Philips bar dots and alphas: identification under tough conditions

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Introduction

Tracking materials, parts and products during production and storage is a logistic function introduced in many production plants. Marking and reading products has become a matter of routine. Still we meet situations where identifying products is a tough job. When a barcode label and a common reader can no longer do the job, a vision system from Philips Industrial Automation Systems (IAS) can offer a different solution.

Pollution, poor environmental conditions, difficult readable printing, constraints with respect to code usage are some examples of tough conditions where a straightforward solution does not fit. In these situations an identification system has to be engineered, preferably out of standard components and techniques.

The identification toolbox

A variety of coding, reading, processing and optical techniques is available for the non-standard identification problems. A toolbox such as the Philips SBIP-II offers support reading of barcode, dotcode and optical character reading (OCR). But also the contours, dimensions and position of a product can be processed and used for identification. Depending on application conditions an appropriate code can be selected from the software library.

The choice for barcode is obvious owing to its support by generally accepted standards. But also the use of barcode has its boundaries. The application of barcodes can be stretched by using special reading devices, paying attention to optical reading conditions, intensive processing and correction of the signals read. A vision processing system perfectly suits applications reading barcode under difficult conditions. Examples of situations where a vision processor brought a solution are reading special types of barcode as used on securities, reading codes printed on low-contrast surfaces and reading under difficult illumination circumstances.

Optical character reading widens the use of the identification code. Using a human readable and machine readable code offers the advantage of combining automated and manual controlled processes. People are excellently trained in reading characters, even under difficult process conditions. The Philips vision processor comes up to the level of noise immunity people can handle, but it has a far better reliability in processing the identification or message.

In many processes where automation has been introduced, the need for identification of items, products and raw materials is indispensable. To facilitate this identification process, many different encoding systems have been developed, the barcode being the most well known. But another code that encompasses many of the advantages of other encoding systems and adds a few of its own is the *dotcode*.

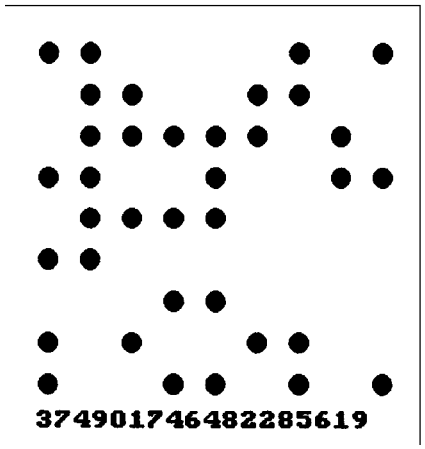


Figure 1. An example of a dotcode

The dotcode

The dotcode (see Figure 1) is a collection of dots arranged on a matrix grid. The format of this matrix can be formed 6×6 to 12×12 dot positions. The combination of absent and present dots in the matrix depict a binary value which represents a number. The structure of the code is such that error detection is performed when reading damaged codes. Dotcodes are read using camera techniques. Reading tolerances are better than for barcodes, because it is not necessary to measure accurately the width of a bar, but only to distinguish if a dot is present or not.

Why use a dotcode?

The dotcode reading process is in many cases superior to barcode reading. This is because of a number of important features:

- *Wide range of sizes*: The dotcode size covers a wide range of sizes: 5 $\times$ 5mm to 50 $\times$ 50cm are practical examples.
- *High density*: When space is limited, a high-information density is desirable. The dotcode is two-dimensional code. Information is present in both *X* and *Y* directions. This contrasts with barcodes, where information is only present in one direction. Consequently, the density of a dotcode is much higher than for a barcode. On average, ten times higher information density can be achieved.
- *Orientation independent*: Often the position of a code carrier of the product is unpredictable. The dotcode can be read without the need for a fixed orientation. Rotation independence is an important characteristic of the dotcode.

Figure 2. The same information in dotcode (left) and barcode (right)

Which code to use?

Dotcodes can contain a variable amount of information. The most commonly used code formats are 6×6 up to 10×10. Table I indicates the amount of information which can be stored in different codes.

