Railway Track Crack Fault Detection using Method of Histograms in Image Processing of MATLAB

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Abstract-*In this project, a computer-based methodology (i.e. image processing in MATLAB) has been discussed which will helped in detecting the cracks on the tracks appropriately with less human intervention. A system will be there to capture the images of the track and send it to the server .i.e. to the computer of the rail employee. The employee just has to browse that image. However, no special knowledge is required to detect cracks which will definitely help the employees of the railway. Also, the overall cost of the project is less with less maintenance.*

Keywords: - *Railway tracks, image processing, MATLAB, drone, histogram.*

1. INTRODUCTION

Most of the people travel by railway and also mostly the goods transportation is also done by railway. The railway is faster than the bus and safer plus economical than an airplane and hence mostly used by all and is the biggest means of transportation. But the problems with the railways are the increasing number of accidents which are caused by the number of reasons such as:-

1] Collision between trains

2] Problems occurring in the signaling

3] Obstacles appear on the rail route.

4] Track failures

But mostly the accidents occur are due to the track failures means cracks occur in the tracks which leads to the accidents. This cause loss of lives and property. So there is a need to avoid accidents. Reasons for the development of cracks in railway track can be due to

1]Development of excessive thermal stresses in the track due to temperature variation.

2]Due to excessive wear and tear on account of repetitive mechanical stresses.

3]Corrosion in track, on account of adverse climatic conditions.

4]Trains having more weight than weight sustainability of the track due to the passenger overcrowding in the coaches of the train than the real coach capacity.

2. Proposed method

In this project, we have proposed a computerized method to detect cracks which require very less cost or even we can say that to detect crack we require no cost at all and also no manual inspection to detect the crack.

This method is based on MATLAB. We have use image processing in MATLAB. In this, first of all a reference image without crack is provided in the MATLAB. This image is always same. Then there is a need to capture the image of the track. This captured image is then provided to the server i.e., somewhere in the nearby station where an employee is sitting to monitor the operation.

This employee has to do just certain operations such as giving a name to the images or browsing the files of the image which requires no special knowledge. After browsing the images in MATLAB, the program file for the crack detection which is already stored there in MATLAB needs to open. Then the image name only has to put in proper format into that program. We can make another arrangement by writing certain different commands for this due to which there will be no need to write the name every time and then the program is run and browse the file of the captured image. The following figure shows the direct browsing window of the file.

By just clicking the appropriate image file, then open that file. The algorithm i.e., all the operations mentioned in the program are applied to this captured image and show the output result.In this project , we will plot the histograms of the reference image which is without a crack and one capture image which can be with or without a crack. After plotting the histograms for both if both histograms are same then there will be no crack

- ☐ present and if histograms are different then there is a presence of a crack. But the main question arises how to capture the images?
- ☐ To implement this project there is a need to observe the tracks continuously by· capturing the images. Also, another need is that we want only the top view of the track. So it s a difficult task to capture images manually.
  In this project, we have mentioned two ways to capture images. Both ways use modern technology.

1] To capture images continuously place cameras after certain distance on the poles and allot a particular range for that camera means the range in which only it has to capture images. After capturing the images, the images are then sent to the server. However, this method requires lots of cameras and hence expensive and requires also a lot of maintenance. So we have mentioned this idea but use this when having sufficient budget.

2] The method which we are going to use to capture the images is to use Drone camera. The image for the drone with a camera is shown in the following figure:-

The drone will have transmitter-receiver and this transmitter-receiver is used to send information to drone and as well to send images to the server when it captures the image. The camera being used must be powerful with the great image capturing capabilities. For capturing the images at night time is a big task but we will use infrared cameras.

Another question arises that how many drone cameras required? If we consider the railway line of 20 Km and drone have a range to travel 20 km. The drone will first capture the images till first 10 Km and send to the server. Then captures for the next 10 Km and that images send to the server.

This drone camera is very useful to capture images because in area likes Mumbai where continuously trains are moving. It is very difficult to monitor tracks manually with a walking stick or inspection vehicle.

every thirty minutes or before the train moves over the track. This drone camera s operation is also very fast and not involves a lot of machinery. Another advantage of using it is that it can use for other purposes such as security.

This is totally dependent on the railway authority to allot ranges or decide the policy; we have just given a rough idea here.

This drone camera will capture the image and send to the server where the employee is sitting. Hence the employee will put the images in MATLAB and run the program. As soon as he gets the result if the employee finds the crack present, the employee can also be able to find the location of the crack immediately in which range it lies and send information to the appropriate authority.

3. Flowchart:-

Input the capture image and reference image in MATLAB

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Convert this RGB images into GRAY images

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Histogram equalization of this GRAY images

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Plot the histograms for both histogram equalized images

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Observe the both histograms

↓

If both Histiograms are equal then crack is not present,otherwise crack is present

The explanation for a flowchart:-

In this first, the captured image and reference image of the track are browsed into the MATLAB. Then start the writing of the commands in the editor of MATLAB. These images are read into the MATLAB. These images are RGB images.

Now we have to apply the algorithm to these images. The algorithm can only apply to two-dimensional images rather than three-dimensional images in MATLAB.
Since RGB image is three-dimensional image so we cannot apply algorithms to these images and hence we convert these images into grayscale images.

