Computer vision based quality control of materials using Python

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Abstract— Quality control is an important process in all manufacturing industries. Normally, it includes checking the final product on sample basis and conforming whether the whole lot is suitable for dispatch or not. However, it is not a foolproof method to ensure quality as the whole lot is judged based on the basis of a few samples. There is a possibility that the samples selected conform to quality standards but many others in the lot don't. Quality judgment depends on the expertise of the person checking the samples. The camera based system takes pictures of the product, which are analyzed after image extraction through image processing and checked against quality standards. In case of blister packing, manufactures need to check whether all the blisters have been filled with unbroken tablets. The system automatically checks the number of pills through the camera and indicates if the number is less than expected. The software for this system is written in Python and uses simpleCV image processing library even beginners can easily get started with computer vision. The software and hardware requisites to run this program are Python 2.7.11, simpleCV, USB camera, windows 7/10 systems.

1 Introduction

Defects and errors in parts and components can negatively impact downstream processes, production efficiency, and product quality. Consistent, reliable inspection of parts and components can help manufacturers identify potential issues early on in the manufacturing process, minimizing lost product and production time.[4] Quality control is the backbone of pharmaceutical industries. Defects in packaging is harmful for dosage. All aspects of a package development that may give rise to quality problems must be identified and minimized by good design.

2 Working

The blister-packed medical pills are manufactured through automated processes [1][4]. These processes are generally carried out using a conveyor system. The packs are put on the conveyor belt, inspected and packed. There you can mount the camera to continuously monitor the packs for quality control. The source code for the system runs in an infinite loop. But for actual implementation,[3] you need to adapt it and make it trigger based, so that processing happens only when the blister pack arrives under the camera.

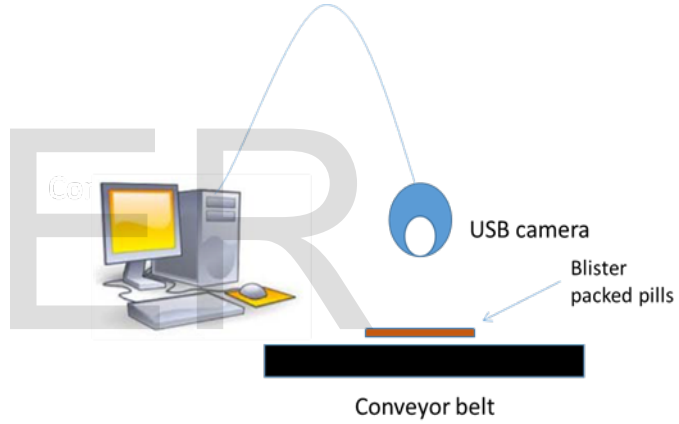

Fig.1 working model

The camera captures an image of the pack and converts it into one that shows hue difference from your predefined value. This means that pills will be shown as black because only at their places there will be no difference in hue from the predefined value [3]. This image is inverted, so pills appear white and the rest of the surrounding area turns black.The objective is to pre-process the image so that the pills area appears as blobs to get detected [2]. The blobs are easy to count and the blob count indicates the number of pills in the package. This number is compared with the desired number of pills for each package, thus missing pills are automatically detected. The software beeps if the number of detected pills matches the desired value. You can also program it to do the opposite.

You will immediately see a screen with various processed images such as the one shown in Fig.7. If the number of

detected pills is equal to the desired value, the software will produce a beep sound and show OK on the console. Otherwise, it will show Fail on the console.

3 PRINCIPLE OF OPERATION

Computer vision is an interdisciplinary field that deals with how computers can be made for gaining high-level understanding from digital images or videos [2]. From the perspective of engineering it seeks to automate tasks that the human visual system can do.

Computer vision tasks include methods for acquiring, processing, analyzing and understanding digital images, and extraction of high-dimensional data from the real world in order to produce numerical or symbolic information, *e.g.*in the forms of decisions[2][3]. Understanding in this context means the transformation of visual images (the input of the retina) into descriptions of the world that can interface with other thought processes and elicit appropriate action.[4] This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory.

As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images [3]. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner [4]. As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.

The fields most closely related to computer vision are image processing, image analysis and machine vision. There is a significant overlap in the range of techniques and applications that these cover "[2], [4]". This implies that the basic techniques that are used and developed in these fields are similar, something which can be interpreted as there is only one field with different names. On the other hand, it appears to be necessary for research groups, scientific journals, conferences and companies to present or market themselves as belonging specifically to one of these fields and, hence,[3] various characterizations which distinguish each of the fields from the others have been presented.

Image processing and image analysis tend to focus on 2D images, how to transform one image to another, *e.g.*, by pixel-wise operations such as contrast enhancement, local operations such as edge extraction or noise removal, or geometrical transformations such as rotating the image.[3] This characterization implies that image processing/analysis neither require assumptions nor produce interpretations about the image content.

