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Design and Development of Image Processing Based Automated Tool Insert Sorting System

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Abstract:-- **In the constantly changing manufacturing world, passion for metal cutting is crucial to stay ahead. Cutting tools are often designed with inserts or replaceable tips (tipped tools). In these, the cutting edge consists of a separate piece o f material, brazed, welded or clamped on to the tool body. They are usually indexable and low cost. This saves time in manufacturing by allowing fresh cutting edges to be presented periodically without the need for tool grinding, setup changes and without changing the programs. Different tool inserts are used for various applications and could be of various shapes like diamond, square, hexagon, triangle, round, octagon, etc.**

The incoming tool inserts could be sorted based on various shapes, dimensional accuracy, orientation and that if they are used or unused tool inserts. The sorting process consists of use of Image processing to grab the image of the inserts and then processing it through MATLAB software. The software will process the image for above said parameters and results would be generated on screen. A complete database for a given tool insert will also be generated and be available to the user whenever required and then the inserts would be placed in the respective bins.

This paper presents a review on need of sorting tool inserts, various methods used for the same and methodology used for the automated sorting of tool inserts.

Keywords: **Tool Inserts, Image Processing, Microcontroller, MATLAB**

I. INTRODUCTION

Today's coated carbide; cermet, cubic boron nitride (CBN), and polycrystalline diamond (PCD) inserts all play an important role in machining the difficult materials like fully hardened steels, hard powder-metals, heat resistant super alloys, and bimetals. Advanced material inserts with special geometries and coatings withstand mechanical shock and heat while resisting abrasive wear. Using cheaper inserts may cause severe problems and advanced material inserts can pay for themselves in shortened cycles times or more good parts per shift. Thus sorting the inserts accurately according to use, shape and dimensional accuracy is the need of the time.

Industrial Automation has became the global trend in manufacturing and with the success stories of Japanese and European industries in terms of quality manufacturing, more and more companies are opting for automation. Industries must undergo automation to deliver best quality products in time according to customer requirements. It will also result in reduced human intervention and human fatigue, less accidents and non-productive time, mass customization, flexibility and most important accuracy and quality of products. Automated sorting systems are vital for businesses aiming at high distribution capacity and short time-to-market. While designing and developing sorting systems, throughput capacities, product variety, types of loads and number of destinations, potential bottlenecks in receipt or dispatch and order processing times should be taken into consideration.

The paper describes the design and development of automated system used for sorting of tool inserts used in industry according to shape, dimensional accuracy, orientation and their use. Database for various tool inserts will be generated and detailed display of information will be available to the user including its dimensions, shape, orientation (angle and face) and whether it's a used or unused tool insert. Image processing will be employed for this. Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image.

II. PROBLEMS WITH THE CONVENTIONAL SYSTEM:

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a. Time consuming process since human intervention is more and multiple parameters are to be checked.
b. Accuracy is low and incorrect tool insert may be selected or used.
c. Heavy manual material handling, awkward postures, existing or previous human injuries may result in development of musculoskeletal disorders.
d. The minor differences in dimensions, color and orientation of tool inserts may not be sometimes visually inspected correctly so there is a risk of wrong insert being selected. Various shaped tool inserts are shown in fig.1.

Fig.1. Tool inserts

III. LITERATURE REVIEW

The authors defined an approach to identify basic geometric shapes and primary RGB colors in a 2 dimensional image using image processing techniques with the help of MATLAB. The basic shapes included are square, circle, triangle and rectangle. The algorithm involves conversion of RGB image to gray scale image and then to black and white image. This is achieved by threshold concept. [1]

The authors developed sorting and handling system for wooden blocks of three different colors and shapes. Image processing was done through MATLAB and the vision application gave almost 100 % accuracy of sorting with specified colors and shapes. Programmable Logic Controller (PLC) was used for the control and the objects were placed using gripper assembly in bin at different angles. [2]

In another automated sorting system for sorting biscuits according to color and size, the authors used MATLAB for image processing. Capacitive proximity sensors were employed for sensing biscuits on conveyor. The image of biscuits was processed and based on the results from MATLAB the biscuits were placed in two separate bins according to color. The biscuits which were not of desired size were removed by stopping the conveyor through PLC. [3]

