

Implementation of MATLAB in Spur Gear Profile System.

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Abstract

An arrangement of Gears on the conveyer plays a key role in determining the physical properties and the performance characteristics of gears. MATLAB is extensively used for scientific & research purposes. It is accurate & also having a number of built in functions which makes it versatile. As Gear defects are a major reason for poor quality and of embarrassment for manufacturers. Inspection processes done on these industries are mostly manual and time consuming. To reduce error on identifying gear defects requires more automotive and accurate inspection process. Considering this lacking, this research implements MATLAB for error detection of gear tooth profile which uses USB camera and RF sensors to identify possible defects. The recognizer identifies the gear defects within economical cost and produces less error prone inspection system in real time. Primarily the USB camera captures digital gear image and converts the RGB images into binary images by restoration process and local threshold techniques. Later, the outputs of the processed image are the area of the faulty portion and compute the possible defective and non –defective gear as an output.

Keywords: Spur gear, Image processing; Defect detection; Geometric error detection; Counting no of teeth; Threshold

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 Rack gear 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 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 To calculate module of gear

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Fig. proposed model



In this regard we have converted the original gear image object into grayscale, and then gray scale of original gear image goes from steps to count the teeth of the gear. It means by using

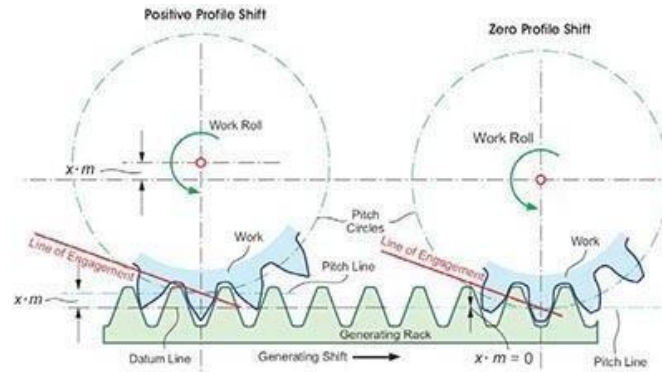


Fig.

programming code, we measure the gear teeth in respect of teeth counted through image processing.

The gears are used in machinery and we know that gear transmissions can be used to alter a machine motion property,



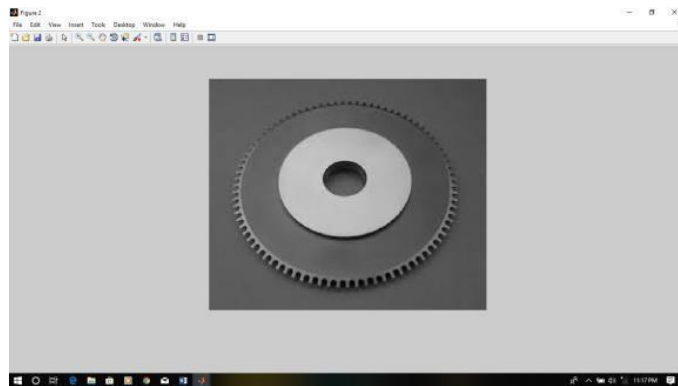
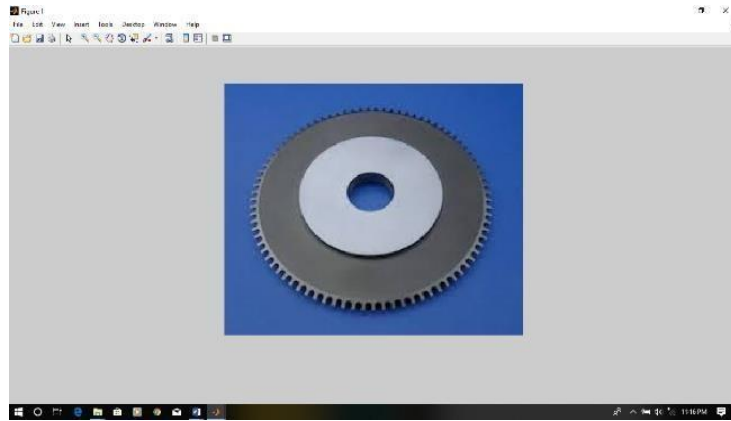
Fig. USB camera

although it ensures the modification in the motion through linear and rotary development of gear. It is an old technology and gear transmission was invented having complexity.

