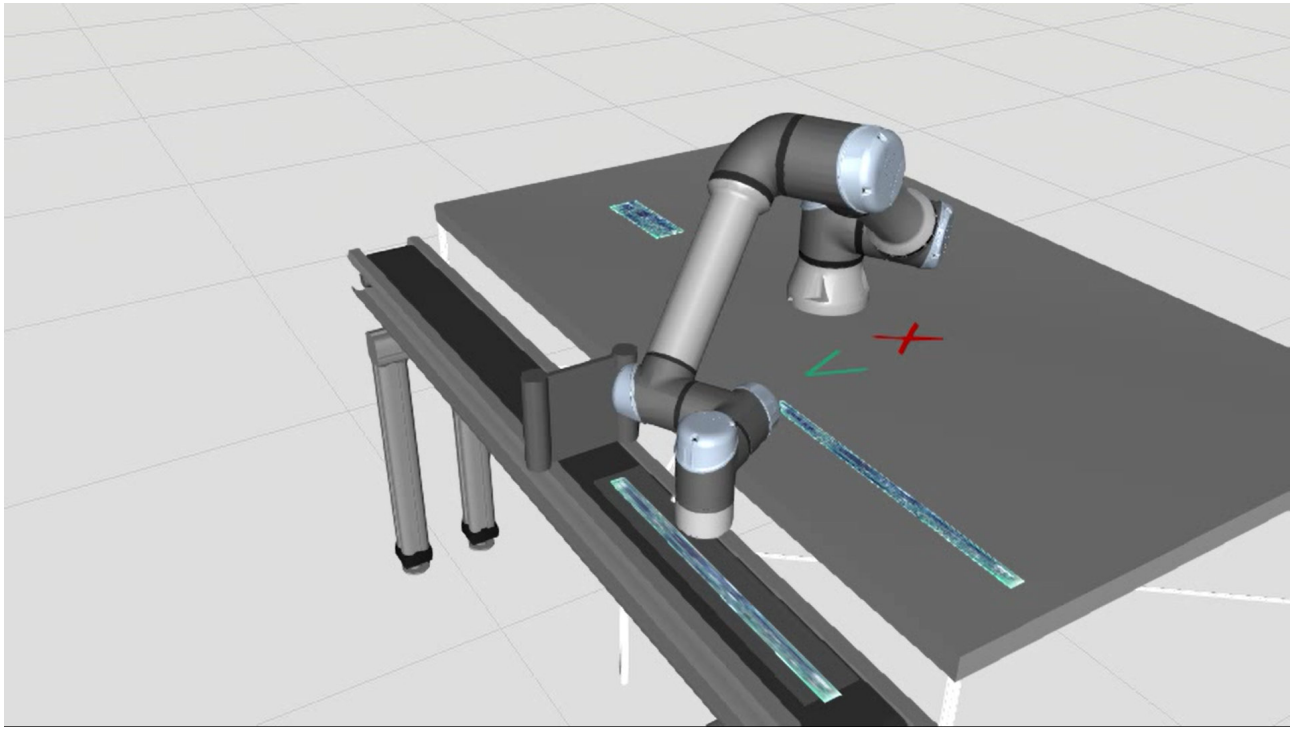
Analysis

In this research, the ideal cobot, gripper, workcell and vision system are selected and designed. Since Mirmex is a small company that employs high-skilled mechatronics engineers, ease-of-use of the robot is not a high priority. The system should be able to inspect the motors and sort them based on the results. For the begin-of-line quality inspection, the gripper system should not alter the wirings in any sense and should be able to pick and place all sizes of motors.