4 FLOW CHART

At the beginning a blister packed medical pills image is captured through the USB camera [2],

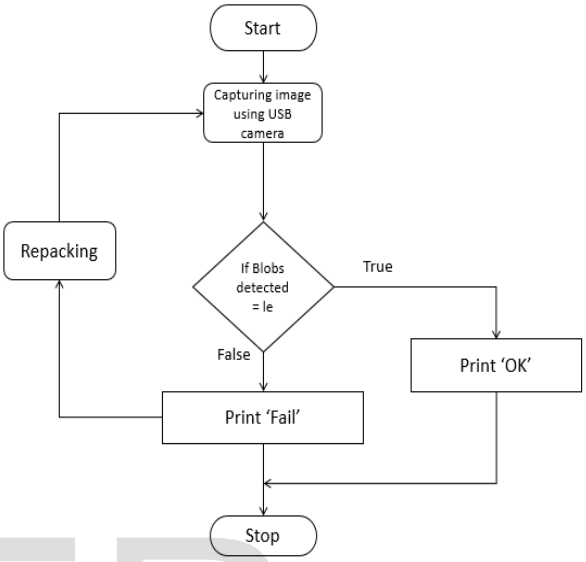

Fig.2. Flow chart

the captured image is tested in the software, if the blobs are detected in the medical pills it gives a message that blobs are detected, "[2], [4]" if the blobs are not detected in the medical pills it gives a message that tablet is free of blobs and it gives us total no of tablets detected in the output screen and process continues.

5 BLOCK DIAGRAM

Program is fed into the base system. USB camera captures the image and is processed using image processing. The result will be displayed on the monitor. [3][4] If the blobs detected are equal to the required number of pills, the blister packed pills are sent for further processing (Test-OK). If there is any defect in the blister packed pills (Test-Fail), and if the detected blobs are not equal to the required number of pills, [3] it is sent for repacking and the process is repeated.

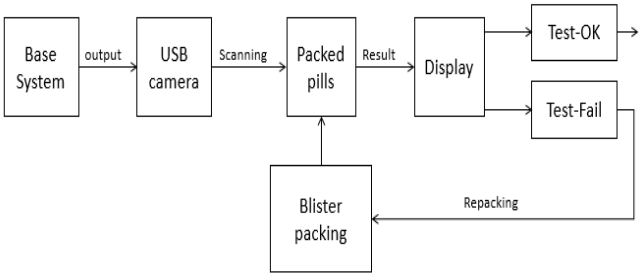

Fig.3. Block diagram

6 SOFTWARE DETAILS

SimpleCV:

- Simple CV is an open source frame-work, means it is a collection of libraries and software.
- It lets you to work with images or video streams that come from webcam or mobile phones.
- SimpleCV is written in Python.

Python:

- Python is an interpreted high-level programming language for general-purpose programming.
- Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

7 RESULTS

The USB camera captures the image and scales it down to 320x240 resolution as shown in Fig.4.

Fig.4 Image of tablets captured by the USB camera

The next task to find the hue value of a tablet. After finding the hue value, it creates another image that indicates the hue distance for the value selected as shown in Fig.5.

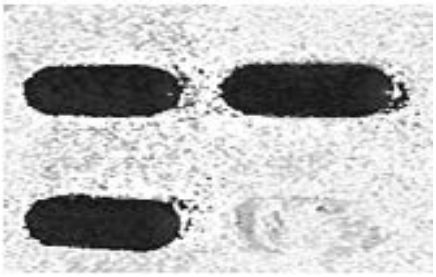

Fig5. Hue of the tablets

To detect the number of blobs the tablet should be white and the background should be black. So, we have to invert the image as shown in the Fig.6.

Fig.6. Inverted image of the tablet

The final display of all the processed images side by side as shown in the Fig.7.

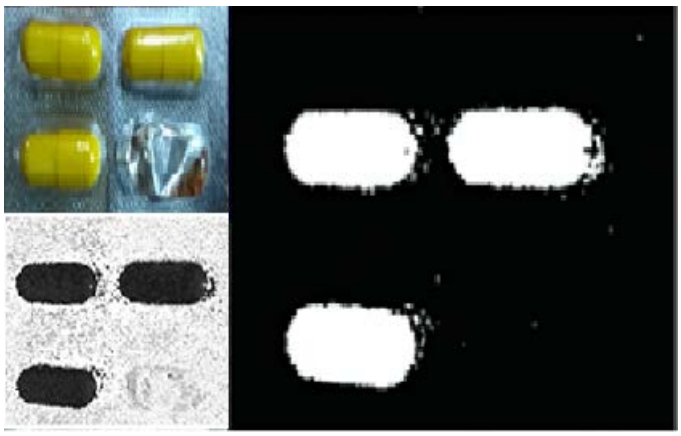

Fig.7. Display of all images

8 Conclusion

Quality control is the main problem faced by the processing industries. The above projected has summarized the best measures which can be taken in quality control of products. In future our work is to carry forward our project in to different sectors of industries. It was wonderful and learning experience for us while working on this project .This project took us through various phases of project development and gave us real insight into the world of software engineering. Due to advance in electronics and computer technologies, vision systems can be installed in almost all the processing industries in the world.

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