The authors presented a hierarchical grading method applied to the tomatoes. In this work the identification of good and bad tomatoes is focused using MATLAB. First they extracted certain features from the input tomato image. Later using different methods like threshold, segmentation, k-means clustering related databases were obtained. Comparing several trained databases, the authors got a specific range for the good and bad tomatoes from which the good and bad tomatoes could be identified. [4]

IV. METHODOLOGY ADOPTED

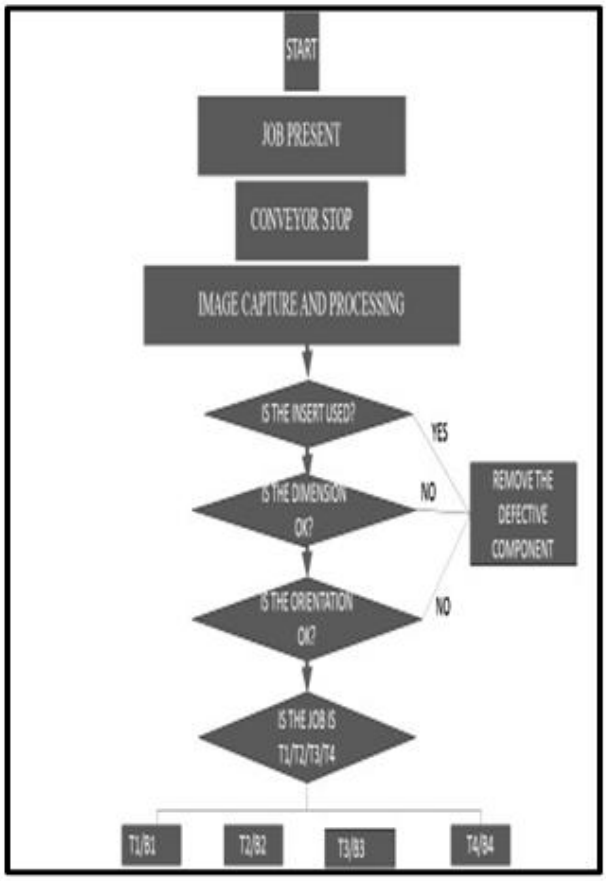

Fig. 2. Flow chart of the sorting process

Fig. 2 depicts the overall flow of operation of automated sorting system. Initially when an insert is sensed on conveyor, the conveyor will move till the insert is

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sensed by an inductive proximity sensor. The conveyor stops and an overhead camera will capture the image of the insert and provide this image to MATLAB for processing. The conveyor after prescribed delay required to capture the image and subsequent processing will start again. Based on the results given by MATLAB, the inserts would be carried to the respective bin through appropriate handling system. The image captured will be compared with the standard images from the database for the dimension, orientation and shape and results are obtained. If the inserts are used, the conveyor will stop after processing giving a signal to the operator to remove it from the system. Thus a fool proof and accurate automated sorting system comprising of image processing, microcontroller and subsequent mechanical assembly is available for sorting the tool inserts.

V. SYSTEM COMPONENTS:

A. Mechanical Components -

The main mechanical component in the system is the conveyor belt on which the inserts would move. The main criteria for selection of belt were material, length and width. The decided material for the conveyor is rubber molded with plastic. The width was restricted so that only single insert will be present on the conveyor to get better image for processing. The other concern was the color of belt to get clear images without any reflection. The other components include rollers, gear motor and camera.

The rollers are of dumbbell size which will avoid the slippage of the belt. Geared motor of 10 rpm is selected to maintain the slow speed of the conveyor assisting in frequent start and stop. HP webcam 1300 camera is used to provide the images of objects for image processing to MATLAB. The camera used is an overhead camera which takes snapshots of the tool inserts. The other specifications include –

Interface: USB 2.0 port and down compatible
USB 1.1 port;
Transmission rate – 640*480/30 fps;
1280*960/10-15 fps.
VFW interface; support seizure of both still and moving image. Automatic white balance, automatic gain control and automatic color compensated.
Support Win98/ ME/2000/XP/Vista, etc.