When barcode reading fails

Barcodes are the most commonly used product identification tools. For industrial use, barcodes show problems in many application areas. In industry codes often cannot be read twice. Extreme temperatures and chemical conditions can prevent barcode labels being used. These and many other industrial application constraints demand more robust identification codes. The dotcode overcomes many of these barcode limitations and therefore can be an ideal code for your application industry.

Camera

A wide variety of video cameras can be used to read dotcodes. Compact and low-cost video cameras guarantee a simple and affordable installation. A considerable distance between the reader and the camera can easily be bridged using coaxial cable. The reading distance between the code and the camera is dependent on the lens. The greater the focal length, the larger the distance. Practical distances are between a few centimetres and 2 metres.

Reader configurations

Reading the dotcode is done by an image processor that takes the image from the camera and calculates the value of the code. The dotcode reading equipment containing the image processing hardware, is available in various configurations:

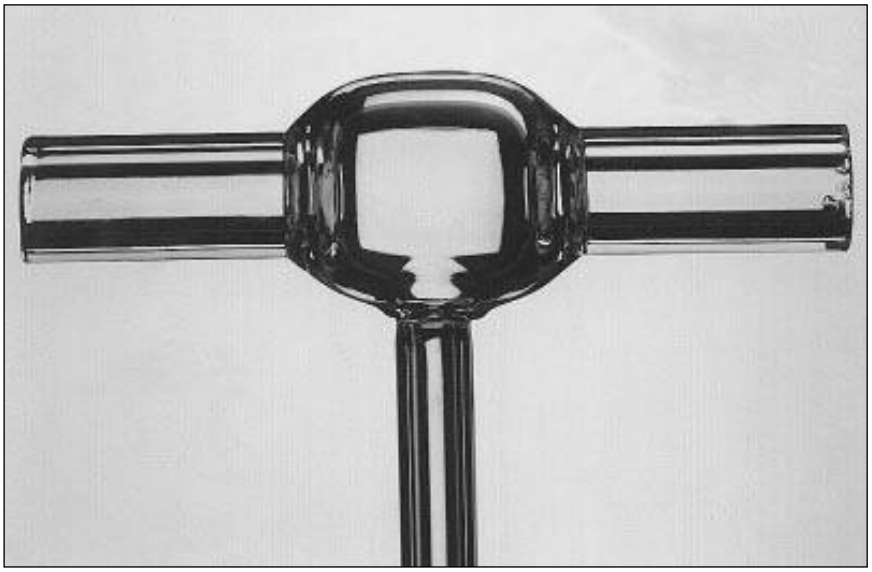
- A compact standalone dotcode reader using RS232 lines to communicate the decode results to other computer systems.
- A personal computer equipped with the Philips PC image processing board, the PC being used for information processing.
- A VME-based system. The solution allows high-speed networking and processing facilities for an industrial environment.

In any case, one to four cameras can be connected to the system. If more than four cameras are required, the configuration can easily be expanded.

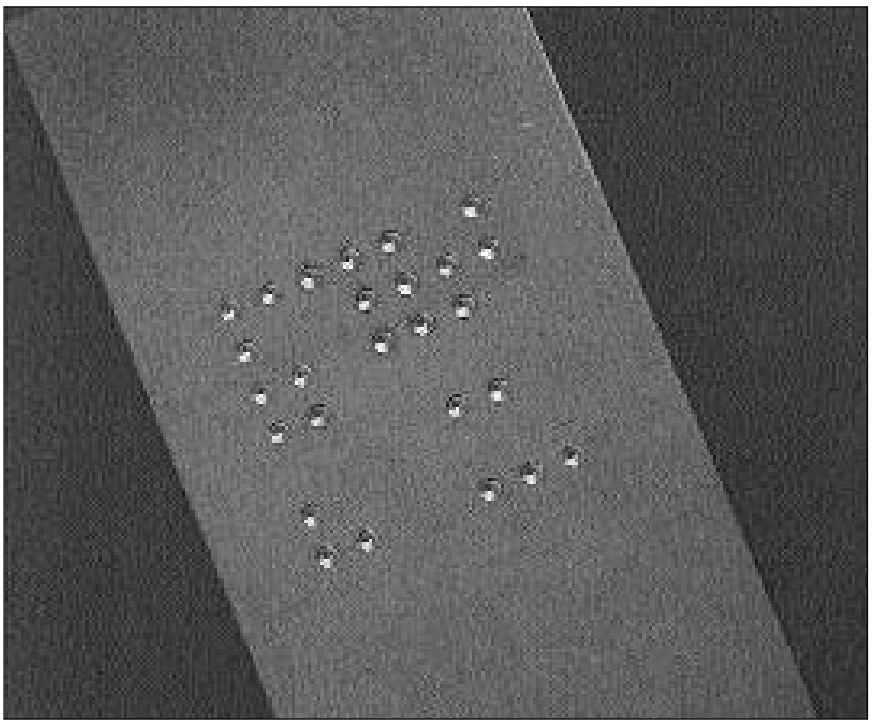
Dotcode formats	Decimal digits
6×6	5
7×7	9
8×8	13
9×9	18
10×10	24
12×12	38

