

Production Line Visual Inspection : Soft Drink Bottling Plant



Background

The most common use of image processing in an industrial setting is for the automated visual inspection of products leaving a production facility. Automated inspection is used to inspect everything from pharmaceutical drugs to textile production. It is estimated that the majority of products bought on supermarket shelves are inspected using automated “machine vision” based systems prior to dispatch. Why? - to avoid the cost of shipping a faulty or sub-standard item to a supermarket shelf that no-one wants to buy!

In this practical exercise we are dealing with a bottling production line in a facility bottling coca-cola for the domestic market. We have a set of images, taken under near constant factory lighting conditions, of the bottles as they leave the bottling line. The bottling company require a vision system to automatically identify a number of different faults that may occur during filling, labelling and capping stages of production so that these bottles can be intercepted prior to packaging.

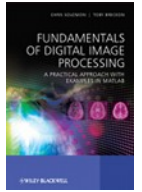
Your task is to design and prototype a image processing system to detect the set of fault conditions that may occur together with identifying the type of fault that has occurred. You will develop this prototype system using Matlab and the techniques discussed in the book.

Task Specification – Automated Visual Inspection

You are required to develop a visual inspection system that correctly identifies each of the following fault conditions that may occur in the bottling plant:

1. bottle **under-filled** or not filled at all
2. bottle **over-filled**
3. bottle has **label missing**
4. bottle has label but **label printing has failed** (i.e. label is white)
5. bottle **label is not straight**
6. bottle **cap is missing**
7. bottle **is deformed** (i.e. squashed) in some way

In each image we are **only interested in classifying the central bottle in the image**. One image is taken for each bottle leaving the production line so faults occurring in bottles at the sides will be detected separately when these particular bottles are themselves photographed central to the image. Additionally, some images may have no bottle in the centre of the image – this is not a fault, just a gap in the production flow stemming from a machine operating further up the line. *Faults with side bottles and missing bottles must be ignored by your system – only the seven faults above must be*



reported. You can tackle each of the cases in any order you wish.

Some examples will contain more than one fault with the central bottle but these cases are rare – identify as many as you can.

In implementing your solution consider the functionality available in the Matlab Image Processing Toolkit. As this is only a prototype – efficiency of your approach is less important than performance.

Sample Data

The (artificial) sample data provided is a set of 141 images of bottles leaving a hypothetical bottling facility. They have been additionally split into labelled sets for ease of prototype development. The images have been captured by a high-speed image camera (but low quality) as they leave the facility – although no motion blur occurs in the images, the positions of the bottles in the image varies slightly from image to image.

These are provided as a set of zip archive files on the book website (<http://www.fundipbook.com/materials/>).

Supporting Matlab Code: We additionally provide a Matlab code example `dir_cycle.m` which provides an easy means to cycle through a given set of files in a specified directory (such as one of the directories provided by extracting the sample data zip archives). The example simply displays each of these images (very quickly, one after another) – the processing for the fault detection is left to the reader! (available from the book website – <http://www.fundipbook.com/materials/>)

For instructors use only: A sample marking scheme and further detailed assignment specifications, including an unreleased/unseen test set to form part of a marking scheme, are available to instructors upon request (email from a faculty address with URL of your course page). This is intended only where the task is being set as a course assignment.