B. Electronic Components –

The electronic components mainly include photoelectric sensors and microcontroller and associated signal conditioning circuit. The sensor will sense the insert and accordingly send a signal to microcontroller to either start or stop the conveyor motor. Microcontroller is easy to interface with MATLAB software and hence is preferred over PLC, the other reason being limited variety of operations. The signal conditioning circuit includes relays to save microcontroller from being damaged from high voltage or current, amplifiers, diodes and relay driver.

C. Image Processing- [5][6]

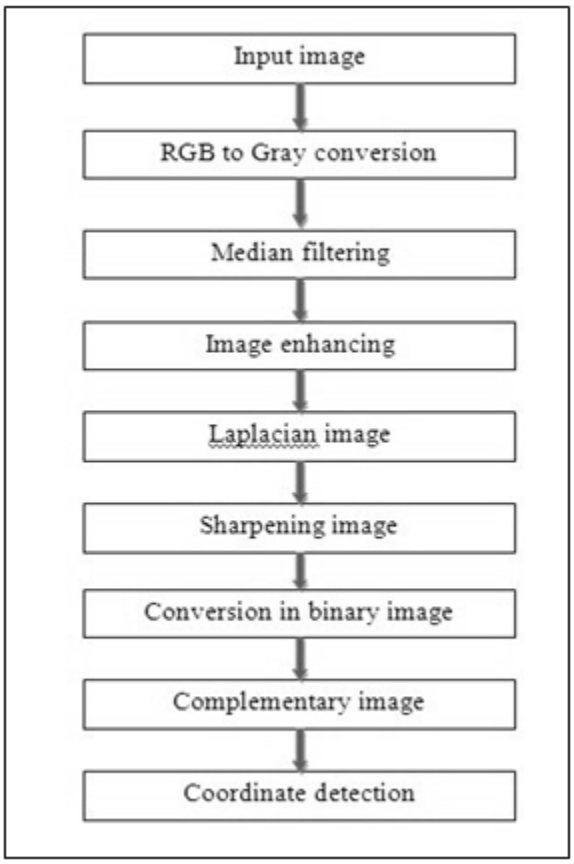

Fig.3. Steps in Image Processing

Figure 3 show the steps in image processing. Image processing is one of the most important step in the system as the sorting would be done on the basis of the image captured and processed. It is done by using MATLAB software. MATLAB is a software package for high-performance numerical computation and visualization. It provides an interactive environment with hundreds of built-in functions. It has its own high-level programming language and the name MATLAB is extracted from MATrix LABoratory. MATLAB is used in communication system, control system, mechatronics, digital signal processing, testing and measurements. The

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commonly used commands in MATLAB are imread to read the input image by processor, imshow to show the image to user for further process, imcrop for image cropping, etc.

The image acquisition is done using a digital camera and it is loaded and saved using MIL software. It supports jpg, tif, bmp and raw formats. A RGB image is received after this stage. The images obtained here are not suitable straight for identification and classification purpose because of certain factors, such as noise, climatic conditions, and poor resolution of an images and unwanted background etc. so it is preferred to go for pre-processing which involve background subtraction, converting RGB to Gray and converting Gray to binary.
RGB is one of the formats of color images. Gray scale or monochromatic images have the only color which is a shade of only gray in between. A binary image is a digital image where the image has two assigned pixel values. Typically the two colors used for a binary image are black and white.

Background subtraction is a process of extracting foreground objects in a particular scene. Image enhancement is basically improving the interpretability or perception of information in images for human viewers and providing better input for other automated image processing techniques. In the complement of a binary image, zeros become ones and ones become zeros; black and white are reversed. After successive completion of all above operations the coordinates of the inserts are obtained. With some of the same steps above combined with related instructions the color, shape and orientation of inserts could be determined.

VI RESULTS

By following the steps mentioned above it is possible to process the image digitally and obtain the required parameters for sorting. The processed images for a triangular tool insert sample are as shown in fig. 4.