Technical Realization

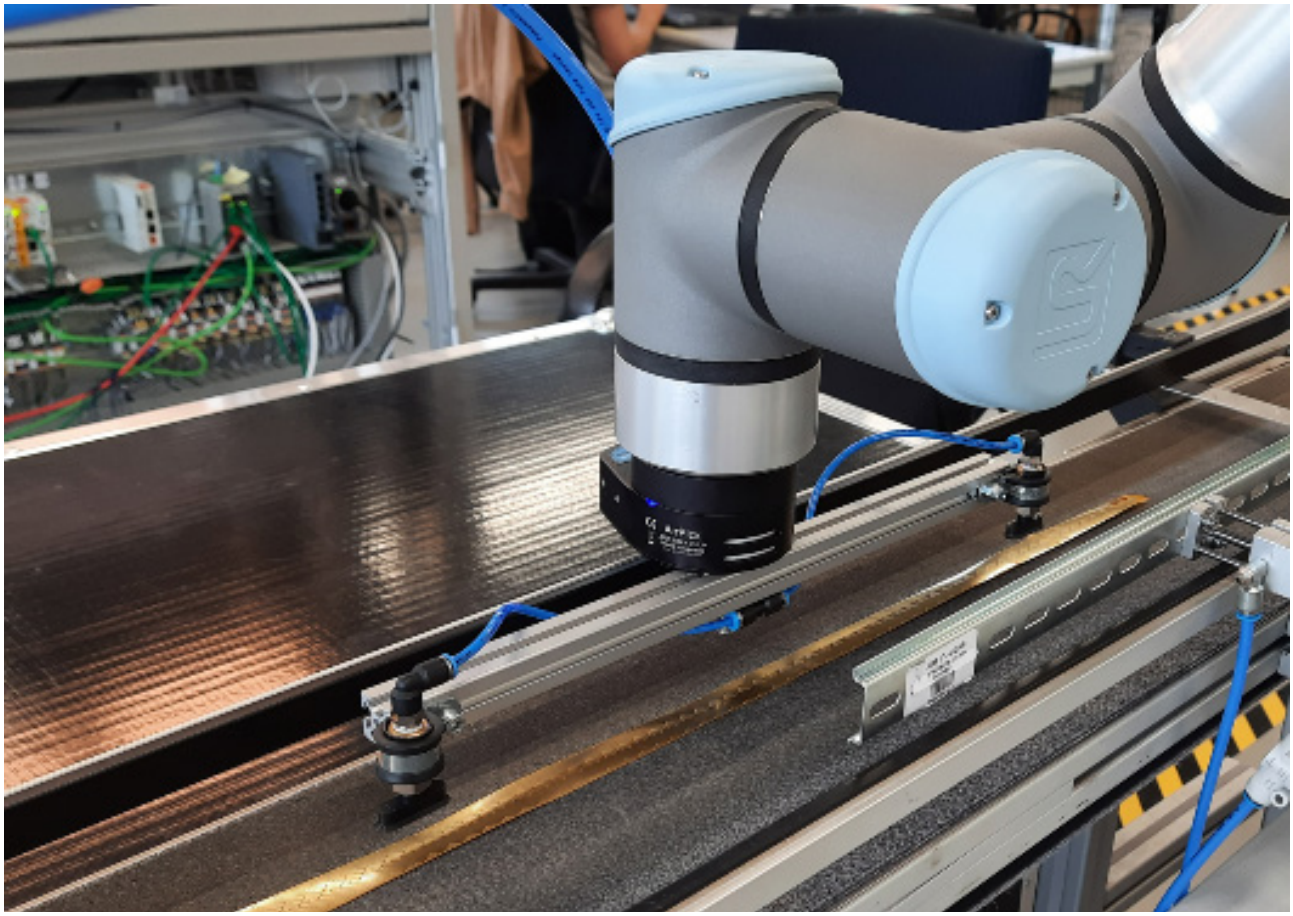
Based on the requirements, a cobot was selected with a two-finger gripper for the end-of-line quality inspection. For the begin-of-line quality inspection, a work cell was designed. A stack of motors is presented in front of the cobot. The cobot picks them up, one at a time, with a gripper with suction-cups. This gripper was custom-built with off-the-shelf pneumatic elements, consisting of a vacuum generator unit with electrical control, filter and pressure regulator, to reduce the price and increase flexibility. The system is therefore less user-friendly than an off-the-shelf gripper, but the mechatronics engineers of Mirmex preferred the extra control.