In light of gear teeth count and to measure the parameter of the gear object complexity of transmission. The geometry is used to measure the gear transmissions for commercial vehicles. Here it presents a technical exposure of gear basics. On the other hand, for appropriate use of gear and design of gear that is necessary to have a minimum know how about the gear.

The research shows that special tooth calipers could be used to measure the Gear teeth. There are different types of gears in market according to need that can be used. It means gears have different profiles. Hence these are in different size and having odd or even number of teeth. The gear may be odd number of teeth profile and also it may be even number of teeth profile.

Hence the gear parameters measurement will be more simple, fast and less time consuming.



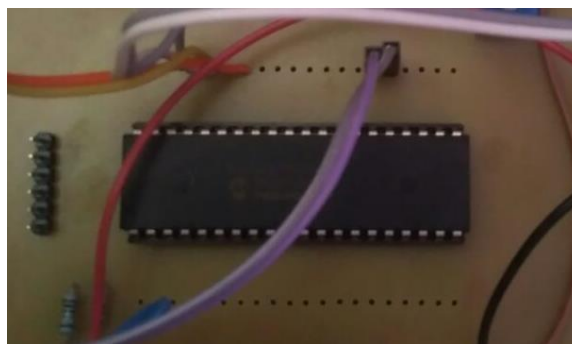
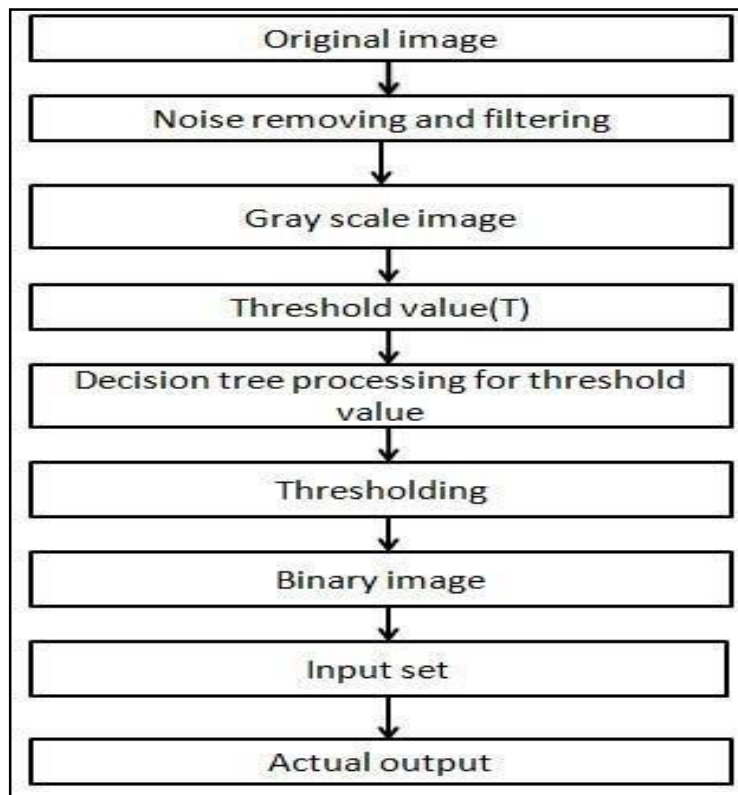


