ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
Vol. 2, Issue 2, February 2016

SMART ROBOT FOR RAIL TRACK FLAW DETECTION USING NDT

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Abstract:-

The main objective of this smart robot is to detect the flaws in the rail track and sends the error or alert message to the base station which handles the smart robot. The detection of flaws in the rail track is identified by using two concepts. One for detecting flaws and another one for verifying the flaws. Optical IR detection and Image processing technique are the two concepts. In this paper we study how the optical reflective sensor is used to detect the flaws in rail track and effectiveness of flaws in the rail track can be recognize by using the Image Processing and Image Enhancement technique which compares the imperfect track picture with the perfect conditioned track captured by HD camera and here the image comparison is done by Adaptive scheduling.. The smart robot in the track is enable by using the Zigbee Tx/Rx. And the error signal from the track is send through GSM module. The Location of the flawed area is identified by using the GPS module fixed in the Smart Robot. Theft identification is identified by using LED LDR connected to the microprocessor unit. The overall system is controlled by using ARM LPC2148 Processor.

INDEX TERMS:- LED LDR, Retro Reflective sensor, Image Processing, Image Enhancement, ARM Processor, Zigbee Tx/Rx, GSM & GPS module, HD Camera.

1. INTRODUCTION

In our country one of the most effective way for commercial transport is being carried out by Railway network. We are the fourth largest network after U.S. Russia, China in the Railways. But still now we can't still achieve the international standards and world class sophistication. Our infrastructures are inadequate to achieve international standards and therefore many problems occurred during the transportation .the major damage is economically notwithstanding to a social life. Due to the flaws in the track can cause derailment and fatigue which results in loss of valuable human lives. Our work in this project gives an implementation of efficient and cost effective method for railway applications especially in the rail track flaw detection.

2. LITERATURE SURVEY

In Rail tracks, The first rail inspections were done visually in early 1891.In Later 1927 Rail track inspection became more important due to several accidents. Magnetic induction was the method used on the first rail inspection cars. Most of other inspection methods does not detects the flaws.

2.1 Traditional Crack detection system:

There are three traditional system used for long time in the railway department for crack detection.

- *Visual Inspection*: Live inspection is carried out by human eyes which may rise error in inspection and identifying cracks.
- *Non-Destructive testing*: Some of the non-destructive testing are ultrasonic emission or acoustic emission, eddy current method, dye penetrate method, fibre optic sensor of various kinds.
- *Graphical and Shuddering* based global method: These methods are inefficient and

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more costlier when compared to new methods.

2.2. Main problems in Traditional Crack detection System

Some of the problem arises in the traditional crack system are more costlier to construct the flaw detection units and also causes errors in the flaw detection whereas the method is not effective in identifying the cracks and needs human involvement to care for the detection of cracks and other related issues.

BLOCK DIAGRAM:

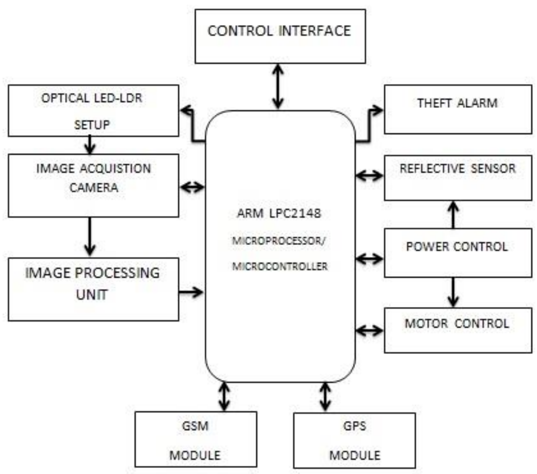

Fig 1 Block Diagram of Proposed system

The block diagram of **smart robot for rail track flaw detection using NDT** is shown in the fig 1, which depicts the overall functioning of the module and proposed system that incorporates embedded system based automated flaw detector.

3. PROPOSED SYSTEM

3.1. Hardware Used:

Some of the major hardware components used in the system are:

1) The Reflective Sensor (GP2Y0A21YKOF): It is connected to the microprocessor unit via connecting wires.
2) ARM Microprocessor unit (LPC2148): This is the assembly which placed in between hardware and software unit. It is used to establish communication between various modules.
3) GSM Module: Here the GSM module is used to communicate the information in form of Short message service between microprocessor unit and server control.
4) GPS Module: Here the GPS module is used to locate the bot where it found the flaws on the rail track.
5) LED LDR: This is connected to MPU used for theft identification.
6) HD Camera: The HD camera here used to capture the flawed track identified by the sensing unit.
7) MAX232 Cable: Connected to MPU, used to provide communication between GSM/GPS module.
7) LCD (2x16) Display: Microcontroller devices use 'Smart LCD' displays to output visual information