The picked up motor is then put on a conveyor belt. The cobot places a plexiglass on top of it to flatten it. The motor is then inspected through a line-scan camera system and automatically analyzed with a custom computer vision algorithm. Afterwards, the plexiglass is removed again and the motor is put in the correct pile.



Result

The performed feasibility studies showed that the proposed system can successfully pick up the motors. A first version of the inspection algorithm showed that the most common defects can be identified with the selected hardware. The speed of the system is well within the requirements of Mirmex.



View from the employee perspective

The inspection is currently performed fully manually, by putting the motors under a microscope or in the inspection station, inspecting them and sorting them. These steps can all be performed by a cobot and computer vision system. The employee only needs to verify when the optical inspection is not completely certain, which takes substantially less time than a full inspection. Therefore, his workload is reduced and he can be freed up for other tasks.

Interview

How could COTEMACO support you?

Via the SME support programme, COTEMACO engages with SMEs from the automotive and food sectors through field labs. These regional field labs in the UK, the Netherlands, Belgium and Germany are showcasing key production steps in the automotive and food industries, in order to tackle current low sectorial awareness and knowledge gaps. The field labs will exchange knowledge on different manufacturing tasks, such as handling and (un)loading.
With the COTEMACO programme, manufacturing SMEs are guided through the process of adopting collaborative robotic and shop floor digitalisation technologies, from the exploration of technological opportunities to the detailed definition of a business plan.

What was implemented and what are the benefits?

Within the COTEMACO program, a potential technical solution for the Mirmex case was identified in order to automate their current manual step for begin-of-line and end-of-line motor inspection. The identified solution was based on employing a cobot with suitable gripper to pick up the motors and place them in the inspection stations. For the begin-of-line inspection, a computer vision algorithm is used to prove the possibility of automatic visual defect detection.
The proposed solution is flexible enough to handle the variance of the motors with respect to size and shape. A feasibility study on the proposed solution was performed; this includes the conceptual design of the work-cell, technical feasibility with validation testing, cycle time estimation, an overview of the estimated costs, and a list of potential subcontractors and suppliers.

What was implemented and what are the benefits?

The incoming inspection of parts is a tedious task, as lots of different defects can be detected, such as dimensions, electrical properties, etc. The automation of this step is therefore mandatory in the scale up of the production process.
Cotemaco came with a solution on paper, which seems promising. A proof of concept of the prehension of the parts was demonstrated with a cobot and an end-tool chosen for our particular application. A proof of concept of the vision algorithm was developed, and showed that some defects could be detected by applying it. A concept of the general solution was drafted, integrating the choice of the main components, as well as the architecture of the solution. The technical implementation could not be performed due to the delay of an important component:the camera.
Before the project, we had a very limited knowledge of cobots and vision systems and their integration. This pilot project allowed us to gain expertise on these subjects. We are now convinced that a cobot is the right option for our product inspection. These early experiments with cobots in our production line will help the design of future testbenches and workstations with the cobot capabilities in mind.
The technical team from Cotemaco is highly skilled and could certainly tackle the technical difficulties of this project.

What is COTEMACO?

The project, which is an initiative of Interreg North-West Europe, aims to support around 60 SMEs in the automotive and food manufacturing industries with so-called „test environments“ and to encourage them to integrate collaborative robotic systems and digital technologies into their business. Accordingly, in addition to increasing production flexibility, the relocation of production abroad will be curbed and the number of jobs in manufacturing increased, which will generally lead to an improvement in the competitiveness of the companies involved.
In the project new technologies are implemented in application examples - the aim is to move from the prototype in the laboratory environment to the transfer to production, taking into account the legal situation and certifications.

You want to become part of COTEMACO too?

You are interested in further Best Practice implementations?

Then visit our website at:
www.robot-hub.org/cotemaco

Implementation partner:

FLANDERS MAKE
DRIVING INNOVATION IN MANUFACTURING

Interreg
EUROPEAN UNION
North-West Europe
COTEMACO
European Regional Development Fund