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# LABVIEW BASED DIMENSION DETECTION AND SEGGREGATION OF GOOD AND FAULTY CRANK PINS

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*Abstract*

In engines, the crank pins are the journals of the off-centre bearings of the crank shaft. Crank pin is a high precision metallic cylindrical rod. Crank pins are heat treated and cured. After that three holes are drilled on the crank pin. Cross hole is the one in which the oil flows from the crank case to the 2mm hole. The 2mm hole is tangential to the bearing such that oil surrounds the bearing. The main purpose of this hole is to cool down the bearing which runs at very high speed nearly 10000 rpm. The dimension of the hole plays a crucial role. At present, the dimensions are measured manually leading to inaccuracy, gross error and time consuming. In the proposed work, the dimensions are estimated using vision assistance tool of LABVIEW software.

*Keywords-- Crank Pin, Calliper, Dimension measurement, Edge detection*

## I. INTRODUCTION

Crank pin plays a vital role in the smooth running of the engines. In a reciprocating engine, the crank pins are the bearing journals of the big end bearings and the ends of the connecting rods opposite to the pistons. If the engine has a crankshaft, then the crank pins are the journals of the off-centre bearings of the crankshaft. In a beam engine the single crank pin is mounted on the flywheel; in a steam locomotive the crank pins are often mounted directly on the driving wheels. Big end bearings are commonly plain bearings, but less commonly may be roller bearings. Crank Pin is a high precision item, having round cylindrical shape. It can be of hole or solid type, but must have a high surface finish, to serve as running surface for needle bearings. Three holes are drilled in the crank pin. The dimensions of the holes need to be maintained at a predefined values. At present, hole dimensions are measured manually now. Due to gross error, the position of the holes cannot be detected accurately and the process consumes more time. In the present work, the dimension of the hole is determined using Image Processing Tool of LABVIEW.

## II. CRANK PIN

Crank Pin is a high precision item, having cylindrical shape. It can be of hole or solid type, but must have a high surface finish, to serve as running surface for needle bearings. The surface must be free from nick marks and must be hard, to bear the normal wear and tear of the vehicle.

It is firmly connected to the connecting rod and as such the geometry of the outer diameter as well as side faces play a vital role in fitment and running. Figure 1 shows the crank connected to the piston. Figure 2 shows the sample crank pins.
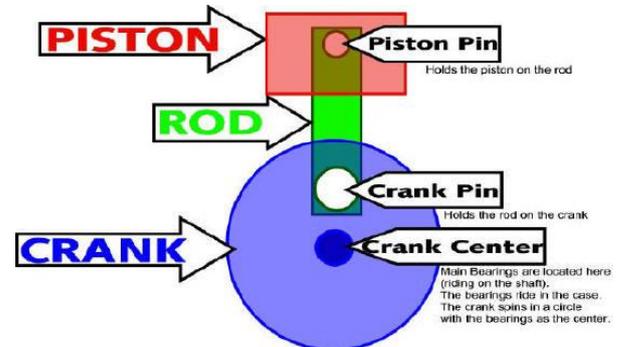


Figure 1. Crank pin



Figure 2 Sample pins

**Figure 3 Process diagram**

There are two types of cranks.

- The first type is the continuously rotating crank, such as in engine crankshafts or on bicycles, where the crank can continuously turn more than 360 degrees without having to reverse.
- The second is the partial circle crank, where the entire rotary motion of the main shaft may be 90 degrees or less, as with steering linkages or ventilation damper adjustments.

Figure 3 shows the various process in the treatment of the crank pin. The crank pins are heat treated and cured. While heat treatment the low level carbons are converted into high level carbons. After that three holes are drilled on the crank pin for the purpose of cooling the engine by allowing the oil to flow through the holes. The dimensions of these holes in the crank pin are measured manually in that company. During the manual inspection there are several difficulties in measurement.

1. Inaccuracy in the measurement.
2. Gross error because the measurement will vary from person to person.
3. Manual inspection is time consuming.

To overcome these disadvantages, the dimensions of the holes are measured using image processing tool of LabVIEW software.

## III. DIMENSION MEASUREMENT USING LABVIEW

LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications. In LabVIEW, user interface can be built with a set of tools and objects. LabVIEW creates programs in block diagram form. The project is done using VISION BUILDER, a special tool in LabVIEW. Using this tool, real time online images of the pins are taken and image processing is done with the images.

