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Gear Error Detection and Analysis using MATLAB

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ABSTRACT: A sampling method of gathering representative data from a group. For example, a manufacturer might check only 2 or 3 gears from a batch of 100 gears. Due to which the whole lot gets rejected if any gear in between has error in it. Thus we need to check each and every gear in the batch but manually this process is time consuming. In our project we are designing and manufacturing a system which will be checking each and every gear. We use a conveyor belt for movement of gear, a camera for capturing and checking the gear parameters for its error by comparing the parameters stored at the back end. If the parameters are matched with the stored parameters then it goes to the accepted lot otherwise with the help of shooting gun it goes to the rejected lot.

Precision measurement of gears plays a vital role in gear measurement and inspection. The current methods of gear measurement are either time consuming or expensive. In addition, no single measurement method is available and capable of accurately measuring all gear parameters while significantly reducing the measurement time. The aim of this paper is to utilize the computer vision technology to develop a non-contact and rapid measurement system capable of measuring and inspecting most of spur gear parameters with an appropriate accuracy.

KEYWORDS: Gear, Gear drives, Motors, MATLAB, Image Processing, Errors, Addendum, Dedendum, Pitch Circle Diameter (PCD, Module).

I. INTRODUCTION

Gear is a widely used mechanical component whose primary use is to transmit power from one shaft to other. These gears are of many types namely spur gear, helical gears, worm gears etc.

Gear drives are used to various kinds of machines like automobiles, metal cutting tools, material handling equipment, rolling mills, marine power plants etc. The friction and other losses in this type of power transmission equipment is comparatively very low.

In this work we use a software called "MATLAB" to determine gear parameters. MATLAB is extensively used for scientific & research purposes. It is accurate & also having a number of built in functions which makes it versatile. The program is a user friendly one & when executed it ask the inputs and performs the necessary design calculations and gives necessary output values. As computers are used to perform the task of gear design becomes simple, friendly & error free.

In this world of fast paced computation where resources with time and money/capital are very important the activities in manufacturing and processing industries are day by day being performed by computers, algorithms and computing agents replacing human or semi- human intervention. Here in the industries that require gears the filtering and classification of gears is very important and is done by human labour, precisely human labour is limited to its way of working and the time, cost required. Classification can be done with the use of imaging devices, Cameras and scanners with developing an algorithm that describes what to accept and reject.

Computer science image processing technology is gradually becoming a part of our daily life as it continues to get excellent results while promoting the technological advancement and development. As the key role of technology that presents gear size and measurement and guides to do research and develop more advanced computer technologies, such as DSP (digital signal processing) technology, and DIP (digital image processing) technology. We will measure the image object features easily by using these technologies.

The measurement is essential task to limit the gear at specific size. By using image processing the fundamental work

has been carried out to measure following things which are its most important features.

II. LITERATURE REVIEW

1. Haque Nawaz, Himat Ali, “Gear Measurement Using Image Processing in MATLAB”, ‘International Journal of Innovative Technology and Exploring Engineering (IJITEE)’, 2014, Volume-3, pp43-47.

Gear Measurement has been carried out by focusing two features of gear image object. The problems are to measure the gear features of gear image object, in the sense the measurement of the Area of the gear image object and as well the teeth of the gear will be counted. We have used MATLAB tool and development code which overcome these problems and measured the area as well as teeth of the gear image object counted. To accomplish this task, we have measured five different gear image objects area and counted the teeth by using image processing.

The gear Area calculated, and teeth counted by using image processing in the MATLAB tool. This paper having the five gear image objects which are processed from developed MATLAB code, all gear image objects found having different value of area and varying teeth with another. These have been measured through the same developed MATLAB code. In this paper each experimental work figure of different gear objects measured with the help of MATLAB tool by using image processing.

As the key role of technology that presents gear size and measurement and guides to do research and develop more advanced computer technologies, such as DSP (digital signal processing) technology, and DIP (digital image processing) technology. We will measure the image object features easily by using these technologies.

The measurement is essential task to limit the gear at specific size. By using image processing the fundamental work has been carried out to measure two things which are its most important features.

- a) To measure the Area of the gear image object
- b) To count the number of teeth in gear image object.

In this regard we have converted the original gear image object into grayscale, and then grey scale of original gear image goes from steps to count the teeth of the gear. It means by using programming code, we measure the gear teeth in respect of teeth counted through image processing.

2. Cheng Pengfei and Feng Changyong Henan, “Characteristic Value Extraction of Gear Defect Based on Image Processing”, ‘Journal of Multimedia’, 2013, Volume- 8, pp 198-205.

Based on the two different image expressions of defect forms, this paper abstract defect is ratio as well as the characteristic value and abstract contrast with Grey co-occurrence matrix as image characteristics. In order to verify the abstracted image characteristic for evaluating pitting and wearing effectiveness, we use the neighbouring method to construct are cognition model and analyse the collected image samples.