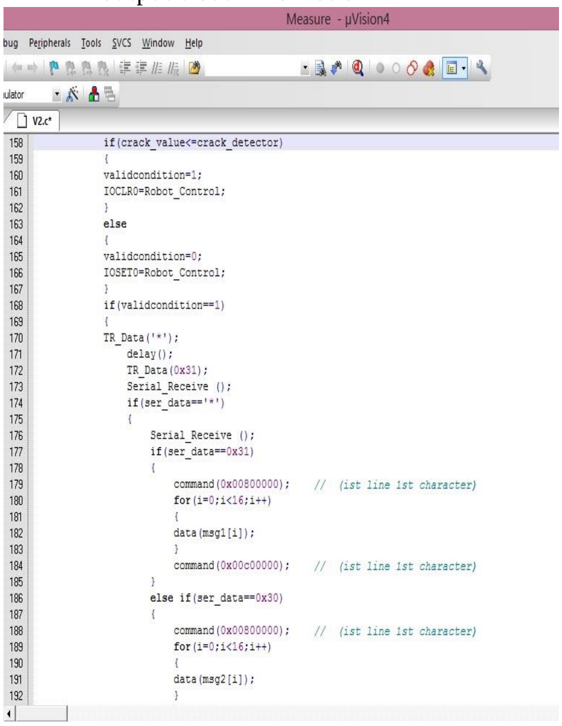

Fig.3.2.1 Keil u vision4 coding-ARM 7

3.2 Software's used:

Some of the major software's used in the system are:

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1) KEIL uVISION4: This is the development tool for ARM processor LPC2148 embedded software supports keil C/C++.

2) MATLAB R2014a: This is the environment for image segmentation and comparison used for image processing.

3) Philips flash Utility V2.2.3: This is the driver software to communicate the main microprocessor unit.

4) Proteus: This is the simulation tool used for ARM 7 processor LPC2148

.

5) Hyper Terminal: This is the network using Telnet communicate to devices checks the output in serial monitor.

6) Logitech: This is the driver software for the camera used to capture live images of the rail track for analysis.

This Smart Robot has the processor ARM7,GSM & GPS modules with HD Camera. Initially the bot get placed in the rail track between two check points of desired distance.

The Person from the control room turns ON the bot through Zigbee Transmitter. Whereas the receiver end receives the signal and the bot gets turn on moves forwardly in the track. Searches for the presence of crack or flaws in the track by using the Reflective sensor (*GP2Y0A21YKOF*)

In-case of flaw detection the bot automatically stops where it identifies the flaws in the track and enables the camera for capturing the live images for image processing which is used to find whether the identified crack is true or not.

If the crack is conformed after the image processing an error message or alert signal is sent through the GSM module to the control end station and the location of crack is shared by the GPS module connected in it.

3.3. Algorithm

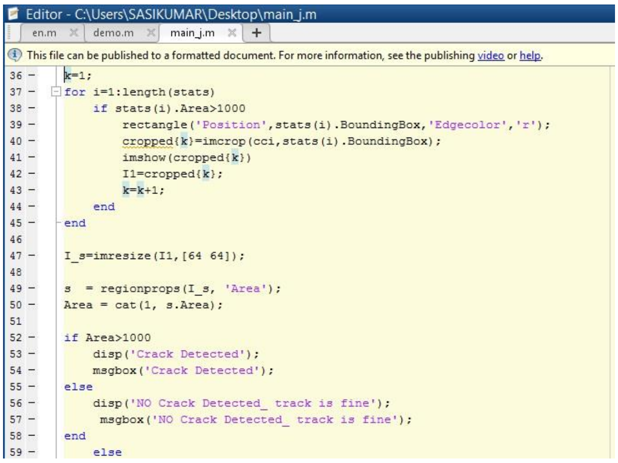

Fig.3.2.2 Image Processing for crack detection

1. START
2. Initialize the device Display, RFID reader, GSM module, GPS module, HD camera, Image processing block, DC motor and sensors.
3. Turn ON the bot.
4. If the Zigbee receiver receives the high input it turns on the bot
    a. If X=0, go to step 3.
    b. If X=1, go to the next step.
5. Check the track for identifying the flaws or crack.
    a. If X=1, stops the bot where it identifies the crack& go to the next step.
    b. If X=0, keep following the step 5.
6. Check the track by image processing unit
7. Turn ON the camera for capturing images..
8. Capture the live images of the track.
9. Process the image by Adaptive scheduling
    a. If Y=0, go to step 9..
    b. If Y=1, go to the next step.
10. Check the crack in track is true or false (air) crack.
    a. If Z=0, go to step 3.
    b. If Z=1, go to the next step.
11. Turn on the GSM module and sends the alert signal to the control room.
12. Turn on the GPS module to share the location of crack in the rail track.
    a. sends the latitude and longitude details.
    b. After location sharing go to the step 3.