The main objective in the proposed work is to create the template of the images and the required properties of the pins such as Linear edge of the top surface of the pin, Circular edge of the top surface of the pin, Radius of the reference hole, Horizontal (x- axis) and vertical (y-axis) distance of the cross hole, Horizontal (x-axis) and vertical (y-axis) distance of the connecting holes.

## IV. IMAGE ACQUISITION

First the images of the pins are taken for image processing using High Definition Camera. Compact vision system is used as the data acquisition system to import the images from the HD camera to the LabVIEW software. On startup, Vision Builder AI loads a blank inspection in the Inspection Diagram window. To build an inspection, it is required to add and configure steps to the inspection. In the Inspection Steps palette, the Acquire Images tab contains acquisition steps-Acquire Image and a Simulate Acquisition step, which simulates image acquisition by loading images from file. The tab also contains a Select Image step, which enables to switch to a previously acquired image that needs to be processed later in the inspection. On completion of the various steps, the captured image needs to be saved.



**Figure 4. Acquire image**

The image is acquired by the selecting the image acquisition tool from the inspection steps palette and clicking the simulate acquisition step. The property page opens in which Acquire Gasket is entered in the step name control. Navigate to Vision Builder AI and select the first image The following instructions are followed to configure a Simulate Acquisition step that simulates acquired image of the pin. OK is pressed to add the step to the inspection.

## V. CALIBRATING IMAGES

By default, Vision Builder AI returns measurements in pixel units. For the inspection to return measurements in real-world units, it is necessary to map pixel units in real-world units through a process called spatial calibration.

To configure a Calibrate Image step that defines the type of calibration, the calibration parameters, and the real-world unit in which the measurements need to be expressed, In the Inspection Steps palette, Enhance Images tab is selected. Calibrate Image step is clicked and in the Step Name control, Calibrate Gasket is entered New Calibration is clicked to launch the calibration wizard. Assumption made is that the camera that acquired the inspection images is perpendicular to the image plane and lens distortion is negligible. Based on these assumptions, Simple Calibration is used to calibrate the inspection images. Simple Calibration transforms a pixel coordinate to a real-world coordinate through scaling in the x(horizontal) and y(vertical) directions.
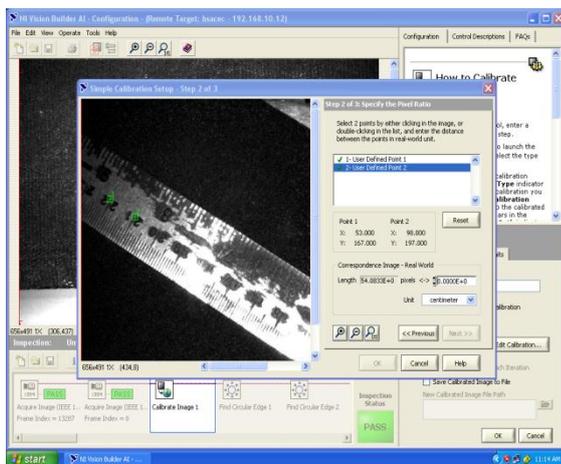


**Figure 5. Image for calibration**

Calibration used in this work is a simple calibration setup involving pixel type. The 21mm and 22mm markings on the ruler is clicked in the image as shown in the figure. In the Correspondence Image-Real World control, 1 is entered for the value, and the unit is selected as centimeter.
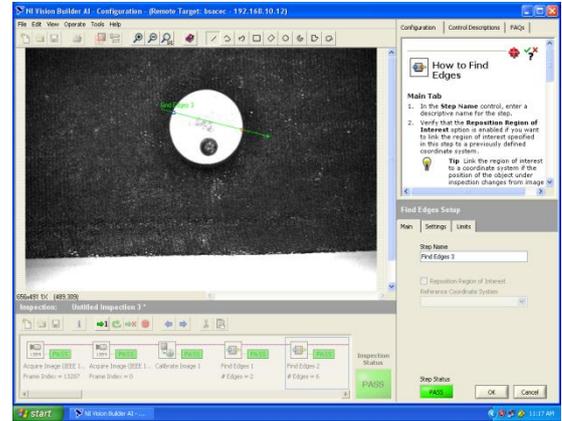
### 5.1. Linear edge detection



**Figure 6 Linear edge detection**

The edge is detected by first Selecting Machine Vision palette and then Edge Detector. In the Edge detector, advanced edge tool is selected which is effective on images with poor contrast between the background and the objects. First & Last Edge are selected so that IMAQ Vision Builder finds and labels only the first and last edges along the line drawn. Contrast is set to 40. The detection process only returns the first and last edge whose contrast is greater than 40. A vertical line is drawn across the surface of the pinto to find the edges that can be used to calculate the edges. IMAQ Vision Builder labels the edges 1 and 2. The sharp transitions in the line profile indicate edges. The number of edges found is displayed under the line profile. Edge detection step is added to the script. Finally the edge detector window is closed.