3. Zhang Jing, “The Research on the Application to Digital Image Technology in Hypoid Gear Contact Zone Detection”, ‘Journal of Computers’, 2011, Volume-. 6, PP 1519-1525

Computer image technology is increasingly applied to all walks of life, continue to achieve good results, and effectively promote the technological progress and development. Computer image processing as an embodiment and the development of various advanced science and technology(including computer technology, signal processing, etc.) is the hot point for the development and application of the current technology.

III. METHODOLOGY

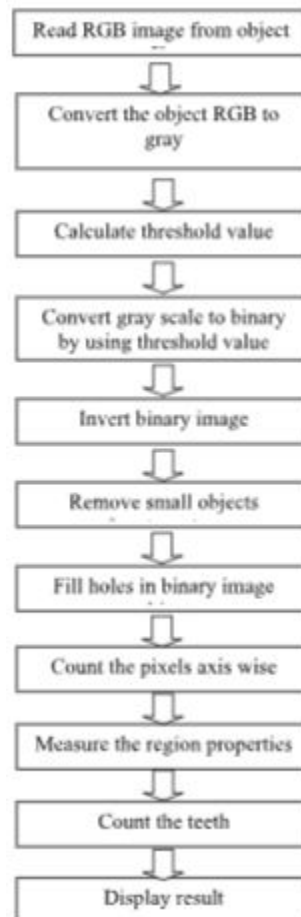


Fig. Flow chart

Methodology

1. Data Collection

Describe the gear samples used for training and testing the detection system.

Specify the characteristics of the gears, including size, material, and manufacturing method.

Explain how the gear samples were prepared, including any surface treatments or markings applied for error simulation.

2. Sensor Setup

Detail the sensors and equipment used for data acquisition, such as optical scanners, laser sensors, or contact probes.

Explain the setup of the sensors relative to the gear samples and any calibration procedures performed to ensure accuracy.

3. Data Processing

Outline the steps involved in processing the raw sensor data to extract relevant features for error detection.

Discuss any preprocessing techniques applied, such as noise reduction, filtering, or normalization.

Explain how feature extraction algorithms were selected or developed to capture the distinctive signatures of gear errors.

4. Error Detection Algorithm

Describe the algorithm or model used for detecting gear errors based on the extracted features.

If machine learning techniques are employed, specify the type of model (e.g., neural network, support vector machine) and the training process.

Discuss how the algorithm was trained, validated, and optimized to achieve accurate and reliable error detection.

