Machine vision systems - an industrial implementation

Popular summary

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ABSTRACT

Your everyday milk carton is coated with thin layers of plastic to protect the carton from soaking up its liquid content and thereby ruining the carton. For more aseptic products the carton can also include a thin layer of aluminum together with a plastic film, see figure 1.

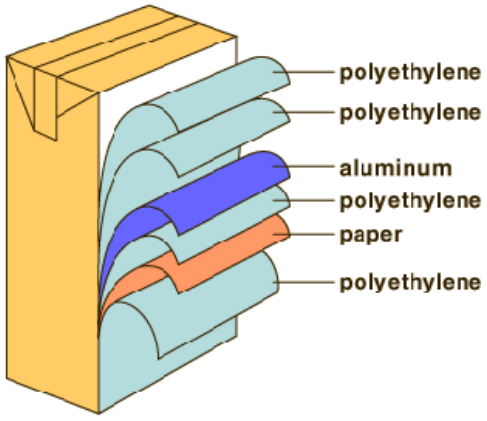

Fig 1: Illustration of a milk carton

The purpose of this project is to analyze the creation process for these thin plastic layers using a machine vision system.

A machine vision system captures and analyzes images in order to provide automatic inspections or guidance for various applications. It is a rapidly growing field as it has proven to be very effective at reducing the number of manual inspections. A typical machine vision set up is illustrated in figure 2. The systems can either be designed as a single complete unit or in separate parts, depending on the application.

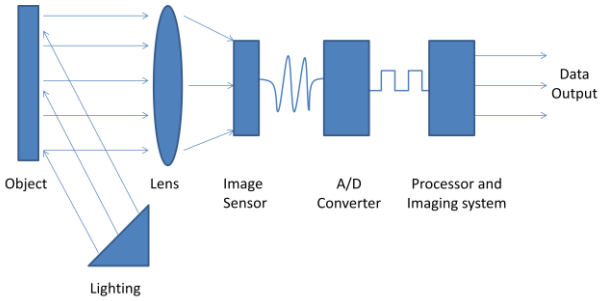

Fig 2: Illustration of a machine vision set-up

The project was produced for Tetra Pak during the first half of 2014 at the packaging material plant in Lund, Sweden.

I. INTRODUCTION

The term efficiency is widely used in industry; something that every manufacturing company strives towards. To be efficient, a company must minimize its costs, production waste and manual operations.

The ambition for this project is to provide an automatic inspection system that increases efficiency by reducing production waste and manual inspections, thereby reducing the production costs.

In addition the automatic system will increase monitoring possibilities and contribute with alarm functions for a more robust manufacturing process.

II. PURPOSE

The manufacturing process that coats the packaging material at Tetra Pak generates excessive waste material due to lack of monitoring possibilities and non-automated control systems.

Furthermore, to generate the inspection data today many work hours are required, hours that can be spent more efficient elsewhere.

This project examines and demonstrates how a vision system can automatically perform this inspection and enable for a fully automated system in the future.

The purpose of the project has been divided into the following objectives:

- Investigate and find the best suited machine vision system for the assignment;
- Implement a vision system that is fully integrated with the factory equipment;
- Evaluate the implemented system;
- Examine the economical benefits of a vision system.

III. LIMITATIONS

The focus of the project is on the implementation and evaluation of a machine vision system and not in detail how the system generates the inspection data.

IV. METHOD

To choose the best vision concept to perform the inspection the front end process presented in Product Design and Development by Karl T Ulrich and Steven D. Eppinger was used.

Unfortunately the selected vision system was not delivered due to problems with subcontractors. Instead another system was borrowed and modified to mimic the selected concept as well as possible.

V. IMPLEMENTATION

In order to test the concept a camera mount and a power supply was developed and integrated with the coating line. To analyze the images and generate inspection data, a vision software application was developed in Cognex Explorer as well as an HMI application. The camera also needed to communicate with the factory PLC in order to log the inspection data.

This communication was developed using the OPC standard. The camera set up is presented in figure 3.

During the implementation a variety of lighting colors were tested where blue lighting gave the best results. The image processing was also tested and optimized in order to reduce the inspection time.

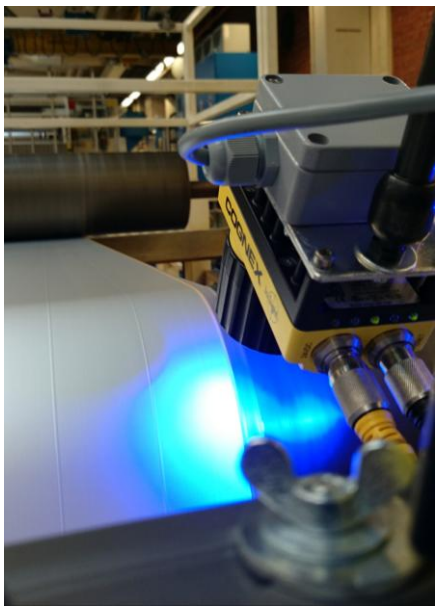

Fig 3: Image of the implemented system

VI. RESULTS

The resulting system provides accurate inspections with high frequency. In addition it automatically logs the inspection data, monitors the process and alarm operators when errors occur in the coating process.

In total, the system performs 7 inspections per seconds, of which 30 percent provides full inspection data, resulting in 2.1 full inspections each second.

VII. CONCLUSIONS

The thesis proves that a machine vision system, similar to the selected concept can perform the inspection with satisfactory result and in accordance with the stated requirements. It also demonstrates that there are many beneficial aspects with the implemented system, both financial and for production stability.