Machine learning for industrial inspection

1. Title

Machine learning for industrial inspection

2. Applicants

ICT for Brain, Body & Behavior (www.i3b.org) is a network of high tech companies and knowledge institutes aimed at joint research, development and commercialization of ICT solutions on brain and behavior. From the i3B network Eagle Vision Systems B.V. will participate.

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3. Suggestions for academic team leader

4. Company information

ICT for Brain, Body and Behavior (i3B), http://www.i3b.org, is a cluster of high-tech companies and knowledge institutes that initiate and carry out R&D and business development in the area of brain, cognition, physiology and behavior. i3B is an independent network, founded by the Dutch "National Initiative Brain and Cognition" (NIHC).

i3B's application domains are wide, covering ICT in Health[1], Food[2], Mobility[3] and Security[4]. i3B develops ICT tools to measure, provide feedback and change behavior; in a wide variety of circumstances like eating, buying, driving, human-system interaction, moving (sports, elderly), stress, social interaction, psychiatric disorders, workplace ergonomics, sleep quality, precision livestock farming and animal models of human disease.

Eagle Vision Systems B.V. (Eagle Vision) develops advanced computer vision products, and delivers them to leading end-users like Heineken, Nestlé, and Danone and to innovative machine builders and system integrators. With the Basic Scout product line, Eagle Vision delivers in-line industrial inspection systems for quality control to the food, beverage and packaging industries. Eagle Vision is market leader of inspection systems for the baby food nutrition supply chain. Main technical expertise: computer vision software, illumination design and industrial systems design. (www.eaglevision.nl).

Eagle Vision

[1] Design of intelligent environments and digital devices to support independent living healthy ageing
[2] Development of healthy nutritional products supporting consumers with respect to healthy food choice
[3] Design of interactive systems in vehicles; simulation and training
[4] Design of intelligent cameras and sensor networks, automatic detection of suspicious behavior

5. Challenge

Background and challenge description

In recent years, machine learning techniques, including deep learning, have gained wide use in computer vision. In industrial inspection applications however, machine learning is not yet widely used. Until now, in most applications, the use of traditional image processing algorithms is sufficient and easier to implement.

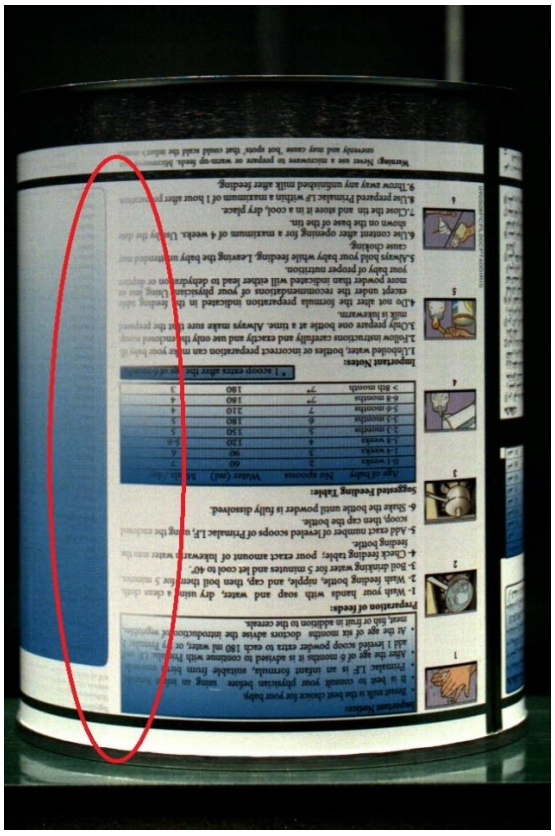
A recent trend however, especially in the baby food nutrition market, is demand for higher inspection performance as a result of higher quality assurance demands from customers.

An industrial inspection system will usually classify images of products into two classes: *accept* for images of good products and *reject* for images of wrong or damaged products. Important characteristics of industrial inspection applications are:

1. The image acquisition is relatively well controlled with relatively constant illumination, intensity and scale.
2. Cost of classification errors is high. In most cases, an error rate < 0.1% is required.
3. Real-time application with time constraints. Typical production rate is up to 1000 products per minute.

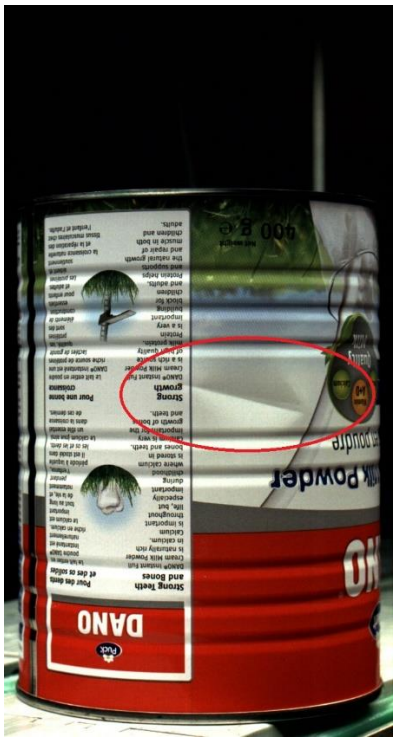
As an example, the 360 inspection module of Eagle Vision is inspecting (with 6 cameras) the complete outside of cans (or other containers) to find damages like misprints, scratches and dents.

Example of misprint:



Example of scratch:

Example of dent:



Using traditional techniques, like template matching and image comparison, it is difficult to distinguish between image irregularities caused by defects on the surface as shown above, and image irregularities caused by reflections or by normal surface geometry or "normal" surface variations due to the can production process.

Example of “irrelevant” image irregularitiy:

A requirement for using machine learning techniques is the availability of a very large set of images (“big data”) for training. By collecting real data from production, it is possible to acquire this large set.

Application domains

Eagle vision intends to integrate the developed technology in the Basic Scout industrial inspection system. Applications in the baby food nutrition are mentioned above, but it is expected that other applications can benefit from the technology like inspections of bottles, contamination inspection in cans, and others. The computer vision for industrial inspection is a multi-billion Euro market.

Scientific challenge

During the workshop, the team will work on the following challenges:

- Selecting and implementing the best machine learning techniques for the classification of the images.
- Optimizing to achieve the desired error rate.
- Optimizing to achieve the required analysis time constraint.
- If time permits: trying to apply the same technique on a second inspection application.

Input for workshop participants

Workshop participants will receive a large number of images for training and for classification (validation). The images are from real-world products and real-world production line.