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13. Bot runs continuously until reaches the check point.

3.5. Working:

Initially the Zigbee receiver in the bot placed in rail track receives the high signal from the server control room by the person through zigbee transmitter. This turns on the bot for detecting flaws in the track.

The bot runs continuously on the track for detecting the flaws by using the reflective sensor unit connected to the microprocessor unit. If the voltage output get reduced in the reflective sensor it stops the bot and turn on the image processing block to check for the flaw present in it is true of air crack.

If the crack is truly identified after image processing the depth of the crack is send to the control room pc. and the alert signal is received in form of SMS through the GSM module from the rail track to the control room. It also share the latitude and longitude values to identify where the crack is present in the rail track through GPS module connected to the microprocessor unit.

Suppose the identified crack is not a true flaw which get conformed the image processing analysis. It doesn't sends any error signal and again checks for the further flaws in the track until it reaches the destination point or check point.

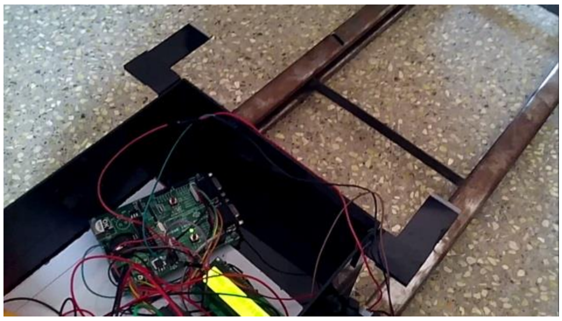

Fig.3.4.1.Flaw Detecting Bot

Fig.3.4.2 Flaw detection values in LCD

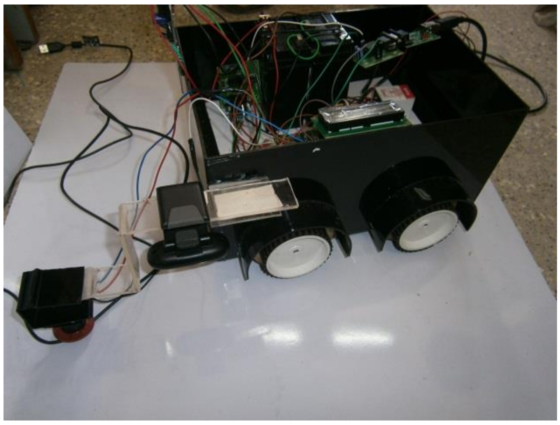

Fig.3.4.3 Flaw Detection Bot

4. RESULT

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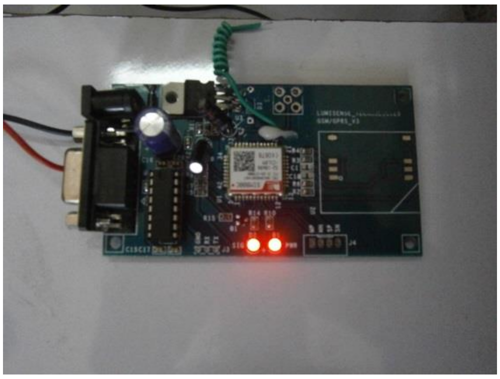

Fig.3.4.3 GSM Module

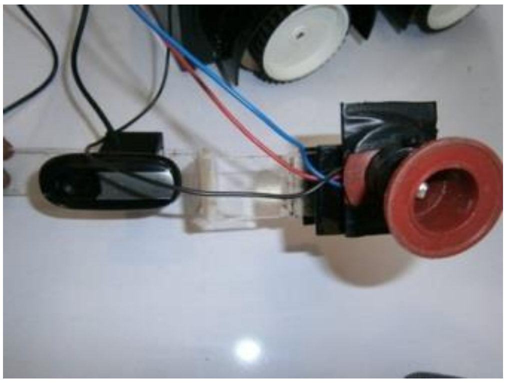

Fig.3.4.2 Camera with Reflective sensor

5. CONCLUSION

The Proposed system for the detection of flaws in rail track is identified without any human intervention. There are many advantages in this system. Some of the system advantages are cheap ,cost effective ,easy to identify the fault, less time for fault analysis, live images of flawed rail crack are seen in the server side, location of the flaws are get through the GPS module which reduces the derailment and other rail accidents to save human lives.

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6. BIBLIOGRAPHY

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ISSN 2395-695X (Print)
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