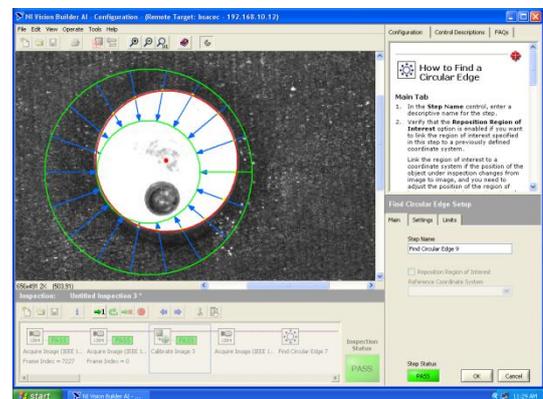### 5.2. Circular outer edge detection



**Figure 7. Circular edge detection for top surface**

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Circular edges are detected by first selecting the Machine Vision and then circular edge detector. Similar to the linear edge detection, here also Advanced Edge Tool is selected. A circle is drawn around the top surface of the pin to find the edges that can be used to calculate the edges. IMAQ Vision Builder labels the circular edges. This edge detection step is added to the script and the radius of the top surface is noted. The Edge Detector window is closed. As shown in figure 7,the red line with yellow colour dots shows the perfect circular edge of the crank pin. The radius of the outer surface of the pin is found here. Thus the circular edge detection of the crank pin was detected and the radius of the outer surface of the pin was calculated as 1.31 cm.This radius of the pin was saved as the template.

### 5.3. Circular EDGE detection for reference hole

The procedure used for the outer edge detection is repeated for the edge detection of the reference hole. A circle is drawn around the reference hole of the pin to calculate the edges. IMAQ Vision Builder labels the circular edges.
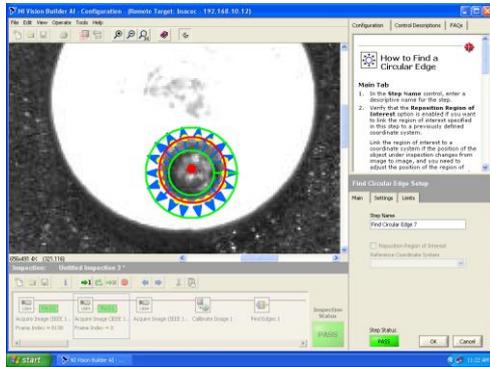


**Figure 8. Circular edge detection for reference hole**

As shown in figure 8, the red line with yellow colour dots shows the perfect circular edge of the reference hole.The radius of the reference hole of the pin is found here. The edges of the reference hole is detected. Thus by using the circular edge detection tool the radius of the reference hole was calculated as 0.31 cm.This radius will be saved for the template.

### 5.4. EDGE detection for cross hole

Since the cross hole is not on the flat surface, the circular edge of the cross hole cannot be determined with simple circular edge detection method. So, it is necessary to use caliper measurement method. In this caliper measurement method, using the co-ordinate system calibration, first the horizontal(x-axis) distance and then the vertical(y-axis) distance are found.

The measurement starts by selecting Caliper in Machine Vision. In the figure 9, points 1 and 2 are selected to obtain the first measurement which specifies the horizontal distance of the cross hole. Then the Center from the Type of Measure list is selected. Measure button is clicked to compute the horizontal distance of the cross hole and the distance measurement is added to the results table. The same procedure is repeated for the vertical measurement also by choosing the points 3 and 4. Finally the script is saved as crosshole.scr. Figure 9 shows the image with Horizontal(x-axis) Distance and Vertical(y-axis) Distance selected on the image and displayed in the results table.
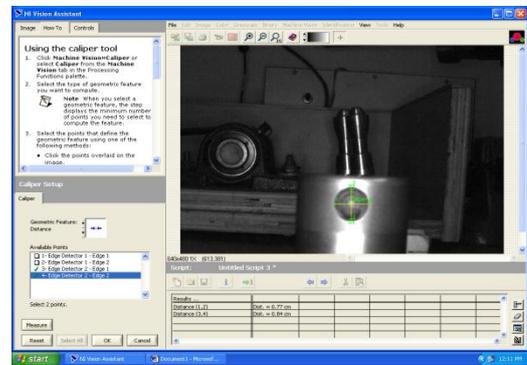


