

Redesign of the Ball & Seat Packaging Process at Ceramaret

Degree programme : BSc in Micro- and Medical Technology
Specialisation : Robotics
Thesis advisors : Prof. Dr. Gabriel Gruener, Fabian Bründler
Expert : Marc-Olivier Gueissaz (Ceramaret)
Industrial partner : Ceramaret SA, Bôle

Ceramaret SA produces ultra-hard material components (ceramics, synthetic sapphire, ruby) for sectors like medical, dental, and watchmaking. A key product line includes Ball & Seat components (\varnothing 0.79–10 mm) used in pumps, flow meters, and pipettes. The current manual packaging process is error-prone and inefficient.

Introduction

Ceramaret's ball & seat are currently manually dropped in a hole of a packaging machine in order: first the ball, then the paired seat. It is essential to maintain this pairing, since components have been fitted together. The current machine frequently jams, causing costly downtime, and performs no quality control. This project addresses these weaknesses.

Methods

The project is divided into three phases:

System specification

The new packaging process must comply with current standards. Some components are used in the medical sector. Changing the packaging would require new validation and compliance testing, with significant additional costs.

Market research

Several packaging machines were analyzed. Two compatible solutions meeting the required specifications were selected. However, none of the market options integrates quality control.

Development and testing of quality control

A vision system using an industrial camera, a back-light and Python software has been developed to verify the type and quantity of components of each package after sealing. Defective packages can be sorted out, ensuring correct delivery to the customer.



Fig. 1: Test setup for real components with integrated camera and backlight. Top left: side view. Top right: top view.

Results

Fig. 1 shows the test setup built, mimicking the vertical space in the selected machine. Checks performed:

- Component dimensions
- Only one component per package

Canny and Gaussian filters, kernels, and contour search were used. To detect seats (cylindrical shape with internal hole) a Region of Interest (ROI) was defined with different filter parameters, which could not be applied to the entire image due to noise generated by the folds in the package. Fig. 2 shows the graphical user interface (GUI). By selecting the item code, the system automatically loads the correct parameters for each component.

Conclusion

Market analysis identified three compatible packaging machines. One was preliminarily selected. The final decision remains with Ceramaret. The implemented vision system confirmed the feasibility of component detection for quality control. Studies have been carried out to automate the system by integrating a robot that feeds the components to be packaged. The selection of a suitable end effector remains a critical challenge that may limit feasibility. As an alternative, the machine may be positioned so that components are packaged directly after the manual pairing.



Enea Mariotti Nesurini
enea.nesurini@icloud.com

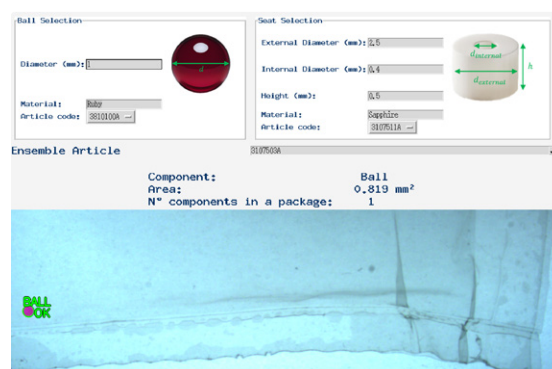


Fig. 2: GUI developed. Top: Component selection. Bottom: Camera view, showing the presence of the selected ball.