Fig Microcontroller



Fig LCD DISPLAY



Fig Motor Drive IC
Programme

1) Median filter

```
function dimg = medianfilter(inp)
% Padarray c=padarray(inp,[1,1],0,'both'); [R1 C1] = size(c);
%Median filter for i=2:R1-1
for j=2:C1-1
    temp = [c(i-1,j-1) c(i-1,j) c(i-1,j+1);c(i,j-1) c(i,j)
c(i,j+1);c(i+1,j-1) c(i+1,j) c(i+1,j+1)]; d = temp(:);
    e = sort(d); med = e(5,1);

    dimg(i-1,j-1) = med; end
end end
```

2) Gear defect

```
%% input image clc;
close all; clear all;
No_of_teeth = 15; s1 = serial('COM8'); s1.Timeout = 1; fopen(s1);

% idn = '1';
% while(idn ~= '0')
```

```
%          idn = fscanf(s1);
% end
% idn = '1';

cam = webcam(1); data_send = 1;
while 1
    idn = '1';
while(data_send == 1) idn = fscanf(s1); disp(idn)
    inp = snapshot(cam); figure(1),subplot(1,2,1),imshow(inp,[]); drawnow;
if idn == '0' data_send = 0; break;
    end end disp('rx')
    idn = '1';
    inp = snapshot(cam); figure(1),subplot(1,2,1),imshow(inp,[]); drawnow;
    %inp = imread('s.jpg'); if size(inp,3) > 1
        inp = rgb2gray(inp); end
    %          figure(2),
    %          subplot(1,2,1);
    %          imshow(inp,[]);
    %          title('input image');
    %% preprocessing
    dimg = medianfilter(inp);
    %          subplot(1,2,2);
    %          imshow(dimg,[]);
    %          title('denoised image');
    %% segmentation
    level = graythresh(dimg); seg_f = im2bw(dimg,level); seg_f = ~seg_f;
    %          figure(2),
    %          subplot(1,2,2); imshow(seg_f);
    %          title('Otsu image');

[imgcnt] = bwlabel(double(seg_f)); stats = regionprops(imgcnt,'all'); img = seg_f;
cnt = length(stats); try
if cnt > 0
for i = 1:cnt
ar = stats(i).Area; if ar <= 500
img(imgcnt==i)=0; cnt = cnt-1;
end end
%          subplot(1,2,2);
%          imshow(img);
%          title('segmented image');
%% cropping
[imgcnt] = bwlabel(double(img)); for i = 1:cnt
```

```

s = regionprops(img, 'BoundingBox'); rectangle('Position',
s(1).BoundingBox,'EdgeColor','r'); end
    xmin = round(s(1).BoundingBox(1,1));xmax =
round(s(1).BoundingBox(1,1)+s(1).BoundingBox(1,3));
    ymin = round(s(1).BoundingBox(1,2));ymax =
round(s(1).BoundingBox(1,2)+s(1).BoundingBox(1,4));
out = img(ymin:ymax,xmin:xmax);
%           figure,
%           imshow(out,[]);
%           hold on
stats = regionprops(out,'all'); cen = round(stats.Centroid);
%           plot(cen(2),cen(1),'r*');
%           title('cropped image with centroid'); cnt = 0;
for i = cen(2):size(out,1); if out(i,cen(1))==0
    cnt = cnt+1; end
end
A = out;
% determine convex hull
    B = regionprops(double(A), 'ConvexImage', 'BoundingBox');
% generate mask image C = zeros(size(A));

C(floor(B.BoundingBox(2))+(1:size(B.ConvexImage,1)),fl
oor(B.BoundingBox(1))+(1:size(B.ConvexImage,2))
)=B.ConvexImage;
C = bwmorph(C, 'erode', 2);
% generate teeth image D = A;
D(C) = 0;
% count teeth
D = bwfill(D,'holes'); [D cnt] = bwlabel(D);
stats = regionprops(D,'all'); for i = 1:cnt
    ar = stats(i).Area; if ar<= 7
D(D==i)=0;
        cnt = cnt-1; end
end
[img, NumTeeth] = bwlabel(D); disp(sprintf('Inner Diameter value: %d',cnt)); cnt1=5*cnt;
%out11=2*(size(out,2));
%out11=50+out11; disp(sprintf('InnerDiameter value:%d
mm',(2*(2*cnt1)/10)));
%disp(sprintf('Outer Diameter value: %d',out11)); disp(sprintf('Outer Diameter value: %d
mm',floor(round((3.2*size(out,2)/10)))); disp(sprintf('No of Teeth: %d',NumTeeth)); disp(sprintf('Tooth
Height: %d
mm',floor(round((3.2*size(out,2))-(2*cnt1)/100))); cnt2=((6*NumTeeth)/3.1415);
disp(sprintf('Pitch Diameter: %d mm',cnt2)); cnt3=(cnt2/NumTeeth); disp(sprintf('Module: %d
mm',cnt3));

