VISION-BASED IMAGE PROCESSING FOR INDUSTRIAL QUALITY CONTROL

Mrs. PARIMALA S.SORATUR

Senior Grade Lecturer

Department of Electronics & Communication Engg.,

Government Polytechnic, Vijayapur,Karnataka

Abstract

Vision based image processing is increasingly utilized in industrial quality control to enhance inspection processes and ensure product quality. It is one of the parameters that often become decisive factor in the company being in profit or loss. The term quality of a product seems very simple term but it is actually very complex. The quality control process is a process which involves continuous testing of products in order to ensure that they are in line with the final requirement of the as desired. Quality control does not only aids in maintaining the consistency of the product but also it can assist in finding out the parameters that need to be controlled to improve the quality of product and cut down the vulnerabilities in the product. A traditional method involved in the quality control is testing the product at each and every stage of the manufacturing. Most often there will be several stages in the production line, so quality checking at so many stages and for each and every product manually is a cumbersome process. The manual testing does not all requires more time but also requires skilled labour. This leads to decrease in productivity of the industry and thus resulting in loss. One of the technique that can help us to improve this is the technique of image processing. This paper highlights how image processing can be used for quality control of products in the industry and thus provides a definite advantage in enhancing the productivity and provide several other advantages

Key Words: Image processing ,hardware, software, camera, lenses, algoritms

INTRODUCTION

Machine vision has long played a vital role in inspecting and sorting products in industrial environments. However, the integration of artificial intelligence — particularly deep learning — has significantly advanced its capabilities. Traditional rule-based systems often struggled to keep up with product variability and complex defect patterns, requiring frequent manual adjustments. In contrast, AI-powered vision systems can analyze large volumes of data, detect subtle anomalies, and adapt to new product types with minimal human input. This makes them especially well-suited for dynamic, high-mix production lines where speed, precision, and adaptability are critical. The concept of image processing is well verse in the field of electronics. It is employed in facial recognition , identifying of the objects, providing authorized access etc. A basic image processing comprises of visualization and recognition. Visualization helps to find the objects that are visible and recognition helps in detection.

A brief survey is presented here. The authors in [1] describe how image processing can be used for identification the edges in the image. The authors suggested that MATLAB software can be employed to implement various kinds of filters. The filters identity the edges by calculating the variation in the pixel intensities. Further in [2], the author presents how the digital image processing techniques can be used to detect, quantify and classify plant diseases by using digital images in the visible spectrum. In paper [3] the authors describe that the diseases in the plant needs to identified for loss prevention and retaining the quality of yield. The author describes how image processing can be used to identify the disease in plants by collecting and comparing the images of the leaves. In paper [4] the author reviews how the image processing tools and techniques can be used in food quality evaluations by employing image processing and imaging systems.

As relevant from the literature survey we can develop a system using the image processing technology which can help in continuous monitoring of the size, shape, texture and several parameters of the product to be monitored. The proposed system utilizes both the hardware and software. The hardware mainly comprises of cameras, lenses, different kind of lighting systems whereas the software that could be employed would a software like MATLAB or Simulink

CONCEPTUAL FRAMEWORK

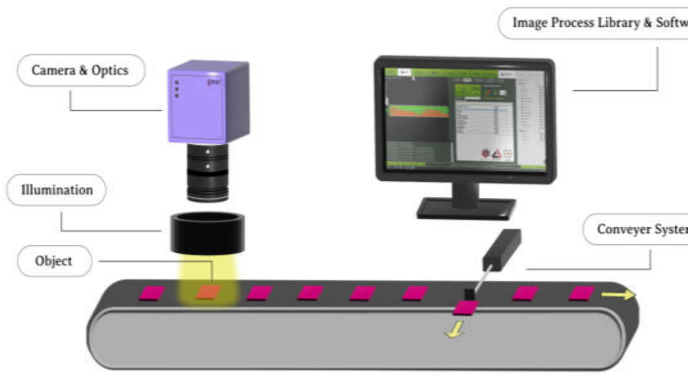

Fig : Block diagram of the system

The image processing system may comprises of i) hardware components b) software component

The Hardware component may include few to many industrial / Machine Vision (MV) cameras ranging from VGA to several Mega pixels, adequate lenses to focus the camera on required area of the product, appropriate illuminations and frame grabbers. The camera captures the images of the required area of the product and sends these images often as uncompressed or raw data to the computer. The computer then processes the image for feature extraction of the image using the software. The cameras may either use area scan or line scan method. The software's such as MATLAB or Simulink can be used for feature extraction. To extract the features of the images different kinds of algorithms may be employed. Examples of few such algorithms are (Scale-invariant Feature Transform (SIFT), Speeded Up Robust Features (SURF), Principal Component Analysis (PCA), and Histogram of Oriented Gradients (HOG).The image processing software plays role in quality control.

The software has multiple options like image analysis,pattern recognition and computer vision. i. Image analysis software – this software provides option to analyze the characteristics such as colour or shape of the image.

ii. Pattern recognition software - this software provides option to recognize patterns in the images.

iii. Computer vision software–this software is used to create the 3D models from 2D images.

The features of images of actual required standard component and present component in the production line are compared and the degree of accuracy is calculated. There can be a tolerance limit that can be set which can decide whether the product can be accepted or rejected. In case the rejection rate is more then the actual reason of rejection can be found out, which can aid in finding out the reason for such a high rejection rate. In case a particular kind of defect is observed more frequently then images obtained can help to analyze the reason of the fault and can help to take precautions for eliminating that particular fault by rectifying the reason of the fault.

ADVANTAGES

The image processing for quality control has several advantages.

Detailed analysis of components under production can be obtained by 3D imaging.

Human interference can be eliminated completely or atleast minimized by automatic defect detection.

The time required for inspection can be brought down significantly.

Human errors can be reduced to large extent in quality control operations.

Large batches of the production can be monitored by few cameras.

Reduces the need of skilled labour

Early detection of fault/defects helps in reducing the loss and hence increase productivity

Improved customer satisfaction due to greater reliability

4. CONCLUSION

It can be thus concluded from the paper that Image processing has a definite advantages in the quality control in production industry.

The image processing technology is a fast growing technology which can have multitude advantage for production in mechanical industries. It does not have the ability to decrease the cost of production and improve the delivery time but it also it can also help in deciding the accuracy desired depending on the application.It also ensures that the required production standards are met.

FUTURE SCOPE

AI-powered machine vision is evolving quickly, and the future holds even more promising capabilities. As computing power grows and algorithms become more advanced, manufacturers will be able to implement smarter, faster, and more autonomous quality control systems than ever before.Manufacturers can expect new innovations such as:

Self-learning models: Vision systems that improve accuracy over time by identifying new defect types without requiring manual reprogramming.[1]

Collaborative robot integration: AI vision guiding robotic arms in real time for precision sorting, assembly, and inspection.

AI explainability: Providing transparent, auditable decision trails — crucial for industries with strict regulatory oversight.

REFERENCES

[1] Industrial Image Processing978-3-642-33905-9 Published: 01 October 2013

[2] Jayme Garcia Arnal Barbedo. "Digital image processing techniques for detecting, quantifying and classifying plant diseases" Published in Springer Plus Barbedo Springer Plus 2013, 2:660

[3]Sachin D. Khirade,et.al "Plant Disease Detection Using Image Processing"Published in 2015 International Conference on Computing Communication Control and Automation

[4] Patel KK et.al, "Image Processing Tools and Techniques Used in Computer Vision for Quality Assessment of Food Products: A Review"Published in: International Journal of Food Quality and Safety Volume 1, page 1-16 2015.