**Figure 9. Cross hole measurement**

The cross hole is not on the flat surface,so the circular edge of the cross hole cannot be determined with simple circular edge detection method. So the caliper measurement is used to find the horizontal(x-axis) distance and vertical (y-axis) of the cross hole. The horizontal distance and Vertical distance of the cross hole were 0.77cm and 0.84cm. The same procedure is repeated for the connecting hole and dimensions are found. Figure 10 and 11 shows the horizontal and vertical measurement of the connecting hole
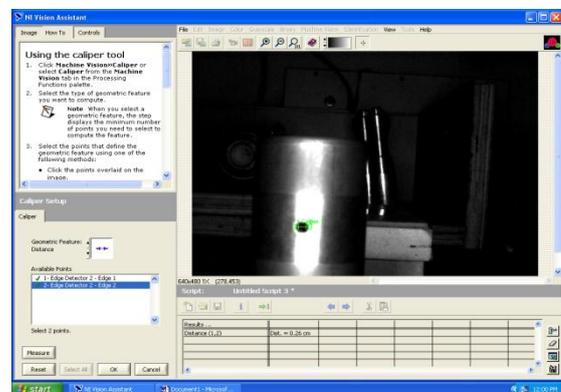


**Figure 10. X-axis distance of connecting hole**

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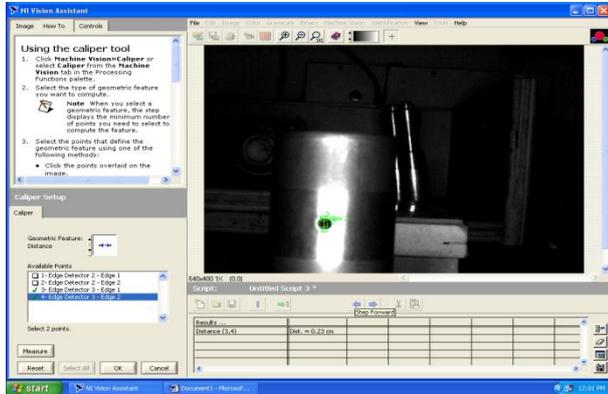


**Figure 11 Y-axis distance of connecting hole**

Thus the horizontal distance and vertical distance of the connecting hole were estimated as 0.24cm and 0.42cm

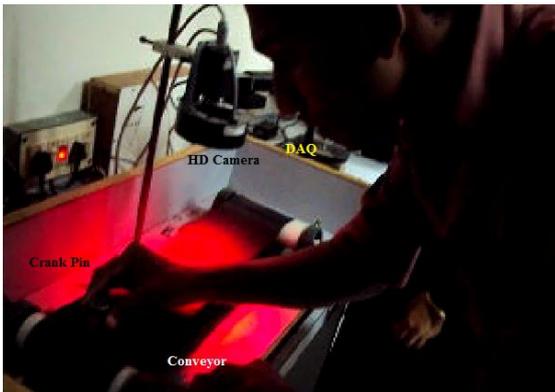## VI.  PATTERN MATCHING AND DIMENSION VERFICATION



**Figure 12.  Setup diagram for the dimension detection process**

The dimensions of the crank pins to be tested are compared with the templates of the standard already stored. For comparison, the Set Coordinate System step based on the Match Pattern step which is configured. In the Inspection Steps palette, Locate Features tab is selected and the property page of the set co-ordinate system step is opened and on the main tab, Coordinate System in the Step Name control is entered. On the Settings tab, Horizontal and Vertical Motion tab are selected from the Mode control. The step to the inspection is added. Figure 12 shows the setup diagram of the Process for the dimension measurement of the crank pin.

## VII.  CONCLUSION

The standard crank pin outer diameter, the top hole diameter are measured by advanced edge tool technique and the cross hole situated on the circumference of the crank pin is measured by the calliper method and they serve as the template for the detection of the good and faulty crank pin. The pins are placed on the conveyor and the dimension of the test pin are compared with the template and a threshold is given. If the dimension matches with the template, the pins are marked as good else are rejected. The method proves to be sturdy and accurate for the determination of the crank pin dimension.

### REFERENCE

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