CAD MODEL –

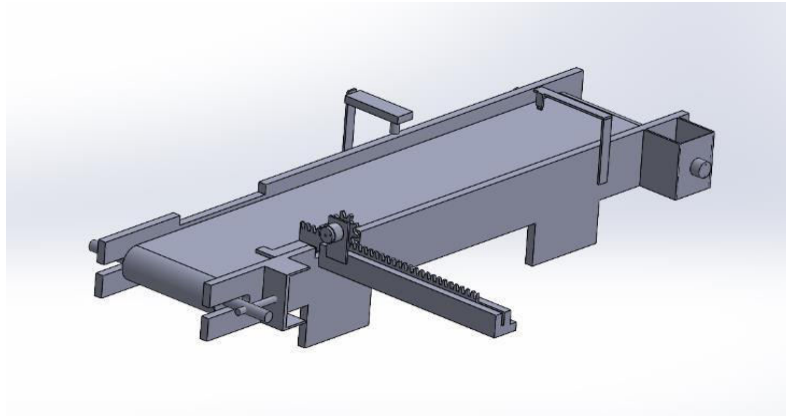


Fig- 1. CAD model

IV. EXPERIMENTAL RESULTS

- Right Gear Result**

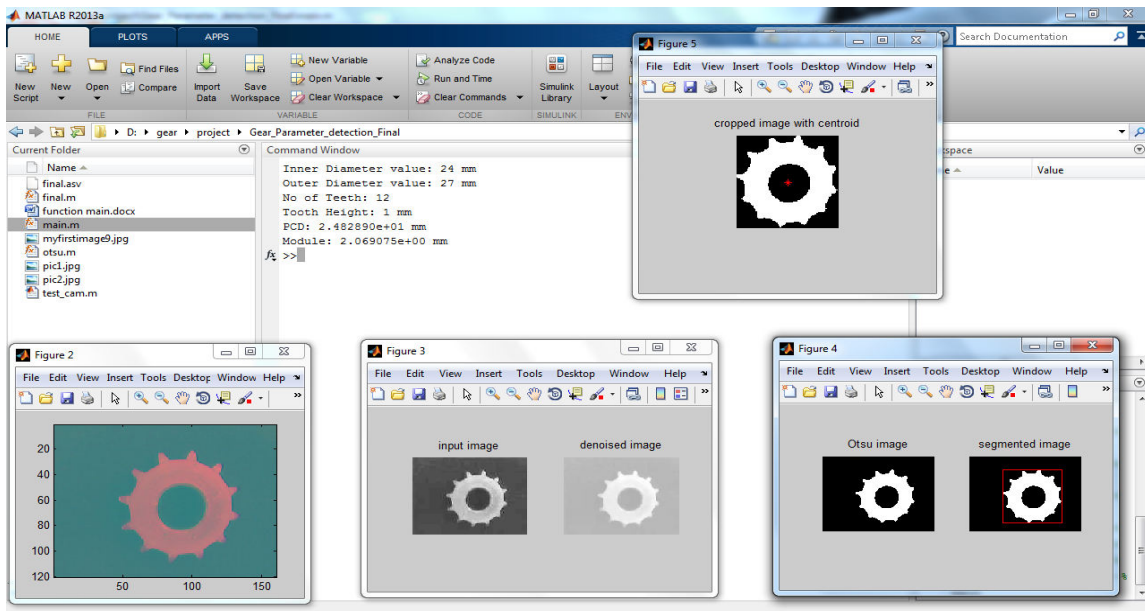


Fig. Right Gear Result

• Defective Gear Results

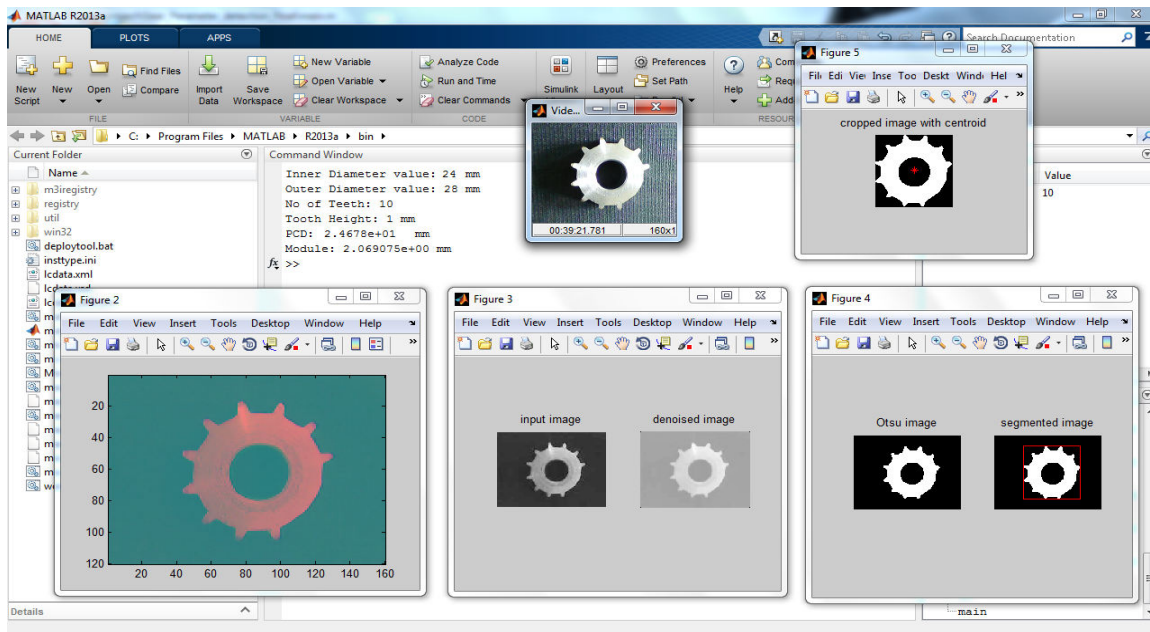


Fig. Defective gear Result

V. CONCLUSION

The gear Area calculated, and teeth counted by using image processing in the MATLAB tool. This paper having the five gear image objects which are processed from developed MATLAB code, all gear image objects found having different value of area and varying teeth with another. These have been measured through the same developed MATLAB code. Gear objects can be measured with the help of MATLAB tool by using image processing.

Digital image processing processes and evaluates images through computer with particular algorithm. In future image processing techniques can be applied in various fields with great achievement. Digital image processing can divide into image transformation, image intensification and restoration, image segmentation, image analysis, image recognition and other technique branches.

With use of MATLAB and Image processing technology gear inspection is achieved in less time. It has applications in other fields such as applicable in nut, gear manufacturing industries, applicable in Quality Control departments, can be applied in gear manufacturing unit, can be used in automobile industry, used in both small scale industries as well as the large- scale industries, All kinds of circular components can the tested.

We conclude that image processing technology can be effectively useful in manufacturing industries, automobile industries, space, medical and biological study, remote sensing, computerized photography etc.

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