# HARDNESS BLOCK SIZE INSPECTION USING IMAGE PROCESSING

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**Abstract-** Hardness block size inspection plays a crucial role in ensuring the quality and reliability of manufactured products. This abstract presents a novel approach utilizing image processing techniques for the inspection and measurement of hardness block sizes. The proposed method begins by acquiring high-resolution images of the hardness blocks using a digital camera or an automated imaging system. Next, image segmentation techniques are employed to isolate individual hardness blocks from the background. Once the blocks are isolated, the image processing algorithm measures their sizes using various geometric analysis methods. To validate the accuracy of the measurements, a calibration process is performed using known reference sizes. The proposed image processing-based approach offers several advantages over traditional manual inspection methods, including increased accuracy, repeatability, and efficiency.

**Keywords-** Testing and evaluation, Computational Vision, Image segmentation, Histogram binarization, Region growing, Indentation images, Manual hardness measurement, Computational system.

## Software components List-

- from scipy.spatial import distance as dist
- from imutils import perspective
- numpy as np
- imutils
- cv2
- time
- cap = cv2.VideoCapture(0)

## INTRODUCTION-

Hardness block size inspection is a critical aspect of quality control in various industries, such as manufacturing, construction, and materials science. It involves the measurement and evaluation of the size and distribution of hardness blocks within a given material. Hardness blocks are small regions or patches within a material that have a different hardness or mechanical property compared to the surrounding areas.

Traditionally, hardness block size inspection has been performed manually using destructive testing methods, such as sectioning and microscopic analysis. However, these methods are time-consuming, labor-intensive, and can potentially damage the material being tested.

Image processing techniques have emerged as a non-destructive and efficient solution for hardness block size inspection. By utilizing digital images of the material's surface, image processing algorithms can automatically detect, analyze, and quantify the size and distribution of hardness blocks.

**Literature Review-**

**Joao Manuel R. S. Tavares [1]**

Mechanical hardness testing is fundamental in the evaluation of the mechanical properties of metallic materials due to the fact that the hardness values allow one to determine the wear resistance of the material involved, as well as the approximate values of its ductility, flow tension, among a number of other key characteristics. As a result, the main objective of the present work has been the development and analysis of a computational methodology capable of determining the Brinell and Vickers hardness value from hardness indentation images, which is based on image processing and analysis algorithms. In order to validate the methodology which has been developed, comparisons of the results resulting from the consideration of ten indentation image samples obtained through the conventional manual hardness measurement approach and a computational methodology have been carried out. This analysis allows one to conclude that the semi-automatic measurement of Vickers and Brinell hardness by the computational approach is easier, faster and less depended on the operator's subjectivity.

## WORKING-

**Image Acquisition:** A digital image of the hardness block is acquired using a camera or scanner.

**Preprocessing:** The acquired image is preprocessed to enhance the quality and improve the accuracy of subsequent analysis.

**Thresholding:** The next step is to convert the preprocessed image into a binary image by applying a thresholding operation.

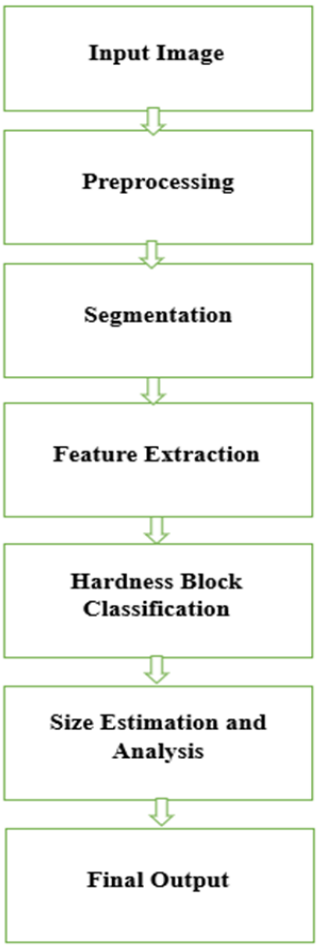
**Object Segmentation:** Once the image is binary, various techniques can be employed to segment and identify individual hardness blocks. This can be achieved by applying morphological operations.

**Block Size Measurement:** After the segmentation, the size of each identified block is measured.

**Analysis and Quality Control:** The measured block sizes can be compared against predefined specifications or tolerances to determine if they fall within acceptable limits.

**Visualization and Reporting:** Finally, the results of the inspection can be visualized and reported.

## BLOCK DIAGRAM-



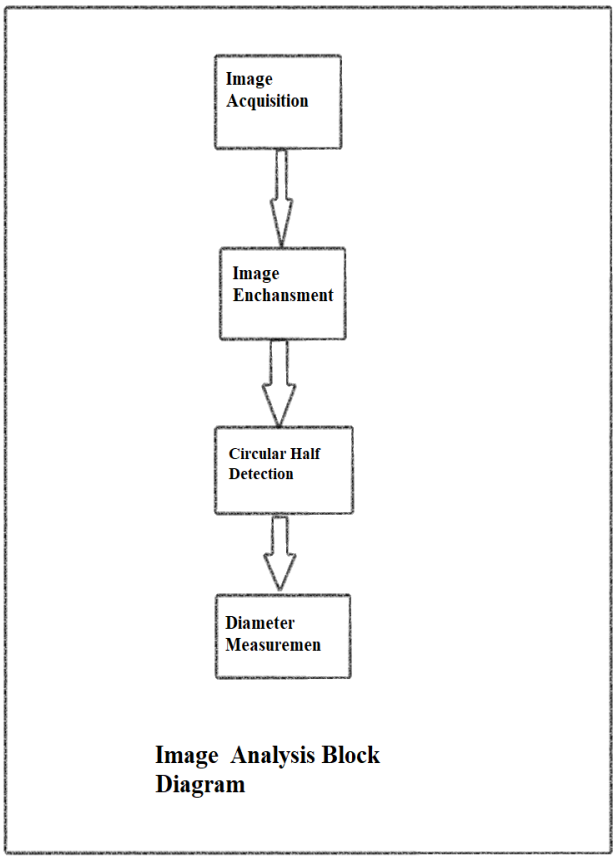



**Image Analysis Block Diagram**

## CONCLUSION-

The conclusion of hardness block size inspection using image processing would depend on the specific methodology, algorithms, and parameters used in the inspection process. However, in general, image processing can be a valuable tool for hardness block size inspection, offering several advantages over traditional manual methods. Here are some key points that might be included in the conclusion:

Accuracy: Image processing techniques can provide accurate and consistent measurements of hardness block sizes, reducing human error and subjectivity. The use of algorithms and automated analysis ensures reliable and objective results.

Efficiency: Image processing allows for rapid and efficient analysis of hardness block sizes. Once the algorithms and parameters are established, the inspection process can be automated, saving time and effort compared to manual inspections.

Reproducibility: Image processing techniques provide reproducible results, enabling consistent measurements and comparisons across different samples or time periods. This is crucial for quality control and monitoring changes in hardness block sizes over time.

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