The series of images start with the original image followed by enhanced image, Laplacian image, then by sharpened image and a black and white or binary image. Finally a complementary image is obtained. Fig.5. shows the final output images used for co-ordinate determination.

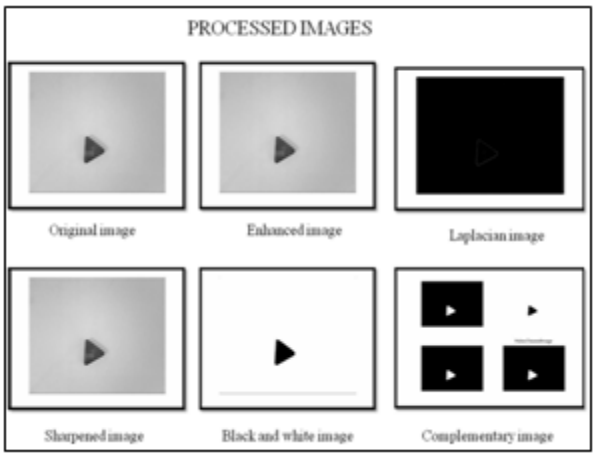

Fig. 4. Series of processed images

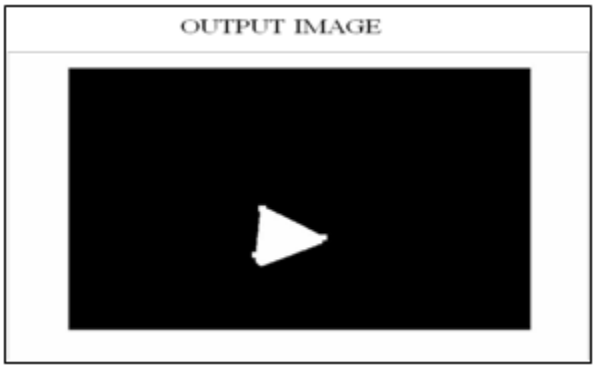

Fig.5. Final output image for co-ordinate determination

The set up for the image processing and handling of the tool inserts is as shown in fig.6. It consists of a conveyor with rollers, attachment for overhead camera, sensor and electrical circuit. The sorting system is yet to be finalized from the available options for which new QC tools have been applied to select the best option.

Fig.6. Set up for insert handling and image processing

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VII. CONCLUSION

The new sorting system will definitely reduce the human intervention and fatigue, improve the accuracy of sorting and hence sorting the objects on multiple parameters with same set up is possible. Similar set up with required modification and scaling can be used for sorting and handling of various components in bakery, medical, textile and many more applications.

The co-ordinates for the tool inserts have been obtained from which the shape can also be predicted. MATLAB programs for other parameters would be defined and the final sorting system hardware will be developed and interfaced with microcontroller thus making it a perfect advantageous mechatronics system.

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REFERENCES

1. Shambhavi Vijay Chhaya, Sachin Khera, Pradeep Kumar, Basic geometric shape and primary color detection using image processing on MATLAB, IJRET eISSN:2319-1163, pISSN:2321-7308, Volume: 04 Issue: 05, May-2015, page no.- 505-509.

2. S. A. Soundattikar, Suyash Dani, Md. Azhar Shahapure, Sharvari Naik, Archana Narale, Automation of Material Handling and Sorting System by using Image Processing and PLC, International Conference on Electronics and Computing, ICEC – 2015, IEEE Bombay Section, April 2015, page no. – 257-263.

3. Kulkarni B. P., Satpute M. A., Soundattikar S. A., Image processing and PLC based Automated Biscuit Sorting System, IJARSE, Vol. No. 5, Special issue No.1, March 2016, pg. no. 72-77

4. R.Kalaivani, Dr.S. Muruganand, Dr. Azha.Periasamy, Identifying the quality of tomatoes in image processing using MATLAB, IJAREEIE, pISSN: 2320 – 3765,eISSN: 2278 – 8875, Volume: 2, Issue 8, August 2013, page no. –3525-3531.

5. Rudra Pratap, Getting started with MATLAB, ISBN: 978-0-19-973124-4, page no. -1-58.

6. www.mathworks.com