Development of an Advanced Gear Measurement System through Image Processing Technique

Mr. Nilesh Jawarkar
Prof. Mech.Dept.
JSPM RSCOE
Pune, India

Niraj Jagtap
Mech. Dept
JSPM RSCOE
Pune, India

Rohit Maske
Mech. Dept.
JSPM RSCOE
Pune, India

Vivek Khirodkar
Mech. Dept.
JSPM RSCOE
Pune, India

Saurabh Metkari
Mech. Dept.
JSPM RSCOE
Pune, India

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 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. A vision system has been established and used to capture images for gears to be measured or inspected.
The introduced vision system has been calibrated for metric units then it was verified by measuring two sample gears and comparing the calculated parameters with the actual values of gear parameters. For small gears, higher accuracy could be obtained and as well as small difference.

In this paper 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 experimental results and statistics have been shown in this paper.

Keywords: Image Processing, Gear Measurement, Gear Tooth Analysis.

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.

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 several 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 labor, precisely human labor 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.

a. To calculate outer diameter (Addendum diameter).

b. To calculate inner diameter (Dedendum diameter).

c. To count the number of teeth in gear image object.

d. To calculate tooth height.

e. To calculate PCD of gear.

f. To calculate module of gear

Problem Statement

Gears have a wide variety of use in mechanical and electrical industries and need to be perfect and flawless with accurate and required number of jaws, diameter, used material , size of jaws, distance between jobs and so on. These all features define the correctness and application in sense where these gears are to be used. This problem of seeing and classifying gears are done by humans but have limitations of speed and accuracy .This responsibility of classification of items can be speeded and made more accurate by the use of imaging technology and computers aided by some mechanical devices.

A gear or more correctly a "gear wheel" is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit torque. Two or more gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, torque, and direction of a power source.

The gears in a transmission are analogous to the wheels in a crossed belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage.

When two gears mesh, and one gear is bigger than the other (even though the size of the teeth must match), a mechanical advantage is produced, with the rotational speeds and the torques of the two gears differing in an inverse relationship.

In transmissions with multiple gear ratios such as bicycles, motorcycles, and cars the term gear, as in first gear, refers to a gear ratio rather than an actual physical gear. The term describes similar devices, even when the gear ratio is continuous rather than discrete, or when the device does not actually contain gears, as in a continuously variable transmission.

There are different types of gears and this fact gives us the idea of the complexity of the problem we are attempting to solve with use of imaging and computers.

Methodology

In figure, the original gear image is read by tool and converted into grayscale then threshold it, after that the area of gear image calculated and highlighted the interested region for to count the teeth, then teeth of the gear counted as shown in below steps.

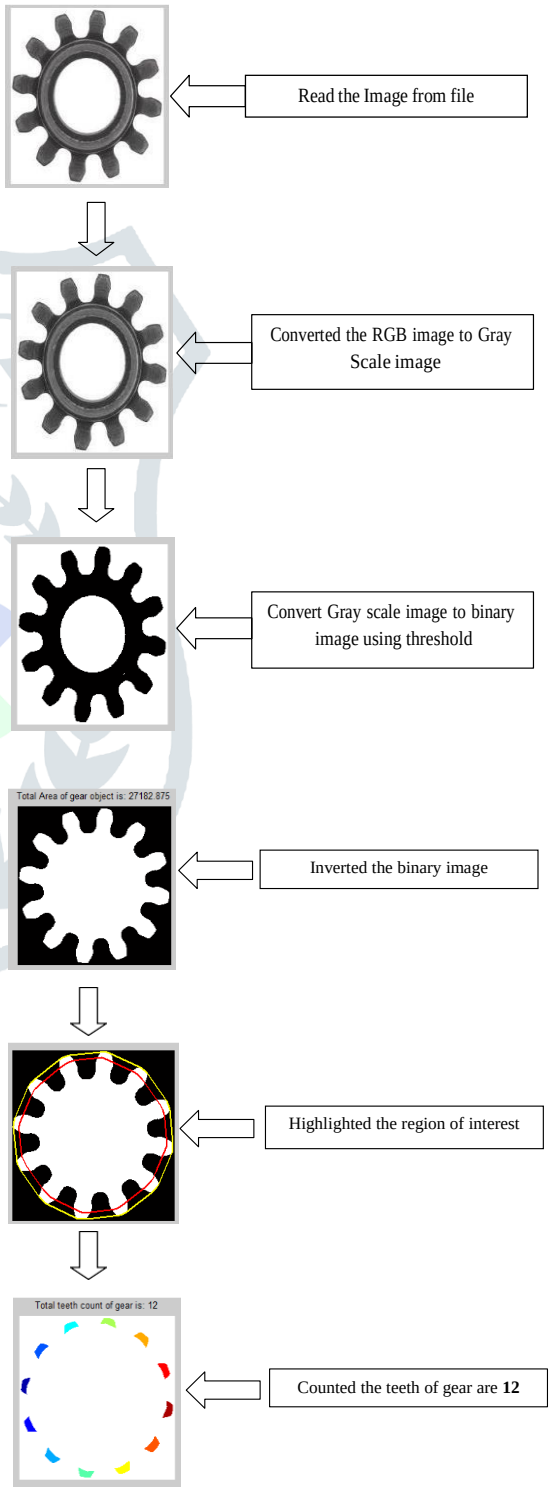

Fig 3.1.1 Methodology

Working:

We have developed Matlab code by using image processing, read the image original gear object and converted original gear object into gray scale image, then calculated the threshold value of gray scale image and by using threshold value we have converted the gray scale image into binary image.

After this process it has removed small objects from the binary image, to overcome the holes of the object it has filled the holes of binary image object, then calculated the surface of binary image of gear object, showing the area of gear object here it is measured.

The code has sequenced in this way, it has measured the properties of the image object regions, after that we have convex the polygon which are in regions, finally it is converted into regions of interest to the regions mask through which it has been highlighted the region with red and yellow lines which indicates the teeth region of a gear object.

Obviously through this process it has measured the gear object area and counted the teeth by using the MATLAB tool, the five different gear objects measured by changing the name of the gear object in same developed code. It is shown in experimental work figures.

The results are shown in results section in which we have found the Outer diameter (Adedendum diameter), Inner Diameter (Dedendum diameter),PCD, Module, Number of teeth and tooth height of a gear image object and counted the teeth.

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 been 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. MATLAB as one kind of high-level computer language, it has a powerful data processing ability that obtains widely application in digital image processing.

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 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.

REFERENCES:

1. E.S. Gadelmawla ‘Computer Vision Algorithms For Measurement and Inspection Of Spur Gears’, Measurement 44(2011) 1669-1678.
2. Amandeep Mavi, Mandeep Kaur ‘Identfy Defects In Gears Using Digital Image Processing’ ISSN:2278-067X,Volume1,Issue 6(June2012)
3. MD. Hazrat Ali, Syuhei Kurokawa,Kensuke Uesugi ‘Vision Based Measurement System For Gear Profile’ IEEE 2013
4. MD. Hazrat Ali, Syuhei Kurokawa,Kensuke Uesugi ‘ Camera Based Precision Measurement In Improving Measurement Accuracy’ Measurement 49(2014) 138-147.
5. Sanjana HK, Soniya MG, Sunitha NR,Vismitha PV ‘Quality management Of Mechanical Parts Using Image Processing’ ISSN:2229-6093(2017)