Table I. Amount of information which can be stored in different codes

OCR and barcode under difficult reading conditions



A tiny dotcode used to identify a glass tube



Dotcodes as holes in blank metal sheet. Assymetry in the dot appearance is corrected by a vision processor

Dotcode software

For all system configurations a software package, BARDOT, provides the support for setting dotcode reading parameters. This package can also read standard barcodes, even in the same image. During installation and maintenance, a video monitor can be used to make adjustments. the monitor is primarily used for positioning the camera and focusing the optics. The monitor can also be used to position labels for manual dotcode reading.

Standardization

The dotcode is an open standard. It has been accepted by the international AIM organization and proposed for standardization to CEN.

Application examples

Dotcodes can be applied in many industrial applications. A feature of the dotcode is that it can easily be applied without using foreign material. Products can be coded with a dotcode using surface deformations. These surface deformations can be applied on the material by various means. On metal, holes can be punched or drilled to create a dotcode. On glass, a laser beam can be used to create dotcodes. The dotcode decoding process is more tolerant to disturbing environmental conditions than a barcode reading process. Because of this, dotcode has been chosen for applications with "rough" environments. These and many more examples show the importance of having an alternative coding technique to barcode. The dotcode is a code which can be applied in numerous industrial environments to fulfil the increasing demands for traceability.

Creative solutions

The combination of a TV-camera, balanced illumination and an intelligent vision processor allows creative solutions for identification, product recognition, quality control, measuring and positioning. Did you ever try to mark a small glass tube in a process where it reaches high temperatures? This is a question you meet in medical and pharmaceutical environments. The creative solution for this problem is the use of a tiny dotcode marked on the glass. Engraving a matrix of dots was quite simple compared with alternative codes. The technique of engraving gives, for most codes, a poor readable marking, but it has the advantage that this technique causes no pollution of the product with ink or labels.

Rough blank metal is a surface that often causes problems, when speaking about tough identification problems. Metal parts undergo often aggressive processing in harsh environments. Protection for damage and pollution of the identification code is a serious problem. Small holes as dots for the dotcode do their job far better under these conditions compared with barcode or OCR. Motor shafts, metal bars, rods and sheets are just some of the numerous examples of the use of dotcode for identification of metal parts. The arguments for dotcode on blank rough metal apply also for a broad range of plastic products.

OCR is used in many situations where also people are involved in identifying the products. Product speed, surface conditions or process environment make the need for an electronic reading device. The Philips vision system allows the use of up to four cameras combined with special illumination, for example, IR or flash. In a truck factory the vision system reads OCR written on frame-beams at several process steps. Another situation where this vision processor board proves its capability in reading OCR under tough conditions is checking vehicle licence plates. For over a year the licence plates are read successfully under varying weather conditions, vehicle speed and position.

Do not give up when identification in your situation is not a case of plug and play. Philips IAS can help you by offering many creative solutions for identification under tough conditions. Type of coding, optical conditions or a Philips SBIP-II vision processor board are some of the alternatives.

For more information on identification of vision processing with Philips, contact Philips UK agency, Mr A. Phipps, 21 Nunsgate Thetford, Norfolk IP24 3EL. Tel/Fax: 01842 754814.

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