ZDMP Blog

Zero Defects in the Electronic Industry using Artificial Intelligence to detect the optical defects

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Some questions for you

- How a wide range of surface defects on a product could be automatically detected?
- How an intelligent automatic system for quality assurance, based on image detection and operator decisions, would look like?
- Could an automatic video detection system perform tests with the speed required for industrial production and faster than an operator's decision time
- How could AI assist in assuring products without defect?

Introduction

Typical automotive displays and instrument clusters, eg those showing for example Speed, RPM, warning indicators, usually contain one or more PCB's (Printed Circuit Board), displays, and other mechanical components (housing, screws, connectors, masks, covers).

Considering that the usage of the displays (including instrument clusters), and the fact that all the surface defects would be very visible, the quality of them should be perfect not only in terms of functionality, but also considering surface quality.

In this case, the testing methodology for displays is very important but it is difficult to formulate due to a wide range of possible defects.

Currently cosmetic and optical functional defects are detected through a visual check by the operator or automatically using a camera and an image comparison algorithm where the captured image is compared with a defined standard picture and considering the acceptable quality of a product.

Unfortunately, the actual solution is relatively inflexible and has the following primary disadvantages:

- There is no feedback or correction loop for the optical inspection program; the inspection program does not learn from mistakes
- There are cases when errors are undetected by the inspection algorithm if, for instance, the type of defect was not even considered in the specification
- Considering the number of product variants and test cases, the resulting test information is significant in size requiring corresponding storage
- The level of the library of testing models reuse for new products is low and, in general, new product setup is time consuming and presumes high failure risks
- Each optical inspection station (display check, pointer calibration, automatic final testing) have a significative risk to not detect the real product defects

Considering these disadvantages, there is the strong need for a new method to improve the quality of the optical inspection which can automatically learn from each performed test, whilst reducing the inspection efforts and costs

What ZDMP will achieve

The ZDMP solution considers the mandatory presence of an operator for visual inspection and for production labelling only at the new product introduction. After relevant visual inspection classifications performed by operators with good and bad products, the pictures are stored in a database. Then the AI model is generated, and the visual inspection continues mainly using AI algorithm and eventually the interaction with the operator for the border cases.

Periodically the AI model will be tuned with updated data and new features, so that the AI model is continuously improved.

Fig. Automatic Final test & Manual final test equipment

Before ZDMP

1. In position 1 is performed the classical image recognition automatic testing for symbols, homogeneity and contamination
2. In position 3 is perform a visual check by operator on specific image pattern for the display

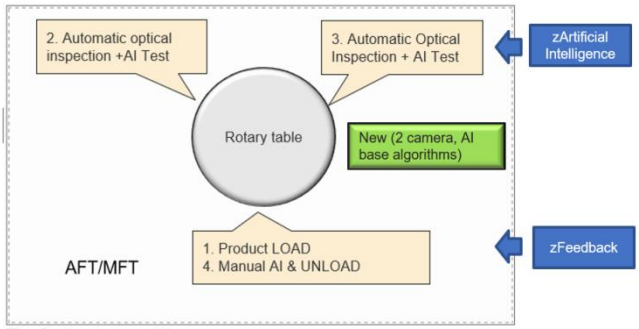

Fig. Station test positions

Using ZDMP

1. In position 1 is performed the classical image recognition automatic testing for symbols, humanity and contamination
2. **In position 2 is perform a visual check based on AI and operator pattern similar with normal operator test**
3. In position 3 is **perform a visual check by operator if the automatic test(2) or test using AI indicate product quality risks**.

Figure: Artificial Intelligence to detect optical defects – implementation details

Regarding the defect types, the AI application has proved to be capable to perform quality tests with good results that are difficult for the operators to detected; eg the symbols and offset defects, the display homogeneity and the contamination and dead pixel defects.

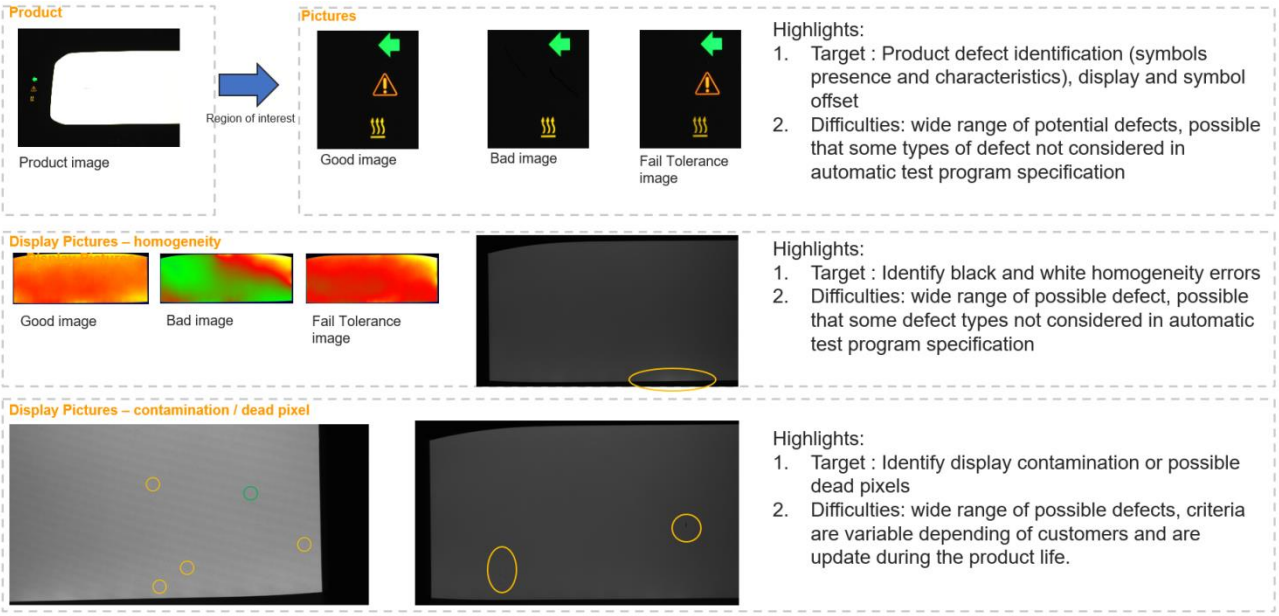

Figure: Artificial Intelligence to detect optical defects

Applying the visual product check using AI allows:

- Reduction of the number of errors. Studies have proven that the visual checks made by operator allows finding a maximum 95% of defects in the case when experienced operators are involved, but with the AI approach this is raised even over 98%.
- Reduction of the inspection time thus increasing the production performance. Moreover, it allows the operator to focus on other relevant production tasks
- Reduction of the effort to introduce the quality tests for the new product. Usually, a high number of product variants are manufactured within the same production line and the effort to manually setup the line is significant

The final results affecting the quality of the end product are the increased product quality, reduced risk if having undetected production defects and costs/efforts reduction of the product quality inspection.

ZDMP Links

• Architecture Component(s)	N/A
• Work Package	WP9 – ZDMP Traditional Sector Cases: Electronics
• Tasks	All

References

None