```



```
%if NumTeeth>= 12
&&floor(round(3.2*size(out,2)))>= 200
if NumTeeth ~= No_of_teeth %&& 2*(2*cnt1) >=
200
disp('nok') fprintf(s1,'1'); data_send = 1;
else
disp('ok') fprintf(s1,'0'); data_send = 1;
end end
catch
warning('gear not found'); end
end
```

3) Gear mechanism

```
int IR_in = 2; int motor1p = 4; int motor1n = 5; int motor2p = 6; int motor2n = 7; void setup() {
Serial.begin(9600);
// make the pushbutton's pin an input: pinMode(IR_in, INPUT); pinMode(motor1p, OUTPUT);
pinMode(motor1n, OUTPUT); pinMode(motor2p, OUTPUT); pinMode(motor2n, OUTPUT);
digitalWrite(motor1p, 1);
digitalWrite(motor1n, 0);
digitalWrite(motor2p, 0);
digitalWrite(motor2n, 0);
}
int ir_val = 0; String readSt = ""; int setFlag = 0;
void loop() {
while (Serial.available()) { setFlag = 1;
delay(3); //delay to allow buffer to fill if (Serial.available() >0) {
char c = Serial.read(); //gets one byte from serial buffer readSt += c; //makes the string readString
}
}
ir_val = digitalRead(IR_in); Serial.println(ir_val);
if (ir_val == 1)
{
delay(1000); digitalWrite(motor1p, 0);
digitalWrite(motor1n, 0); Serial.println('a');
// digitalWrite(motor2p, 0);
// digitalWrite(motor2n, 1);
// delay(2000);
// digitalWrite(motor2p, 0);
// digitalWrite(motor2n, 0);
```

```
}  
if (setFlag == 1 && readSt[0]=='1')  
{  
  
setFlag = 0;  
  
digitalWrite(motor1p, 1);  
digitalWrite(motor1n, 0);  
digitalWrite(motor2p, 0);  
digitalWrite(motor2n, 0);  
}  
else if (setFlag == 1 && readSt[0]=='0')  
{  
setFlag = 0;  
digitalWrite(motor1p, 1);  
digitalWrite(motor1n, 0);  
digitalWrite(motor2p, 1);  
digitalWrite(motor2n, 0); delay(2000); digitalWrite(motor2p, 0);  
digitalWrite(motor2n, 0);  
}  
readSt = "";  
}  
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```

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Result

- The time required for the checking the gear is reduced from 5 minutes to 2 minutes.
- This Machine reduces the manpower, reduces human errors and increases reliability. ie. for 100 gears only 1 person is required.

Conclusion

It is demonstrated above how image processing technique in MATLAB could be employed by taking

gear images from economic USB camera to evaluate gear parameters accurately. Image processing can be used in order to compute accurately other useful parameters of gear. This non-destructive evaluation method could potentially be applied in various fields of biomedical imaging, material engineering and other photogrammetric applications.

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