After this these grayscale images are converted into histogram equalized images. the reason behind the conversion into histogram equalized images is that it spread the intensity values over the full range, thereby improving the contrast. Due to the' histogram equalization, the contrast gets adjusted automatically to evenly distribute the image s pixel values over the full potential $_{range\ is}$for the$_{\leq X \leq}$storage$_{,for}$ class$_{uint}$ of $_{it}$the$_{is}$ image$_{\leq X \leq}$. For an$_,$ $_{and}$ima $_{for}X_{,double}$with a$_{it}$ storage$_{is \leq X \leq}$ class$_,$ of uint8, the full Then the histograms for both histogram equalized images are plotted. Histograms are a way of visualizing the predominant intensities of an image. As a definition, image histograms are a count of the number of pixels that are at certain intensity. When represented as a plot, the X-axis is the intensity value, and the Y-axis is the number of pixels with that intensity value.

The X-axis is the intensity value from 0 to 255(these images are uint8). The Y-axis varies depending on the number of a number of pixels in the image and how their intensities are distributed.

4. WORKING:-

Load the capture image in MATLAB first and read this image. The commands for this are as follows:-
[fname, path]=uigetfile('*.*','Enter an image');
fname=strcat(path,fname);im=imread(fname);
imshow(im);

title('original captured image');

The result for this is shown in MATLAB as

Figure 1 Original captured image

This RGB image is then converted into GRAY image and the commands for this are as follows:-

b=rgb2gray(im);imshow(b);title('gray image of original capture image');

Figure 2 Gray image of original captured image

This GRAY image is then converted into histogram equalized image. The need for histogram equalization is that track is brighter than the background due to sunlight. Hence to observe track clearly histogram equalization is required and the commands for this are as follows:-

c=histeq(b);imshow(c);title('histogram equalized of input captured image');

The result for this is as follows:-

histogram equalized image of gray image of original capture image

Figure 3 Histogram equalized image of gray image of original captured image

Then the histogram of this above image is plotted. The reference image without crack is provided. Similarly it is converted into gray image and then into histogram equalized image. After this histograms for both images are plotted.

The commands are as follows:-

subplot(2,2,2);

imhist(c);

title('histogram of captured image');

REF=imread('rail2.jpg');

m=rgb2gray(REF); n=histeq(m);

subplot(2,2,3);

imshow(n);

title('histogram equalized image of reference

image');

subplot(2,2,4);

imhist(n);

title('histogram of reference image');

 The result for this is follows:-

The whole program is shown ones again:-

[fname path]=uigetfile('*.*','Enter an

image');

fname=strcat(path,fname);im=imread(f

name);

imshow(im);

title('original captured image');

b=rgb2gray(im);

c=histeq(b);

subplot(2,2,1);

imshow(c);

title('histogram equalized of captured

image');

subplot(2,2,2);

imhist(c);

title('histogram of input captured

image');

REF=imread('rail2.jpg');

m=rgb2gray(REF);

n=histeq(m);

subplot(2,2,3);

imshow(n);

title('histogram equalized image of

reference image');

subplot(2,2,4);

imhist(n);

title('histogram of reference image');

The result for this is as follows:-

histogram equalized of captured image

histogram of input captured image

histogram equalized image of reference image

histogram of reference image

If we observe the above two histograms then it is clear that both are different and hence we can come o the decision that there is a crack on a track. The employee of the railway just has to identify the histograms and then can give the decision about the presence of the crack.

5.Literature review:-

☐ VOL 3, ISSUE 4, 2017 , Rizvi Aliza Raza, Khan

Pervez Rauf, Ahmed shafeeq :

In this research paper a computer vision based method has been suggested to detect cracks. This research paper suggests that rolling stock is used to capture images. They have used Graphical User Interface in MATLAB.

☐ International Journal of Engineering Science Invention ISSN, Mr.Prashanth.addagatla and Mr.G.Koteshwar Rao : They have suggested the effective use of LED and LDR system. In this research paper it is given that when light from the LED deviates from its path due to the presence of a crack or a break, a sudden decrease in the resistance value of the LDR ensues. This change in resistance indicates the presence of a crack or some other similar structural defect in the rails. In order to detect the Existing location of the device in case of detection of a crack, a GPS receiver whose function is to receive the Existing latitude and longitude data is used. To communicate the received information, a GSM modem has been utilized. The function of the GSM module being used is to send the Existing latitude and longitude data to the relevant authority as an SMS .The robot is driven by four DC motors. With this Existing system only latitudes and longitudes of the broken track will only be received so that the exact location cannot be known.

6. Future Application and Development

This project can be helpful in areas like Mumbai. where crowds of trains are very much high. The above described method is simplest method to detect crack. In future, instead of image processing we can use video processing.Various types of features can be obtained fromthis image processing in MATLAB.

7.Conclusion:-

In this paper, a method to detect cracks in railway tracks has been presented using image processing techniques. The proposed method helps to detect cracks with some manual working on the computer. Pictures of the tracks are taken with drone and given as input to the suggested system to detect cracks. This will help to detect cracks immediately and reduce the possibilities of accidents.

The proposed method detects cracks with accuracy and hence the utmost efficiency of the system can be ensured. So with the help of image processing in MATLAB, it is able to find the cracks in the tracks easily.

8. References

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